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LEARNING AND COLLABORATION VIA DIGITAL COMMUNICATION TECHNOLOGIES IN ECOVILLAGES

A Study on Learning in Ecovillage Communities of
Practice and Affordances of Virtual Immersive
Learning Environments

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Abstract

Ecovillages are intentional residential communities aimed at improving human quality of life while protecting and regenerating the surrounding nature in order to create a more sustainable lifestyle based on cooperative culture and sharing (Dawson, 2006; GEN, n.d.b; Mychajluk, 2017). This study by drawing on Communities of Practice (Wenger, 1998) and Situated Learning Theory (Lave & Wenger, 1991) considers how learning is seen, planned and facilitated in ecovillage communities which are motivated to function as learning hubs (Dawson, 2006). Together with the identification of ecovillage type of learning, this study aims to explore the potential benefits that could be generated by the use of digital communication technologies with an emphasis on immersive technologies. Data for this study is collected through qualitative semi-structured interviews conducted with two members each of two ecovillages in Australia and analyzed by qualitative content analysis method. Guided by a research model; a mapping of CoP concepts and affective and educational affordances in Virtual Reality (Shin, 2017), this study identifies the necessary affordances for facilitating learning in ecovillages by means of immersive technologies. The study results imply that the potential is heavily dependent on the practices of communities which determine the need to facilitation of remote collaborative learning, on the availability of the technology, on the current knowledge on the use of communication technology and on ecovillagers concerns on the environmental and social impacts of using of high-tech.

Keywords

ecovillages, learning, affordances, communities of practice, situated learning, immersive technologies, remote collaboration

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1. Introduction

The consequences of the technological revolution speeding up in the second half of the 20th century alongside with economic growth have put human needs in jeopardy as far as known that there are limited resources for human society for sustaining the already existing economic and social system (Bourne, 2018). Limited natural resources have been an obstacle and a challenge on the face of progress and development. The commercialization of the access to food resources results in a socio-ecologically unsustainable process. To challenge this socio-ecological crisis, many ecovillage communities have been established all over the world which go against modern notions of life that they consider cause the unsustainable process; they offer practical solutions to agriculture, architecture, entertainment, communication, governance, socialization, and encouraging collective action through connecting via virtual networks for achieving sustainability in all areas of life.

Ecovillages “provide opportunities to learn how to live more sustainably” (Dawson 2008, as cited in Mychajluk, 2017, p. 180) and “non-formal education is the largest source of income for many ecovillages” (Dawson, 2006, p. 56). Therefore, ecovillages have become learning hubs for individuals from all around the world to learn and practice sustainable lifestyles especially, for new generations; “there is a massive incorporation of young people into ecovillages” (Fanjul, 2015 as cited in Renau, 2018; Hilmi & Burbi, 2016). There are many initiatives by international organizations like GEN¹, European Commission, WWOOF² to encourage young people to repopulation of rural areas through organizing youth exchanges and trainings (European Commission, n.d.; Yes to Sustainability, n.d.), volunteer services (WWOOF, n.d.) for attracting youths’ attention to pursue a ‘career’ in the rural and encourage them to live sustainably (Zondag et al., 2015).

Considering their networked organization, ecovillages tend to employ digital communication technologies for maintaining their connections with other communities and for communicating within their community more effectively. In light of their current use and of view of digital communication technologies, this paper aims to highlight the potential of these technologies to facilitate learning in ecovillage communities of practice, and the possible challenges that are involved when incorporating immersive technologies in these communities.

In today’s world, digital communication technologies are transforming the patterns of human communication dramatically. These technologies even attempt to “automate the component processes of thinking and problem solving, changing knowledge interchange in societies” (Lave & Wenger, 1999, p. 12); these new technologies redefine how humans know and understand, have not just happened to be; there is a two-way relationship between human needs and technology development. Humans’ need to communicate remotely has never been greater in such a world; “numerous societal conditions are aligning to create this need” and “the urgency of reducing environmental impact” is one of them (Apostolopoulos et. al. 2012, p. 975) Considering this need, this study aims to highlight the importance to study ecovillage communities because of their contribution to sustainability as being role models of sustainable living (Ergas, 2010; Walker, 2005), as aiming to reduce “the environmental impact”. Also, this study manifests a need for more interdisciplinary approaches in communication studies; the

¹ Global Ecovillages Network

² “WWOOF (Working Weekends on Organic Farms) is a worldwide movement linking volunteers with organic farmers and growers to promote cultural and educational experiences based on trust and non-monetary exchange, thereby helping to build a sustainable, global community.” (WWOOF, n.d.)

need to gather distinct-looking fields of study in order to challenge the impact of rapid transformation by and of communication technologies on human communication.

In conjunction with this general objective (and the anticipated eventual outcome), this study has a specific research inquiry, that is ecovillage communities of practice. This aim of this study is to understand how the notion of learning is seen, planned and facilitated in order to investigate how ecovillage learning could be facilitated by means of digital communication technologies, with a focus on immersive technologies. According to various research on digital communication and learning technologies, using immersive technologies in education raises learner motivation and improves learning efficiency (Herrington & Oliver; 1995; Mei & Shin, 2011; Dede, 2012; Di Serio, Ibáñez & Kloos, 2013). In fact, immersive technologies can help learners develop skills without the real-world consequences of failing, providing customizable 3D environments and advanced virtual interaction opportunities, enabling virtual communities (Hai-Jew, 2011) and enhancing memorability (Morie, 2005), therefore the use of immersive technologies in educational (and many other) contexts is becoming popular (Knowles, 2020). Immersive technology consists of several tools: virtual reality (VR), augmented reality (AR), mixed reality (MR) and tele immersion. These technologies allow interaction with the designed immersive environment by sensing body movement, postures, gesture of users as inputs (Matamala-Gomez et al., 2019). In light of these insights, lastly, this study aims to highlight the limitations and challenges involved in the possible incorporation of these technologies in ecovillage communities of practice.

For conducting such a study requires first, an understanding of how ecovillagers learn and share knowledge and how they have already been making use of existing technology applications, and secondly, an assessment of the affordances that are required to enhance “ecovillage type of learning”. For these purposes, this study uses semi-structured qualitative interviews as the main data collection method. Two ecovillagers from two ecovillages in Australia are interviewed. Since the researcher has got established connections in Australia for the sake of following through the previous plan (*See Section 6.2*), it has been more convenient to sticking to the ecovillages that the researcher has been in touch with as well as the following reasons: Australia is known as the birthplace of permaculture movement (Crosby, Lorber-Kasunic & Accarigi, 2014); this movement has a rooted history in Australia because of how it had inspired people from all around the world who followed counterculture movements starting from 1970s (Holmgren, 2017) which as well has inspired the ecovillage movement (Liftin, 2012).

Since most of the ecovillage communities attach importance to learning (Dawson, 2006), this study focuses on finding out: how these communities of practice facilitate their current learning activities and through which affordances; what the current and future immersive learning technologies can offer to them in terms of learning affordances; and what challenges are involved in the prospective incorporation of immersive technologies in ecovillage communities. To provide answers to these inquiries, two research questions guide this study:

1. To what extent can/do digital communication technologies facilitate learning in an ecovillage community of practice?
2. What challenges are involved when incorporating immersive technologies in ecovillage communities of practice?

2. Literature Review

2.1 The Gap in the Field

Since the main focus of this study is intentional ecovillage communities which are rarely (Mychajluk, 2017; Pineda, 2011) approached from communities of practice perspective and never approached from affordances perspective with one exception (Kopljar, 2016) (Nevertheless in Kopljar's study, ecovillages is not the main focus), this study draws on several sources which employ various theoretical approaches to create an overarching research model for studying the potential benefits of a newly emerging technology which could be generated in a specific community of practice context. Therefore, this study turns to ecological approaches of design for identifying the relevant affordances which could be created by immersive technologies and aims to match communities' learning styles -which are identified through interviews, with what immersive technologies can offer to them.

Generally, ecovillages as a research area is left quite untouched; there are very few studies conducted on ecovillages and digital communication. Cerrato-Pargman, Pargman and Nardi (2016) explore the footprint of digital infrastructure in ecological communities; query how new communication technologies affect the social life in ecovillages. Their study is not a study specifically on learning but explores how technology is used to facilitate activities that require off-line and online communication practices such as reskilling. Nevertheless, their study gives insights on ecovillagers' views on digital communication technologies, how they are used, for what purpose and how they can help. For example, the authors emphasize how community members use the Internet to get "reskilled". These are referred to as "forgotten" skills (e.g. creating composts, planting trees, building with clay, etc.) and learning these has been termed "reskilling" (Hopkins, 2008 as cited in Cerrato-Pargman, Pargman and Nardi, 2016, p. 7). They observed that the Internet plays an important role in reskilling. "Members exchange links, YouTube videos, blogs, articles, reports, and smallholders' stories that contribute to the development of knowledge in the community" (p. 7). However, they conclude: "Members' communication and information practices associated with the Internet do not work as a primary influence for the development of this type of intentional community" (p. 11).

Another study on digital communication technologies and ecovillages is conducted by Lisa Nathan (2012). Their study focuses on the relation between information tools and ecovillagers understanding of sustainable living. They conduct an ethnographic study on two ecovillages in the US. Their study results reveal that ecovillagers are "heavily reliant on telephones, signs, paper-based bulletin boards, laptops, email and other applications available through the Internet" (p. 178), however the more members become more dependent on information technology, the more tension becoming evident as Nathan states. Ecovillagers' concerns include health, relationship and environmental concerns such as such as "severe back strain attributed to prolonged computer use" as a health concern, "email flaming" as a concern related to relationships and "high ecological costs of creating, running, and disposing of digital information tools" as an environmental concern (p. 178).

In summary, there are very few sources that researchers of this inquiry can get insights from on how digital communication technologies can facilitate learning since the focus of the existing studies are on ecovillagers views on information technology. However, the two studies (Cerrato-Pargman, Pargman & Nardi, 2016; Nathan, 2012) identify certain concerns and factors that shape ecovillagers' views which are specific to ecovillage communities, therefore shedding light on this study's inquiry.

2.2 Ecovillages as Communities of Practice

The theory used as the main framework of this study is communities of practice (CoP) which was drawn from an earlier work of Lave and Wenger (1991), “Situated Learning: Legitimate Peripheral Participation”. CoP is a social theory which focuses on socialization, learning and identity, and borrows many theoretical aspects from various fields such as education and sociology (Wenger, 1998). Wenger (1998) uses Situated Learning Theory which they and Lave (1991) formulated around the notion of apprenticeship, to build and expand their concept of CoP (Li et al., 2009). The necessity of using such a social theory, CoP, for studying learning in ecovillage communities is thoroughly explained by Lisa Mychajluk (2017); they argue that applying such a theory in ecovillages context reveals “socially interactive processes of learning how to live and work together” (p. 182). CoP extends beyond the scope of cognitive sciences, bridges cognitivist and sociological perspectives, allowing one to examine how learning occurs in and through social and cultural systems, and additionally it allows one to study how individuals form their social environments and have the ability to change them (Mychajluk, 2017).

Lave and Wenger (1991) see “the idea of traditional cognitive learning simply as a process of acquisition” (Besar, 2018, p. 54) Hodkinson et al. (2004, as cited in Besar, 2018) argue that this acquisition view of learning based on cognitive processes only focuses on mental processes, concerned with formal learning and analyzes learning and context separately (p. 55). Contrary to this view, Lave and Wenger (1991, as cited in Besar, 2018) argue that learning takes place in informal situations, and according to their paradigm, “learning and situation are inseparable” (p. 55). Notwithstanding, Lave and Wenger’s methods have been criticized. It is argued that they do not compare for instance, schooling examples with cases of apprenticeship (Patel, 2017). Moreover, Hodkinson et. al (2004, as cited in Patel, 2017) say that their book is “flawed” due to the uncertainty of whether apprenticeship is a better form of learning, which they argue that this approach lacks empirical evidence to argue so. Another criticism is that Situated Learning cannot be applied in larger contexts where very different socio-cultural aspects apply like “China and USA” for instance (Roberts, 2006, p. 636) However, since no formal schooling exists in ecovillage contexts (despite very few exceptions) and they are intentional communities that gathered around the notion of being “like-minded”, decentered apprenticeship learning (*See Section 2.3*) which Situated Learning and CoP emphasize can best explain how ecovillagers learn.

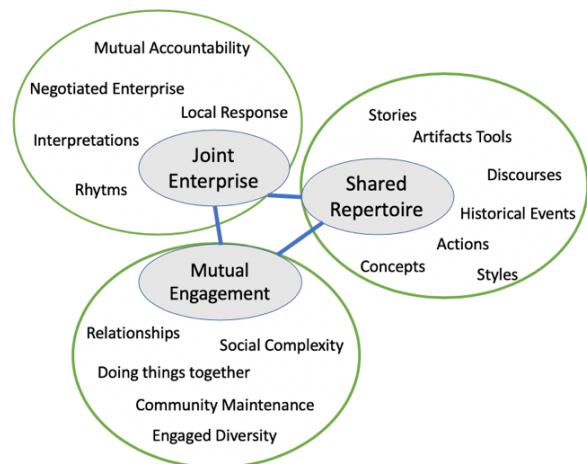


Figure 1: Key components of communities of practice (Wenger, 1998, p. 73)

2.3 Learning in Ecovillages

To apply CoP as the main framework for this study, there is a need to comprehend the concepts formulated by Lave and Wenger (1991) in Situated Learning Theory which were later borrowed by Wenger (1998). According to Lave and Wenger (1991), “learning is an integral part of generative social practice in the lived-in world” (p. 35). It occurs as a result of legitimate

peripheral participation in communities of practice, which is referred to as a step or a process by which newcomers gradually situate themselves in, understand and practice the underlying rules of communication of a particular community and gradually become old-timers as they work their ways towards full participation through internalizing discursive and interactional features of the community in time (p. 47). This path towards the full participation is formulated around the notion of apprenticeship. However, according to Lave and Wenger’s (1991) observations, mastery of knowledge, the authority of masters and their involvement in apprenticeship “dramatically vary”, which necessitates the development of a “decentered” view of apprenticeship as it “leads to an understanding that mastery resides not in the master but in the organization of the community of practice of which the master is part” (p. 94). They render the importance of a decentered view of mastery as it moves the focus onto complex structures of learning resources of a community of practice that concerns the components presented on Figure 2, which is central to their concept of legitimate peripheral participation as Wenger (1998) asserts.

Lave and Wenger (1991) consider legitimate peripheral participation as a ‘conceptual bridge’ serving the purpose of the development of knowledgeable identities and the reproduction and the transformation of the communities of practice. This emphasis through legitimate peripheral participation on identity and transformation, make it possible to think of “sustained learning” as a phenomenon embodying the “structural characteristics of communities of practice” (p. 55) According to Mychajluk (2017), “this dual purpose highlights an understanding of learning as an on-going process that occurs in practice, as well as the negotiated and dynamic nature of the community of practice” which Wenger (1998) later explained as “an emergent structure, neither inherently stable nor randomly changeable” (p. 49).

While Wenger (1998) uses situated learning and legitimate peripheral participation to formulate CoP, they additionally build a more comprehensive social theory which fairly emphasizes meaning creation, knowledge building and identity development in and among communities of practice through participation and interaction. Each of the components on Figure 2 are “deeply interconnected and mutually defining” and refine what they call “a good functioning community of practice” (p. 214).

Wenger (1998) frequently refers to their and Lave’s previous work (1991) in their book; they define ‘a community of practice’ as a “living context that can give newcomers access to competence and also can invite a personal experience of engagement by which to incorporate that competence into an identity of participation”; here, they portray the “good functioning” community of practice, mentioned earlier, which ‘must’ have “a history of mutual engagement around a joint enterprise”, which creates an “ideal context” for a “leading-edge learning” that “requires a strong bond of communal competence along with a deep respect for the particularity of experience” (p. 214). In other words, communities of practice become centers for knowledge generation when having met these conditions.

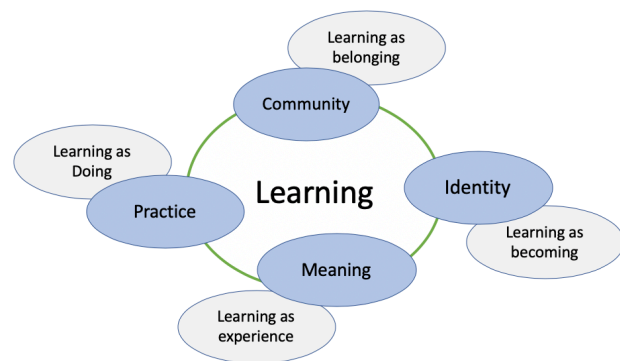


Figure 2: Key components of communities of practice (Wenger, 1998, p. 5)

2.4 Affordances

After having reviewed the main theoretical social theories, which is central to understanding how ecovillages learn, an account of the theory of affordances is presented as follows for identifying how immersive technologies can help ecovillage learning.

An affordance is a term which was first coined by Gibson (1986) in their book “The Senses Considered as Perceptual Systems” which they wrote in 1966. Their definition of affordances explains the interaction between a specific entity or any element of the world and an organism under which the feature of an item or an environment “affords” an organism the ability to act (Gibson, 1986). The concept of affordances is shortly defined as “the object possibilities for action” which is one other aspect of how the world is being perceived, together with other visual properties like object shapes or spatial relationships (Soegaard, n.d.). Affordances theory is and has been a pragmatic concept guiding design decisions “in developing cues that are both functional and easily perceived by the intended user” (Shin, 2017, p. 1828).

Ian Hutchby (2001) further developed Gibson’s concept into an analysis of technology and society. They define affordances as “functional and relational aspects which frame, while not determining, the possibilities for agentic action in relation to an object” (p. 444). They introduce a ‘third way’ to the ongoing debate between social constructivist and realist positions by suggesting that “there may be specific forms of interaction” that have developed as a result of “a complex interplay between the normative structures of conversational interaction and communicative affordances” (Hutchby, 2001, p. 13). Hutchby transposes Gibson’s main idea to up-to-date technologies and the information society by summarizing four main points regarding the nature of affordances:

“(1) there are many different types of affordances that all may interact with each other; (2) affordances are not just functional, but also relational aspects of an object’s material presence in the world; (3) when it comes to the world as experienced by humans, objects and their values can also be tied in with complex sets of concepts and conventional rules governing their use; (4) affordances of artefacts do not necessary derive from natural features of the artefact’s materiality” (Hutchby, 2001 as cited in Willard, 2013).

In summary, as Willard (2013) describes, Hutchby’s interpretation of affordances allows the study of technology “in a way that considers human-computer interaction as cyclical and interconnected”. In fact, this interconnectedness of what is intended by the designer as the design choice of the affordance and how the user perceives it, contribute to the formation of new meanings; lead up to the way for a negotiation in the meaning and functionality of the affordance.

2.5 Affordances of Immersive Learning for CoPs: Main Research Model

In order to identify the learning needs of ecovillage communities of practice and study the potential learning benefits that immersive technologies can provide these communities with, this study employs two models and map each other in order to create an overarching model that brings two distinct research perspectives together. The first model used is introduced by Etienne Wenger (2001) for propagating and widening the scope of CoP; for accommodating the theory to today’s conditions shaped by the advancement and diffusion of technology applications. Wenger (2001) states that “there is an increasing number of communities of practice today which are geographically distributed does/must rely on some kind of technology for keeping in

touch, and even the co-located communities often need to keep in touch between meetings and to create a repository for their documents” (p. 38). They introduce a model which proposes “thirteen fundamental elements of successful communities of practice which technology can affect”. In furtherance, Pineda (2011) applies CoP in ecovillage contexts and argues that ecovillage communities learn and develop through technology in today’s world. The author draws on the importance of shared practices and learning which are “best echoed, taught and preserved through technology” (p. 93). In that sense, applying Wenger’s (2001) taxonomy to a study on learning in ecovillages help revealing how ecovillages learn and how technology can support their learning.

Wenger (2001) draws seven aspects of communities of practice from their own theory of CoP which they argue are fundamental to the creation of successful communities of practice (See Figure 3). Under these main aspects, Wenger counts and defines “areas where technology can be expected to help” (p. 38) These notions are described as success factors by Wenger.

In addition, by using Wenger’s taxonomy, it becomes possible to identify how ecovillagers learn through utilizing these notions for the creation of a theoretically informed interview guideline (See Appendix 1). While this model provides a basis for the identification of ecovillage’s current learning needs and affordances, the study still necessitates a model for studying the possible implications of technology affordances in supporting CoPs, specifically, affordances of immersive technologies. Herein, this study uses Shin’s (2017) study on “the role of affordance in the experience of virtual reality learning” which provides insights on the determinants of user acceptance of virtual learning environments (VLEs) through the lens of affordances (See Figure 4). Shin (2017) formulates a model in light of technological and affective affordances in virtual reality and identifies two affective (*immersion* and *presence*) and two educational affordances (*empathy* and *embodiment*).

Main Aspects	Areas where technology can be expected to help	Definition
Time and Space	Presence	The need of the community to be visible and present in the lives of its members
	Rhythm	The need of a “rhythm of events and rituals that reaffirm their bonds and value”
Participation	Variety of Interactions	The need to interact for developing shared practices
	Efficiency of Involvement	The necessity of an easy and smooth participation process
Value Creation	Short-term Value Creation	The importance of value creation on interaction-specific level
	Long-term Value Creation	The development of the domain of a community in the long run
Connections to the World	Connections to the World	Also value creation; Described as through connecting to a wider community which “its members care to keep abreast of”
Identity	Personal Identity	Very crucial aspect of participation Members bring their identities to the community which develops and shapes both their own identities ---
	Communal Identity	--- and the communal identity Identity creation is a mutually constitutive process
Community Membership	Belonging and Relationship	Generation of personal value through interaction It is “not merely instrumental” but a factor shaping identities as well
	Complex Boundaries	The multiple levels and types of participation within a community which is crucial especially for the ones that are on the periphery
Community Development	Evolution	An emphasis on the long-term development of the community, on “how they go through stages of development and find new connections to the world”
	Active Community-building	The people or the core group who take active roles and responsibility along the community’s evolution

Figure 3: 13 elements of successful communities of practice which technology can affect (Wenger, 2001)

Affective affordances are related to the “users’ perceived characteristics from technological features”, whereas educational affordances are considered “users’ perceived characteristics for learning from affective affordances” (p. 1830). According to this model, two affective affordances determine *usability*, which then influence two other educational affordances on *learnability*. Shin (2017) describes the model as “it shows the technological features of VR and usage dynamics regarding users’ cognitive process in VR environments” (Shin, 2017 p. 1830), therefore it is a useful model for analyzing the effects of affordances in immersive learning.

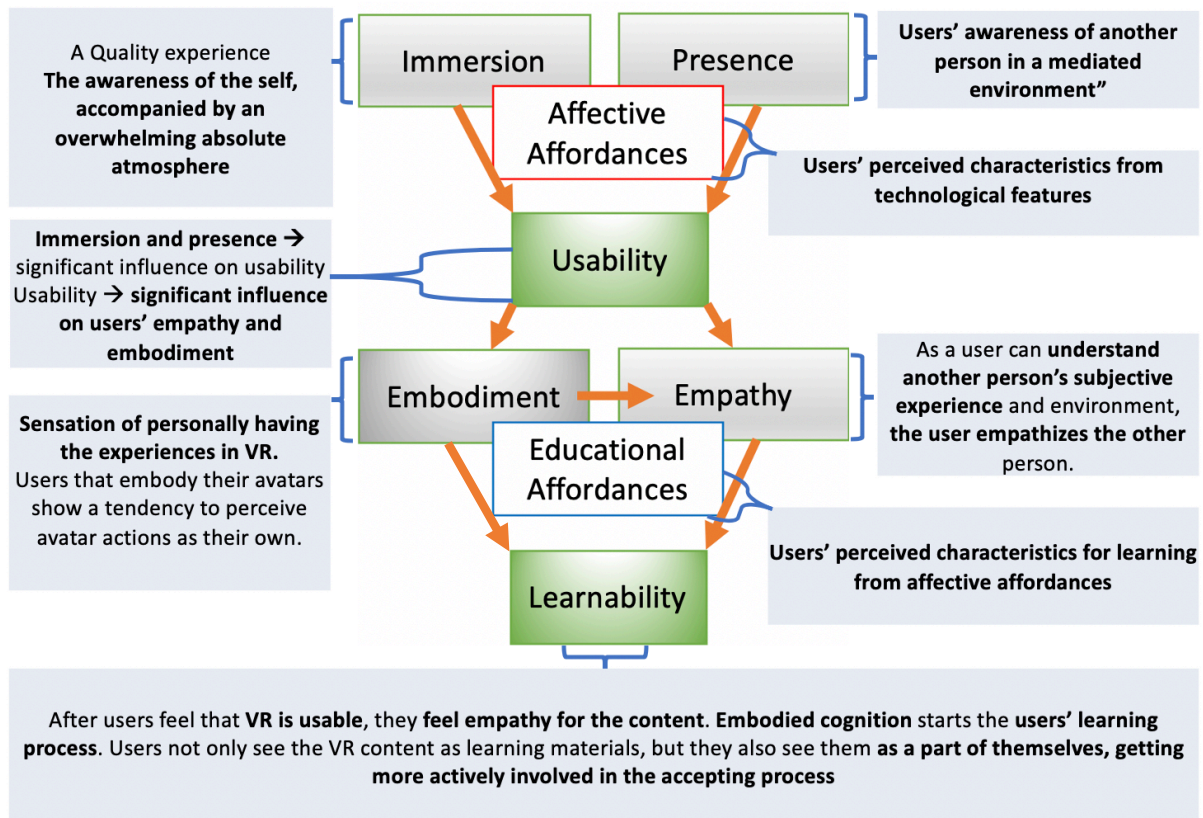


Figure 4: VLE experience model (Shin, 2017)

Shin (2017) approaches learning from cognitive perspective which is actually confronted by Situated Learning (Lave & Wenger 1991, p. 11); however it provides a model for better identification of affordances in learning in VLEs which to be exploited for the purpose of creating a holistic model for studying learning as social practice -and if VLEs’ can support this practice- by means of mapping the proposed affordances onto the elements of successful CoP which technology can affect. These two models are identified as they are corresponding; as a matter of fact, for the purpose of this study, they are mapped on each other as seen on Figure 5.

Apart from the model presented on Figure 5, various other literature contributes to this study’s scientific richness as well as there some others that provide relevant insights on the subject of affordances. There is a very limited literature on the use immersive technologies in learning from CoP perspective; however, the ones which exist propose arguably accurate models in regard to CoP and Situated Learning. For instance, Mei and Sheng (2011) investigates on the application of immersive technologies in a situated medical education context. As argued

by Herrington and Oliver (1995, as cited in Mei Sheng 2011) “situated learning environments should provide authentic contexts, provide access to expert performances and the modelling of processes, support the collaborative construction of knowledge, provide coaching and scaffolding” (p. 299), Mei and Sheng conclude that VR helps learners to visualize and develop abstract concepts, therefore can stimulate learner motivation (p. 302). This reasoning can be applied to all immersive learning technologies as long as they are utilized as VLEs.

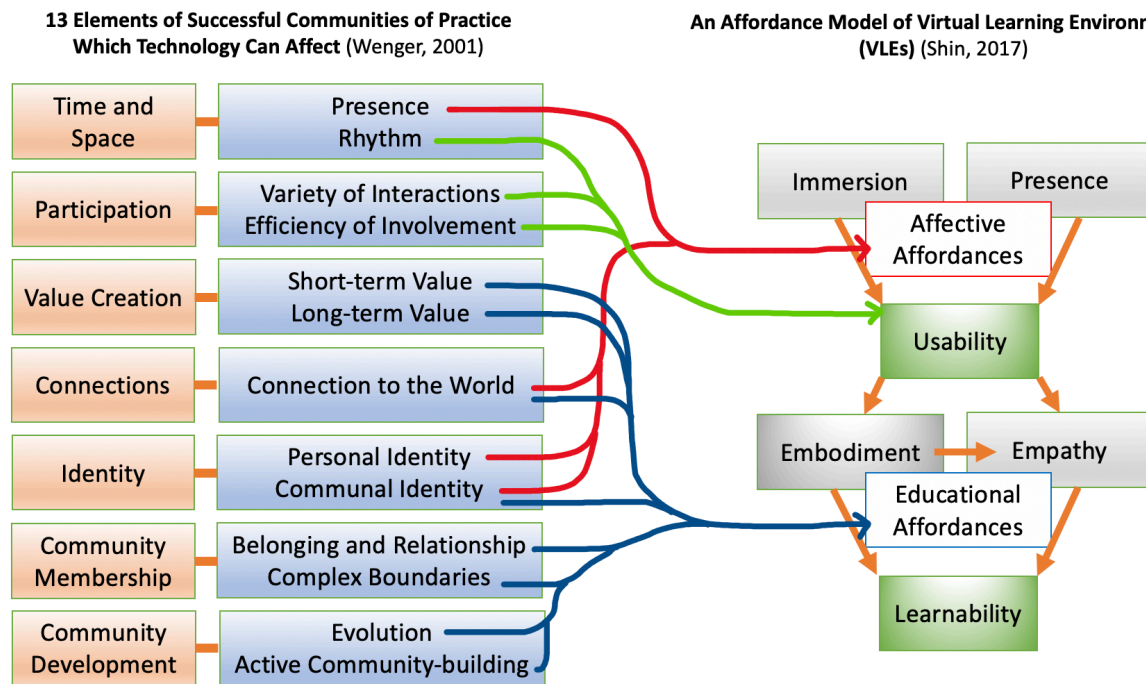


Figure 5: Main Research Model (Wenger, 2001; Shin, 2017)

Contrary to the positive effects of VR learning, Yusoff, Zaman and Ahmad (2010) argues that realistic 3D virtual worlds can be perceived as ‘heavily’ virtual as “they depart so much from the actual world that they might feel less authentic” (p. 886) However, they suggest other types of immersive technologies like AR or MR which they consider as advantageous as being “affordances for authenticity”. Even though there is less simulated sensory input and they are light on virtual information, “they play the role of balancing the strengths and weaknesses of virtual media in creating authentic learning environments and to ‘lightly’ structure activities that take advantage of the authenticity of real-world environments together with live social interactions with other participants” (Yusoff, Zaman & Ahmad, 2010, p. 886).

3. Method

3.1 Research Strategy and Design

This study is guided by CoP perspective with the aim to discover the potential benefits which could be generated by the use of immersive technologies and the challenges involved when incorporating these technologies in ecovillage communities of practice, through using qualitative semi-structured interviews as the data collection method; it is widely used within social sciences to explore subjective viewpoints (Bradford & Cullen, 2012).

For evaluating the learning styles of ecovillagers and whether the current technology can supply the necessary affective and educational affordances to these communities, an interview guideline is prepared in light of the theoretical frameworks used for this study. Then, interviewees are selected and are sent the guidelines by means of purposive sampling. After an interview is done, all audio is transcribed and coded on NVivo³. All data is analyzed by means of qualitative content analysis (QCA) through inductive and deductive coding both research questions.

In addition, the Covid-19 pandemic of 2020 required a readjustment for the data collection phase (*See Section 6.2*). Since the ecovillage communities were not accepting any non-members within their community spaces, face-to-face interviews was not a possible data collection method anymore. The researcher instead focused on carrying out online interviews via Zoom⁴.

3.2 Target Population and Sampling

The target population of this study are people who actively take part in the development of an ecovillage which is connected to a broader network of other ecovillages. Sampling process for data collection from the indicated target population is conducted according to the resources available (*See Section 6.2*) and based on purposive sampling method, that is “the selection of cases from a pool or population without random sampling” (Elliot et al., 2016). To reflect a relevant setting for analyzing the issue from communities of practice perspective and for the samples to differ in terms of the key characteristics (Bryman, 2012), the researcher bases the notion of apprenticeship for purposive sampling; a difference in opinions between an old-timer and a -relatively- newcomer is sought. The terms “newcomer” and “old-timer” refer to a set of relations that develop and evolve in time in a community of practice, which draw the main framework of legitimate peripheral participation (*See Section 2.3*): “The community of practice encompasses apprentices (newcomers), young masters (old-timers) with apprentices and masters some of whose apprentices have themselves become masters” (p. 56). Legitimate peripheral participation is the process of newcomers/apprentices becoming experienced members and eventually masters/old-timers of a community of practice.

By using this method to differentiate samples, the researcher anticipates differences between the interviewees’ opinions since the core aspects of communities of practice are shaped around this binary and multidirectional relationship between those who are within the periphery and those who are outside. The researcher chooses the interviewees according to how the interviewees consider the others and themselves within this framework.

³ “NVivo is a software that supports qualitative and mixed methods research” (NVivo, n.d.).

⁴ “Zoom is a cloud platform for video and audio conferencing, collaboration, chat, and webinars across mobile devices, desktops, telephones, and room systems” (Zoom, n.d.).

The researcher approaches the target population in a strategic way; those sampled are relevant to answering the research question; the researcher “ensures that there is a good deal of variety in the resulting sample” (Bryman, 2012, p. 417). Within this framework, two different type of ecovillages from Australia are chosen. The reason for choosing Australia is because it is known as the birthplace of permaculture movement (Crosby & Lorber-Kasunic & Accarigi, 2014) that inspired counterculture movements starting from 1970s (Holmgren, 2017; Liftin, 2012).

Prior to the interviews, the researcher goes through the two ecovillage’s web sites, for gaining detailed knowledge about the ecovillages in order to efficiently communicate with the interviewees; Narara Ecovillage defines itself as a learning center whereas Aldinga Arts Ecovillage is an eco-neighborhood which has quite different approaches to community. The researcher’s intention to pick structurally different ecovillages (*See Section 3.3*) is to notice and evaluate if any structural or ideological difference affects how they perceive learning and if it changes ecovillagers’ perception of using digital communication tools for learning.

3.3 Case Context

Aldinga Arts Ecovillage is located in Aldinga which is a southern suburb of Adelaide, South Australia. Aldinga Ecovillage is built on 34-hectare land where first settlements began in 2004 after its initial construction in 2002. Today, it consists of over 200 households and has a population of over 400 members. As an intentional community, Aldinga Arts Ecovillage focuses on environmental sustainability and artistic creation-expression. All houses in the village were built according to eco-friendly design principles that aim to reduce the ecological impact. There are also several ongoing and completed “affordable eco-housing” projects in the village. (Aldinga Arts Ecovillage, n.d.)

Narara Ecovillage, as defined on their website as an “intergenerational residential community on the Central Coast of Australia, surrounded by bushland, close to pristine beaches and an hour north of Sydney”. The planning and research phases of Narara Ecovillage date back to early 2000s while it is still considered as an ongoing research project on sustainable living. First houses were built in 2019 but until this point on, the site has been used for open days and community gatherings. The property was bought in 2013 and the infrastructure was completed in 2017. Even though not all members live on site, currently Narara Ecovillage has over 172 members and they aim to host 300 members and have +150 households when the project is completed that is phased in 3 stages; at the moment, only stage 1 is completed. (Narara Ecovillage, n.d.)

3.4 Data Collection

According the study’s focus, an interview guideline is prepared in light of the theoretical frameworks used for this study. Interview guideline consists of four parts: Goals, Process, Ethical Considerations and Questions. Considering the fact that the interviewees might not be familiar with the concepts used in the study, the researcher provides a short definition of immersive technologies, a brief summary of the study’s goals and a summary of the planned processes (*See Appendix 1*). Lastly, the interview questions are provided on the interview guideline. For preparing the questions, the researcher utilizes Wenger’s (2001) taxonomy which highlights “13 fundamental elements of successful communities of practice which technology can effect” (p. 39-40); the researcher has come up with theoretically informed interview

questions for evaluating the learning styles of the communities (e.g. “How tightly-knit is your community?” to identify “Complex boundaries”). Some questions are directly taken from Wenger’s (2001) work, from “Issues to Consider” section where he provides “a number of questions to ponder” (p. 49) and some of the questions are derived from the success factors which underlies this study’s main theoretical framework.

Despite not explicitly displayed on the guideline, the questions section consists of two parts that are expected to direct the flow of the interviews. The first cluster of questions -that is for identifying community goals and practices- and a few questions following the first section -that are for understanding the interviewee’s opinions on learning and for identifying how they perceive their community practices- are expected to answer RQ1. Thereafter, the questions about ecovillagers’ current use of technology in their community lives, and finally, the questions for understanding how the interviewees’ view immersive technologies are added; these questions are expected to provide answers to RQ2. (*See Appendix 3 & 4: Coding Scheme 1, 2*)

The empirical data for this study is collected through qualitative semi-structured online interviews conducted with members of ecovillage communities. The researcher is interested in doing an in-depth analysis of interviewees’ point of view. Since researcher focuses on what the interviewees consider relevant or important, qualitative semi-structured interviews work best as this method is considered as flexible and involves open-ended questions, therefore allowing new ideas to emerge during interviews (Bryman, 2012, p. 470-472). Braun and Clarke (2006, as cited in Evans, 2017) state that “qualitative semi-structured interviews can be used as much to consider experience, meanings and the ‘reality’ of participants’ experiences and to explore how these experiences, ‘realities’ and meanings might be informed by discourses, assumptions or ideas which exist in wider society” (p. 2). Since this study aims to gain in-depth knowledge about and gather in-depth accounts of ecovillagers’ experiences of learning; what they consider as learning and what they think about learning and the use of technology, it necessitates “independence from a single theoretical framework or epistemological position” (Evans, 2017, p. 2) which becomes possible by means of using qualitative semi-structured interviews. On the other hand, using semi-structured interviews grants the researcher the ability to “address a defined topic whilst allowing the interviewee to answer in their own terms and to discuss issues and topics pertinent to them”, “additionally allow other relevant themes to develop throughout the interview” (Evans, 2017, p. 2).

The interview sessions are held online via Zoom. The researcher individually contacts the participants, provides them with the information about the research project, answers their questions, sends the consent forms (*See Appendix 2*) to be signed online and books an interview time. The interviews take approximately one hour. All sessions are video recorded.

Additionally, throughout the rest of the paper, the interview data will be referenced according to the interviewees’ assigned code not to reveal their identities based on the reasons indicated in Section 3.6:

A1O: the “old-timer” from Aldinga Arts Ecovillage; Female, Age: early 60s

A2N: the “newcomer” from Aldinga Arts Ecovillage, Female, Age: mid 30s

N1O: the “old-timer” from Narara Ecovillage, Female, Age: late 60s

N2N: the “newcomer” from Narara Ecovillage; Female, Age: mid 40s

3.5 Coding Scheme and Data Analysis

The interviews are recorded and later transcribed, then reviewed and critically examined. Once the interview transcripts are uploaded on NVivo, first, they are coded on the priorly created categories based on Wenger's (2001) taxonomy by way of deductive QCA to answer RQ1 (*See Figure 3*). Secondly, additional categories are added when common patterns are identified in different data sets during the analysis by means of inductive coding. Analysis to answer RQ2 is conducted predominantly by way of inductive QCA as well as some deductive codes backing the inductive codes. (*See Appendix 3 & 4: Coding Scheme 1 & 2*)

QCA is described as a set of techniques addressing the underlying themes and core ideas found in the materials being analyzed (Drisko & Maschi, 2015; Bryman, 2012). For the analysis of this study, QCA is found to be best fitting the research interests; because by QCA, it is possible to “develop a conceptualization of the content” (Drisko & Maschi, 2015, p. 3). QCA is also described as a “research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” (Krippendorff, 2004, p. 36). Krippendorff lists three types of inferences from which two types are used in this study for analyzing textual data: inductive and deductive. If there is limited knowledge or previous studies conducted on the research inquiry, inductive QCA is used, and if there are previous research, theories or frameworks regarding the topic, deductive QCA is used (Elo & Kyngäs, 2008).

This research uses both inference types for answering the two research questions that are formulated for different purposes. To answer RQ1, a research model is built by combining Wenger's (2001) taxonomy and Shin's (2017) affordances model for VR; they are mapped on each other for the purpose of creating an overarching model (*See Section 2.5*). This research model and concepts are used for the preparation of the first part of the interview guideline and to deduce the first part of the codes. During the interviews, the interviewees raised two issues that relate to what determine their ways of utilizing digital communication technologies and their understanding of learning: “Community Structure” and “Covid-19”. These two codes are added in the Coding Scheme during the analysis.

To answer RQ2, predominantly, inductive codes are used. As some similar issues raised by several interviewees, those were considered as categories as being induced from the interview data, such as “Lack of Knowledge” and “Over-Immersion”. While the research inquiry is novel and current literature on similar topics do not provide adequate empirical endeavors -which is the main reason to mostly use inductive coding to answer RQ2, the researcher appeals two deductive codes to help answer RQ2. They are: “Worldview” (based on Nathan's (2012) study) and “Authenticity” (based on Yusoff, Zaman and Ahmad's (2010) study). Prior to data collection, the researcher has hypothesized that these concepts might be potential sources of challenges.

3.6 Ethical Considerations

All participants are required to sign an informed consent form to take part in this research (*See Appendix 2*). The participants are approached individually and are provided an explanation of the goals of the study and the data collection process (*See Appendix 1*). The participants are given appropriate time to ask questions and express any concerns. All participants are given the right to interrupt the session for whatever reason and to withdraw from the study at any time even after signing the consent form.

All interviews are video recorded; consent to record the interviews is gained through the consent form. Recordings are only used for data analysis by the researcher. Via the consent form, the researcher ensures that participant names and identities are kept strictly confidential in the reporting of the study and during the dissemination of the findings. Recordings are not given to any third party than the researcher and, if requested, by the supervisors and the examiners. Privacy and confidentiality of the participants are preserved through not revealing participant names and identities at any phase of the study.

Participants are given the chance to read their transcripts before the publications to avoid possible misunderstandings and inconsistencies between their thoughts and what is reflected on the report. The findings of this research project are expected by the end of June 2020. An executive summary of these findings will be provided to all participants who are interested in the findings of the project.

4. Findings

4.1 Ecovillages as CoPs

The interview data reveals similarities and differences in the practices of the two ecovillages in focus and a difference in opinions on certain issues among the responses of newcomers and old-timers from the two ecovillages, especially about identity. Even though their communal and member identities and their structural characteristics differ, all interviewed ecovillage members emphasize on the idea of being “like-minded” in a general sense and on “the variety of interactions and practices” among which one could find something that fits their interests and capabilities, and on a “contribution to a bigger goal”.

For instance, A1O who is an old-timer from Aldinga community mentions a change or some adjustment in their identity in time since they joined the community. They tell a memory from when they were a newcomer: They were told “You have not been here long enough” by an old-timer when A1O introduced a proposition during a meeting and was very enthusiastic about it. They also mention that members’ identity is “shaped by the social interactions”. Even though A2N also mentions kind of an adjustment in identity, they don’t specifically emphasize a certain “giving up” in their identity.

Both interviewees from Aldinga Arts Ecovillage affirmed that their community is more like an “eco-neighborhood” than an ecovillage. A2N mentioned that in Aldinga they lack common spaces where they could share more: “They are building a sharing shed, but there is not really a hub here where people gather regularly like say in Findhorn where people eat together.” A2N as an experienced “community facilitator” in their own words, compares Aldinga to one of the most well-known ecovillage communities in the world, Findhorn in Scotland where they had resided. Whereas in Narara Ecovillage which is defined as a “mainstream community” by N2N, there is a special focus on building a shared repertoire and knowledge. N2N also likens the village to a “start-up company” in conjunction with what N1O mentions “businesses” as part of the main practices in the community: They describe their community as a “registered business”: “It’s a for-profit cooperative at the moment.” They mention the three businesses they have been planning to gradually start: education, accommodation and food. The education business is the project, the Collective Know-how Education Center. The accommodation business they are planning to start is for renting out rooms to visitors; they believe they can monetize accommodation on site. The food business has already started; one member runs a café on site, and they would like to develop similar businesses in the future.

Only old-timers tend to identify their community as more tightly knit than how the newcomers do. For instance, A1O described Aldinga as “a much more tightly knit community than an average suburb would be” whereas A2N described it as not tightly knit at all. Same goes for the Narara Ecovillage; N1O described their community as a very tightly knit whereas N2N described it as not tightly knit; they describe a tightly knit community as where “everybody’s connected to each other as individuals.”

There is a common point which is highlighted by all interviewees that they “learn by doing”. Even though it is not explicitly mentioned that their learning is based on apprenticeship, each interviewee tells about sort of a guided learning. For instance, N1O mentions a type of “consultancy learning”.

Both ecovillages, regardless of their differences in practices are communities of practice and have similar learning styles but do not have similar learning needs which are determined

by their approach to their intention to further develop their community. Their difference in their intentions which could be identified as the difference in the intention to build knowledge on sustainable practices (Narara is establishing a research and education center called “Collective Know-How Education Center” which’s mission is to build knowledge through research and practice and offer education opportunities to members and to the wider community) characterizes their practices. These intentions determine how they are benefiting from digital communication technologies and how they are likely to incorporate immersive technologies.

4.2 Benefits of Digital Communication Technologies

Narara Ecovillage as being a learning center and a more closely-knit community -than Aldinga, demands the knowledge on how to incorporate more tech as they attach more importance to common knowledge building, to the development and to the further evolution of the community. As mentioned by both interviewees (N1O, N2N), there is a clear interest in the integration of more technology in the village. This interest is mentioned as a need emerging from the community’s intention to outreach. N1O explicitly says that they actually use quite a lot of technology and they “do rely on a lot of technology”.

N2N specifies the current purpose of using technology as for communication. They say that Zoom has been used “for ages” for internal communication among the community members. The main reason stated by the interviewee is that not all members are permanently living in the village which has granted them the capability to cope with digital tools when the physical distancing laws applied. They also mention the circumstances that the Covid-19 situation has brought which they consider will be “great for the village”.

Quite many times, the ecovillage’s intention and motivation to market itself, its mainstream identity and their business approach that has been adopted from the initial phases of the establishment are mentioned. A few times, their intention to incorporate more technology has been uttered together with their motivation to market themselves. N2N touches on their wish to grow; mentions that they are still wanting new members, which they consider will create a need to use technology as mentioned during the interview followed by their opinion on how technology would become more widely used : “I think that more technology will become stronger around how we communicate internally as more people come on board.”

Narara Ecovillage already employs several digital communication tools such as cloud storage, a customer management system, a Wiki (an Atlassian Confluence⁵ mostly used for meeting minutes), Facebook pages and groups both for members and non-members (Narara Eco-living Network) and Zoom. They are also investigating on using “Airtable”, a management, planning and a documentation tool, and Airbnb⁶ for their prospective accommodation business. When the researcher asked if they consider incorporating more technology, N1O said “I would love to incorporate your technology”, referring to their motivation to investigate and incorporate immersive technologies and to the researcher’s supposed expertise in the area. Since N2N is a pioneer member and the founder of the “Collective Know-How Education Center”, they uttered that they are aware of the potentials in the use of immersive technologies in education. Additionally, N1O also touches on the Covid-19 situation and express their interest in knowing more on how to use immersive technologies

⁵ “Confluence is a collaboration wiki tool used to help teams to collaborate and share knowledge efficiently” (Atlassian, n.d.).

⁶ “Airbnb is an online marketplace that connects people who want to rent out their homes with people who are looking for accommodations in that locale. It currently covers more than 81,000 cities and 191 countries worldwide” (Folger, 2020).

“particularly in this time of physical isolation and in future”. They ask for more information about these technologies from the researcher, requests advices, articles, websites etc.

Whereas Aldinga Arts Ecovillage as being defined as an eco-neighborhood does not use “that much” technology already just because common use of technology has only been needed for basic documentation so far. However, the interviewees mentioned their individual use of online sources for learning. They use certain cloud-based web tools for administrative purposes: a server where they store the meeting minutes; web forms for polls and decision making; video conference tools but only at the moment due to the Covid-19 lockdown. Even though a strong tendency or motivation is not observed among the interviewees from Aldinga towards the use of more technology, A1O touches on the issue of distances being long in Australia and remarks that they would be “happy to use technology to make connections with other intentional communities in distance”.

In addition, an interesting point is made by N2N about the carbon footprint which is very much related to ecovillage practices and their relation to sustainability. They say, “My carbon footprint is completely smaller now that I am using technology in a whole other way to resource my life”. They mention their attitude towards technology is changing in this “interesting time” where they start to explore the two spaces, namely, technology and eco-living which they had thought very distinct. They now think there is a “clear interchange”; “not just in the ecovillages, but across many communities”.

Current lockdown situation due to the Covid-19 pandemic has created a need to go online regardless of the differences in community practices and identities. This circumstance is mentioned several times by all interviewees from both ecovillages as affecting their lives both on individual and social levels. A1O mentions that they had their first management committee meeting via Zoom. They mention an increase in community’s technology use both individually and collectively. However, Narara Ecovillage seems to be foreseeing a more online future considering the current lockdown situation than Aldinga. N2N thinks Covid-19 is easing up the acceleration of how they grow; they are wanting new members therefore they market their ecovillage via social media. They depict a future which they consider is close, when they will not only use social media for marketing themselves but “become able to do -interactive- virtual tours where people can live stream and people can ask questions and you can kind of show people around so that they don't have to kind of come here, potentially a long distance, just go...”. As also raised by A1O and mentioned earlier, the Covid-19 is pushing the limits of ecovillagers’ imaginations and influences them in a way to think about solutions to challenge current physical distancing laws.

In summary, current technology use and the need and intention to use more technology in ecovillage communities of practice are directly proportional to the practices and communal identities of ecovillage by taking into consideration the fact that the unforeseeable Covid-19 lockdown situation has been generating demand for convenience in the online world even in ecovillage communities of practice.

4.3 Challenges of Immersive Technologies

A few times, the importance of *presence* and *immersion* is mentioned by the interviewees as being significant aspects of learning and so interaction and socialization are; however, without touching on any aspect of immersive technologies. Except N1O, all other interviewees mention their inexperience with the technologies and lack of imagination on how it could be used or how it could help even though they were provided with the information about these technologies prior to the interviews by the researcher. However, all of them are curious about how it could

be used in ecovillage contexts. A1O gives an example: “Maybe we could develop a virtual reality package that introduce the whole village, take you on a tour in the village, describe our ethos and our social activities...”; this idea shows similarity to what has been proposed by N2N and been demanded by N1O; the knowledge to employ these technologies to market their ecovillage community for the sake of inspiring others.

A1O mentions their belly dancing teaching occupation and that they have started to teach on Zoom: “We have that kind of introductory interactive technological sharing and teaching going on but not virtual reality.” Nevertheless, they also say “Zoom is much nicer to use than just a telephone call”, basically intending to mean: the richer the media the more effective the communication. A2N who also deals with dance teaching as a (full-time) “conscious movement” teacher also states that they have started offering their classes online. As opposed to A1O’s positive and ease views on going online, they say they “had a big resistance to offering something online” but now they think it is “amazing” because of having explored a personalized way to do it.

A2N mention that they would not prefer immersive technologies over “the physical form” to which they attribute importance as a “conscious movement teacher”. They also state a very critical view on the use and the development of technology by referring to their view on the importance of physical contact: “People who develop technology... they are looking at the way of connecting but they are not, we are not considering how we connect” which is argued as “bodily” by A2N. Yet, this issue of physical contact raises another point; being an emerging pattern out of this study’s data: motion sickness. All interviewees express their concerns on motion sickness without explicitly uttering the term but referring to the phenomenon as feeling dizzy, nausea, etc. This highly relates to what has been raised by A2N which is also mentioned in the literature as a shortcoming of VR technology as complete isolation from the reality which is mentioned as “over-immersiveness” by this paper, and the lack of physical contact (*See Section 5.3*). In fact, motion sickness or complete isolation from the physical reality is mostly related to VR technology and could be overcome through the development of AR or other immersive technologies. Moreover, A2N has already stated that her dance teaching or the type of dance they are practicing does not have to involve bodily contact which contradicts their previous statement on their need of physical contact: “I can easily facilitate people to access the movement through the body without being in person”.

A1O mentions their possible motivation to use immersive technologies in the future if they are easily available with affordable prices. The researcher indicates an average price for an average VR headset during the interview and A1O states their possible motivation to buying an immersive technology product for learning purposes in the future, but they also touch on the fact that the availability, affordability and how widely it is currently used are significant aspects of endorsing buying new technology.

A1O states that technology is certainly supporting them particularly at this moment and time, referring to the current lockdown situation and the physical distancing laws in force, however, they touch on their community’s ethos of sociability and argue that “people are much more likely to want to meet together face-to-face as soon as they can and not want to use technology”. N2O also mentions that they would prefer having face-to-face meetings instead of online, but they touch on the fact that they are not always able to drive up to the village. Additionally, while mentioning the information technology-friendly approach of the community (IT-savvy), they indicate that not all members are comfortable with the amount and frequency of digital communication technology they use and rely on. However, they have a quite positive stance and those who are not much comfortable with technology reliance are the minority.

5. Discussion

5.1 Ecovillage Learning & How Immersive Tech Can Help

Ecovillagers' own description of their practices and their learning styles underline the elements of successful communities of practice introduced by Wenger's (2001) just because these ecovillage communities of practice admit that they learn like what is argued by the Situated Learning Theory. Brown, Collins and Duguid (1989, as cited in Yusoff, Zaman and Ahmad, 2010) describe situated learning before Lave and Wenger formulated legitimate peripheral participation as being "embedded within and inseparable from participating in a system of activity and deeply determined by a particular physical and cultural setting and also interaction with their social teams which lead to their adoption of learned behaviors" (p. 886). In reference to A2N's discovery of a personal way to do online classes on Zoom and their prior negative perspective of technology use, and considering how physical and cultural settings and interactions determine learning, since immersive technologies provide ecovillages with the necessary affective and educational affordances in the form of customizable collaborative immersive environments, they could enjoy their conceivable capability to design their own collaborative learning spaces which they could also use for connecting with other communities, for communicating their intentions and their knowledge with the wider community and serve their purpose of creating a sustainable world.

Ecovillage practices involve CoP and Situated Learning styles, and for that reason they tend to facilitate collaborative learning as much as they can for sustaining and developing their community lives for achieving the aforementioned "sustainability goals". Apart from their focus on sustainability, these communities of practice do a lot of work together (building, farming, attending the administrative meetings, cleaning, etc.) despite a little less in Aldinga, have connections beyond their physical contexts, they build and share knowledge and intend to outreach; they are in need of certain solutions to challenge certain problems on intracommunication, external communication, governance, documentation, financing, legal documentation, etc.

Ecovillage learning involves all the material and non-material aspects and factors influencing the communities' social interactions within the community as well as their interactions with the outer world which is the point where immersive technologies can affect. Considering the point made by Wenger (2001) that there are many geographically distributed communities that have to rely on some kind of technology for connecting to each other for various purposes, plus, since an interviewee also raised that the distances are very long in Australia, immersive technologies can help these communities to connect through the facilitation of remote collaborative learning, not only in Australian context but on a global scale as ecovillage communities tend to take part in networked global organizations like GEN and other networks.

5.2 CoP, Affordances and Technological Development

By referring to the research model created for this study, it is possible to correlate the "elements of a sustainable community of practice" to the affordances made available, perceivable, interpretable and reconstructable (Gibson, 1986) by immersive technologies. Wenger (2001) identifies these elements of "successful" communities of practice for updating and adjusting his theory of CoP to the newly emerging technologies in the beginning of the millennium. While these elements correspond to their model of communities of practice, they also add on to them.

Wenger formulates this model through analyzing the currently existing and developing technologies at their time (See Figure 5). However, a lot has changed since they formulated this model based on the technologies of their time which was in 2001; one could argue that this model below is outdated since technology has advanced.

Advancements in technology since Wenger (2001) conceptualized his model leads to creation of more holistic and integrated management systems (Tschirky, Lichtenthaler & Pfund, 2000). For example, when Wenger came up with his concept, even video streaming had not yet become prevalent; above all, even YouTube hadn't been founded. In fact, today, YouTube is a media giant that has surpassed traditional media, entirely transformed the way people consume and produce media. Most importantly, as an example, YouTube has become a learning hub in the context of demand-driven learning. As Lee and Lehto (2013) assert, "the popularity of YouTube hinges on its ability to create a social and digital community of individuals interested in a specialized topic and expertise" (p. 203). In other words, considering how the release and development of one application changed the course of human communication and learning, there is no chance that Wenger's (2001) concept is not outdated. While their concept provides an overview of the technology available at that time and their conceptualization and categorization is still valid in terms of the needs of communities, one has to take into account

that today, there are many applications already aggregating many of these aspects. For example, on Airtable which is mentioned by NIO, users can store information in spreadsheets, manage customer relationship (CRM), do task management, project planning, and tracking inventory (Airtable, n.d.), etc. Since many other companies have started to follow more multifaceted strategies due to the advancements in technology (artificial intelligence and machine learning, the Internet of things, big data management, etc.) (McBeath, 2019), all the technology products that are presented on Figure 5 are either not existing anymore or integrated into holistic and multifaceted platforms.

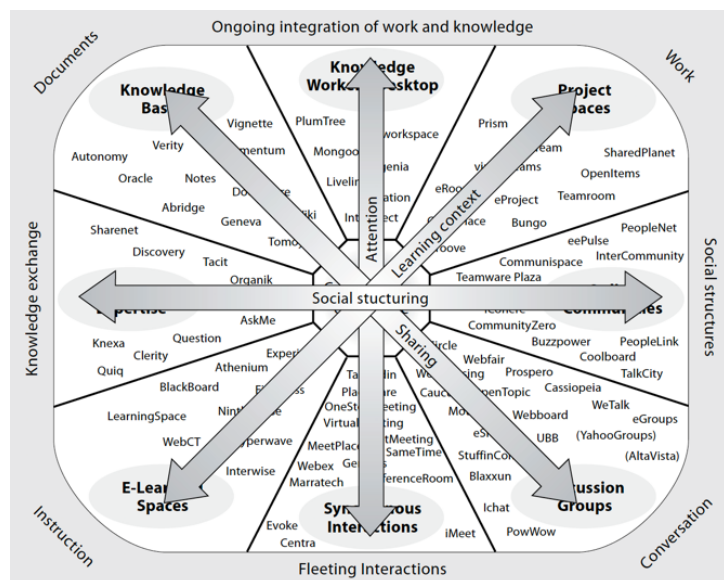


Figure 5: Graphic representation of the current market of community-oriented technologies and the illustration of tensions (Wenger, 2001, p. 37)

For that reason, this study creates a more up-to-date model than Wenger's, however, it is nevertheless reduced to immersive technologies. By taking into account the fact that the Internet has brought so many more affordances (Hutchby, 2001), and since the communities of practice are more than everywhere (Wenger, 1998), it has become almost impossible to create an overarching model of successful communities of practice which "a generalized notion of technology" can affect due to globalization and social media popularity. However, this study contributes to the creation of an overarching model to study specific technologies such as immersive technologies which's affordances show similarity within their own specific areas of focus. Herein, the concept of affordances determines the uses of specific technologies; It would be impossible to define the affordances of such a general medium, for example, of social media.

For instance, even though immersive technologies are studied here all together (VR, AR, MR, etc.) with their affective and educational affordances, it is yet an immature technology (Bouchard & Rozzo, 2019) that its constituents / sub-technologies would become disintegrated from each other in terms of the how they are studied in the future.

5.3 Over-Immersiveness & Authenticity in VLEs

Since this study's focus is not only VR but all immersive technologies, the shortcomings of VR technology which are also highlighted by the interviewees such as over-immersiveness and motion sickness, can arguably be overcome through the development of other immersive technologies like AR and MR. However, these technologies are yet to be easily accessible. Technical and logistic aspects still preclude the incorporation of immersive technologies in ecovillage communities of practice, at least for the moment. However, despite the "heavy virtuality" issue as mentioned by Yusoff, Zaman and Ahmad (2010) as it decreases "authenticity", other types of immersive technologies (AR and MR and tele immersion) could overcome the weaknesses of VR in creating authentic learning environments (p. 886). In addition, the term "over-immersiveness" is created in response to the lack of a similar word in the literature to explain what can be referred to as a combination of "heavy virtuality" and "lack of authenticity" in VR asserted by Yusoff, Zaman & Ahmad (2010). The lack of such a terminology to describe that situation which is also touched on by the interviewees with expressions like "complete isolation" and "not seeing the real environment" indicates a need to create an overarching term which this study favored as "over-immersiveness" (See Section 6.3).

5.4 The Extent of an Affordance

Besides the fact that immersive technologies raise learner motivation (Mei & Sheng, 2011), there is still room for improvement for these technologies to be considered as they provide "successful immersion". The notion of "successful immersion" could correspond to Shin's (2017) concept of "usability" with an additional element which is "*presence*". However, Shin also asserts that "particularly, *immersion* had the most significant effect on usability, followed by *presence*" (p. 1832). The author describes the identification process of affordances from a user perspective as a "path".

Usability and learnability are realized, gradually, while users are interacting with VR learning contents, and successful interaction and engagement is only possible if the content and the interface attracts the user. Since "VLE's affordance is obtained through users' action and interaction with the technologies" (Shin, 2017, p. 1834) and as the sense of immersion and presence is the starting point of the experience of VLEs, or in Shin's words, *immersion* and *presence* "respond to tactile input from the user" (p. 1834), the key to design effective VLE interfaces and content is only possible when technological qualities can afford more realistic media and higher resolution. According to Bowman and McMahan (2007), display resolution plays a big role in determining the level of *immersion* as well as lighting, soundscape, frame rate and other factors do (p. 38).

In addition, Shin (2017) puts forward that "immersion is based on active participation or knowing by doing" (p. 1834). In this respect, considering the underlying philosophy of Wenger's (1998) concept "learning by doing", technology can only afford more active interaction if higher media qualities are available which it could then raise learning motivation of the prospective ecovillage users. In this circumstance, immersive technology affordances

rely on the currently available media cues, however, considering the current ongoing research on the development of new advanced versions of immersive technologies will have created new affordances (i.e. more realistic grasping would enhance the sense of immersion, more realistic avatars would enhance the sense of presence, etc.) due to the newly emerging prospective technological capabilities in the future. Those advances may positively affect learning motivation since they will have enhanced the way of learning by doing by providing the users more capabilities to do tasks.

5.5 Worldview as Obstacle

Apart from the general challenges that are identified above, there is one challenge that is specific to ecovillage communities; that also makes of some general challenges, which is their worldview. Ecovillages as having grown in part from the permaculture movement, are “skeptical of modernity’s notion” (Liftin, 2012, p. 130). Considering the two interviewees’ words on sociability, their community’s (Aldinga) strong emphasis on this phenomenon in their ethos, some members’ discomfort with high reliance on information technology in Narara (despite minority), it is necessary to speak of the influence of their “ecovillage” worldview on their views on the use of technology and on their concerns on the use of immersive technologies. According to Liftin (2012), “permaculture movement has an essentially pessimistic view of the trajectory of human culture” and the followers of this movement believe in a technological and economic collapse according to how they see the current system as unsustainable (p. 130). Permaculture is therefore considered as a “descent culture” aiming a low-energy sustainable future whereas the current industrial culture is condemned to collapse according to this view; it is going to reach its peak which is referred to as “postmodern cultural chaos” by permaculturalists (or ecovillagers who are permaculturalists). In that sense, ecovillagers have concerns regarding the socio-ecological impact on the use and encouragement of new technologies which they consider would go against their worldviews as ecovillagers and permaculturalists. Nathan’s (2012) findings for instance, best explain this skeptical point of view (*See Section 2.1*). However, permaculturalists does not see “the descent” as “a return to preindustrial societal forms” since the modern society is a “fast-breeder system that generates new information, knowledge, innovation and culture” (Holmgren 2002, p. 22) meaning that the accumulation of knowledge and human expertise up till now will not disappear which should be made use of to challenge the existing unsustainable system.

Moreover, Nathan’s (2012) findings, and the results of this study highlights a need to use digital communication technologies in ecovillage communities despite the awareness of the socio-ecological impacts in ecovillage communities. In addition, an interesting point is raised by A2N about the reduced carbon footprint due to Covid-19 lockdowns. If this is the case (going online reduces a person’s carbon footprint due to less need/ability to travel or due to more connection opportunities online), this problematique should be thoroughly investigated by environmental scientists whether going online can reduce one’s carbon footprint as this impacts how ecovillagers view high-tech.

5.6 Summary

Despite the shortcomings of the current technology which could be listed as the availability and prevalence; requirements for training to make use the available technology; the lack of authenticity due to quality factors and over-immersiveness which is highlighted as an issue related only to VR, it is proven that there is an overt interest and curiosity among the

interviewees towards what the future will bring, especially at present times due to the lockdown situation caused by the Covid-19 pandemic. However, as being permaculturalists, ecovillagers are very much skeptical on the notions of the modern industrial society therefore on the diffusion of technology, which is pretty much the biggest obstruction and a significant challenge to be overcome in the face of an immersive learning future in ecovillages. Nevertheless, considering the difference between Narara's more positive views on high-com-tech use and Aldinga's more negative, the factors that shape a community's worldviews can be various, and this study therefore calls the researchers of this inquiry for exploring these since it is out of this study's scope.

6. Conclusion

6.1 Summary

This study aims to provide a detailed account of how learning seen, planned and facilitated in ecovillages to analyze if immersive technologies can help to facilitate learning in those communities of practice. Through conducting qualitative semi-structured interviews with 4 ecovillage members from 2 ecovillages the researcher found out that ecovillages are first and foremost communities of practice (Wenger, 1998); they do learn like what is argued by Situated Learning Theory (Lave & Wenger, 1991); and they do need to facilitate remote collaborative learning for reaching their long term goals refined by sustainability notions (GEN, n.d.a), which they intend to achieve since their foundation. Study results imply that immersive technologies can afford ecovillage type of learning through facilitating remote collaborative learning based on the analysis of the affordances of VLEs (Shin, 2017).

In addition, current lockdown situation due to Covid-19 pandemic has pushed ecovillagers for going online; generated a demand and curiosity among ecovillagers towards exploring online solutions for overcoming the challenges created by the physical distancing laws and perhaps for the first time towards investigating the potentials of incorporating immersive technologies to go beyond the physical limits of the physical world, to connect to the world, to inspire and get inspired. Nonetheless, there are several limitations to facilitating remote collaboration via immersive technologies generally due to the lack of certain quality features (Bowman & McMahan, 2007) of the currently available immersive technologies (over-immersiveness of VR, motion sickness, high resolution etc.). There are also requirements that have to be fulfilled for successfully incorporating these technologies in ecovillage communities of practice such as the need for training on the use of tools, economic affordability and popularity of the tools in the society. Additionally, ecovillagers' worldviews is identified as a challenge on the face of immersive learning in ecovillages based on how they view technological development and its ecological costs and how ecovillagers value face-to-face interactions; via immersive technologies they concern sociability may get lost due to heavy virtuality and lack of authenticity in immersive environments.

6.2 Limitations

This research project was going to be carried out in collaboration with Think Digital, a technology firm based in Adelaide, Australia as an explorative on-field case study on a specific ecovillage. Australia was chosen as the main location for the case study because of the researcher's projected access to technical and logistics support provided by Think Digital which currently is developing a collaborative learning platform for enhancing agricultural education (Farm VR World); the first plan required a supply of hardware, software and IT support. Since the researcher has got established connections in Australia for following the previous plan, it has been more convenient to sticking to the two ecovillage communities that the researcher has been in touch with for this final study as well as the ecovillages practices in this study also reflect two different approaches to community life (*See Section 3.3*).

Additionally, the research is conducted with a limited sample: 4 interviewees from 2 ecovillages in Australia. Even though newcomer and old-timer division is used as a baseline for purposive sampling, the sample is still small for generalizing the results. Nevertheless, this study as being an investigative qualitative comparative analysis without the intention to generalize the findings over all the ecovillages and ecovillagers, achieves its aims to raise a

debate on the use of immersive technologies in ecovillage communities of practice through investigating factors that shape ecovillage learning by studying two examples. In this regard, one of the main objectives of this study is also to encourage further comprehensive research on CoP learning in ecovillages context and how immersive technology affordances can affect.

6.3 Further Research

This study at first aims to fill a research gap in the field of communication studies. As well as there are very few studies in the field of communication that focus on ecovillages, learning and digital communication, there are no studies that combine these three. By gathering these three distant looking domains, the researcher aims to draw the academy's attention to the evidently changing, rapidly transformed human communication by new digital communication technologies. Since the researcher considers ecovillages as potential role models for sustainable living in today's world where social and environmental problems arise quicker and affect humanity on a global scale, studying ecovillage learning and digital communication technologies would contribute not only to communication studies but to human development.

There is a limited literature on the utilization of the idea of CoP in ecovillages context. Therefore, this study aspires to inspire further research specifically on the development of CoP learning in ecovillages and how it can be facilitated through the use of immersive technologies. As Herrington and Oliver (1995) assert, "computer-based representations and microworlds do provide a powerful and acceptable vehicle for the critical characteristics of the traditional apprenticeship" -despite their focus being "the classroom environment (p. 2), further research can delve into ecovillage type of learning from the perspective of Situated Learning through the lens of technology affordances which is attempted by this study.

Additionally, as also raised by one interviewee, the current lockdown situation might be shrinking people's carbon footprint. A further research related to this issue could investigate whether this situation is increasing data use due to an increased the Internet use and whether this might end up with a bigger carbon footprint per capita or vice versa.

Study results highlight an apparent curiosity and need to facilitate learning by digital communication technologies in ecovillages, and there are apparent challenges that relate to technology affordances and ecovillage worldview. These insights are believed to inspire further research and eventually contribute to creation a new study domain that gather more fields including sustainability studies, environmental sciences, intercultural communication, user-experience (UX) design and many more. Further research on organizational structures of ecovillages and their communication within their community or among other communities could highlight more aspects that can serve to creation of this prospected new field of study.

6.4 Practical Implications

Considering the relation between theory of affordances (Gibson, 1986; Hutchby, 2001) and UX design approaches (Soegard, n.d.), this study can provide insights to the further development of customizable collaborative immersive learning environments for ecovillage communities as results highlight how they learn and what affordances of immersive technologies may help for the creation of more effective platforms in the future. As long as *immersion*, *presence*, *embodiment* and *empathy* affordances in VLEs as identified by Shin (2017) are improved, the effectiveness of immersive learning increases. At this stage, user-experience (UX) design is key to the development of better immersive learning platforms. However, Shin (2017) also

emphasizes that “whether such engagement concerns total immersion, empathy with characters, pleasures of navigating a space, or interacting with other users, depends on individual preferences and the specific contextual situation” (p. 1834). Since cognition plays a bigger role in the perception of the virtual environment by users according to Shin’s perspective, the UX has to focus on building environments which can be customized by users for the sake of building more efficient customization features than what today’s technologies offer. However, in the context of ecovillage learning, collaborative learning environments have to center community identities since CoP centralizes all social interactions and all material and non-material aspects of community life. So, alongside quality improvements which would enhance affective and educational affordances in VLEs, affordances that enable collaboration and collective customizability have to be considered in the designing of remote collaborative environments for communities of practice. In addition, as demanded and proposed by some interviewees, for their communication and marketing needs 360° video contents, virtual ecovillage tours could be produced by using 360° cameras until when immersive technologies have advanced to an extent that enable ecovillages communities to create their own immersive collaborative learning platforms or they may collaborate with technology firms for developing immersive technologies according to their needs.

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8. Appendices

8.1 Interview Guideline

Project Title:

Immersive Technologies & Learning in Ecovillage Communities of Practice

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Goals: This study investigates the potential benefits which could be generated by the use of immersive technologies in ecovillage communities of practice. Immersive technology refers to technology that attempts to emulate a physical world through the means of a digital or simulated world by creating a surrounding sensory feeling, thereby creating a sense of immersion. Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) are considered as immersive technologies. Immersive technologies are known by their impact on education; helping learners develop skills without the real-world consequences of failing, providing customizable 3D environments and advanced virtual interaction opportunities, enhancing memorability and enabling virtual communities.

This study focuses on ecovillage communities and their extended social and professional networks. A needs analysis is conducted to see whether ecovillage communities need to facilitate remote and collaborative learning via immersive technologies, and if not, what takings could be derived from the current and future learning needs of ecovillages and what the current and future immersive learning technologies can offer to them.

Process: The empirical data for this study is collected through semi-structured online interviews with members of ecovillage communities. Semi-structured interviews involve open-ended questions, allowing new ideas to be brought up during the interviews. The interview sessions will be held online via Zoom. The researcher will individually contact the participants, provide them with the information about the research project, answer their questions, send consent form to be signed online and book an interview time. An hour before the interview, the researcher will send an invitation to the participant on Zoom. The interviews will take approximately 1 hour. All sessions will be recorded.

Ethical Considerations: Each participant who takes part in the activity are given the right to interrupt the session whenever they feel the need for whatever reason. An explanation is given to potential participants that they have a right to withdraw from the study at any time even after the informed consent is signed.

The anonymity and confidentiality of the participants is preserved by not revealing their names and identity in the reporting of the study findings. Privacy and confidentiality of the activity environment are managed carefully during the dissemination of the findings.

All interviews will be video recorded. Recordings are only used for data analysis by the researcher. Via the consent form, the researcher ensures that participant identities are kept strictly confidential. Recordings will not be given to any third part than the researcher and, if requested, by the supervisors and the examiners.

Participants will be given the chance to read their transcripts before the publications of results to avoid possible misunderstandings and inconsistencies between their thoughts and what is reflected on the report. Participant identities are not be revealed in the reporting of the study findings. The findings of this research project are expected by the end of June 2020. An executive summary of these findings will be provided to all participants who are interested in the findings of the project.

Interview Questions

1. What is(are) the practice(s) of your community?
2. What are “the most important goals” of the community from your perspective?
3. Are community members likely to know each other?
4. How tightly knit is the community?
5. How much work are they doing together?
6. (events, cleaning, building, farming, management etc.)
7. How frequently do you, organize public events like workshops, conferences?
8. To what extent do you inherit your community’s identity?
9. How much common knowledge is your community building?
10. How important is building, spreading knowledge and inspiring others?
11. Do you belong to any other communities than your ecovillage community? (i.e. online forums)
12. To what extent do you share and pursue a similar path/ideal with other communities in larger networks of intentional communities (like GEN)?
13. How do community members communicate with each other and with members of other communities? (i.e. messenger, Facebook group, phone, email, etc.)
14. To what extent is learning important for individual members to sustain their own ecovillage life and for the community in general?
15. To what extent do you consider any type of community practice as learning?
16. Do you think you learn better in groups? To what extent are interaction and socialization important aspects in learning?
17. How active is your community on social media? How common is the use of social media among community members?
18. How much are non-members followers involved in community practices? (Any)
19. How is technology currently supporting your community practices or how can it support in the future? Do you have plans to integrate to incorporate more tech in your community?
20. How important are documents, tools, and other artifacts in the management of the community? Do you prefer online documentation?
21. How is the general stance on technological development in your community?
22. How much knowledge do your community members have on the use of digital tools? How skilled are they?
23. Do you see a use in virtual reality in the future other than gaming?
24. To what extent can immersive technologies help spread knowledge on sustainable practices?


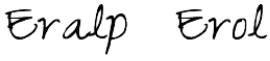
8.2 Consent Form

An Example Signed Consent Form:

Project Title: Immersive Technologies & Learning in Ecovillage Communities of Practice
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Consent to take part in research

- I..... voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview within two weeks after the activities.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio and video recorded.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I understand that disguised extracts from my interview may be quoted in the final report of this research.
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities.
- I understand that signed consent forms and original audio-video recordings will be retained in the researcher's encrypted personal computer until the exam board confirms the results of their dissertation.
- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.
- I understand that under freedom of information legalization I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

<p><i>Signature of research participant</i></p>  <p>Apr 28 2020</p> <p>Signature of participant Date</p>	<p><i>Signature of researcher</i></p> <p>I believe the participant is giving informed consent to participate in this study.</p>  <p>Apr 28 2020</p> <p>Signature of researcher Date</p>
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8.3 Coding Scheme 1

Research Question 1

Type	<u>THE NODES/</u> <u>Categories</u>	Corresponding Technology Affordance	Related Interview Question #	Example <u>CODE(s)</u>
Deductive	Presence	Affective	5, 12, 16	A1O: "it's much nicer to have the vision with the audio. You know Zoom is much nicer to use than just a telephone call."
Deductive	Rhythm	Usability	3, 5, 6, 12	A1O: "Normally we have a process of f2f meetings where people get to discuss the proposals with their propositions which have been put up to the meeting. Then we have discussion at the meeting, fairly short usually and then we have in person voting and that gets quite exciting".
Deductive	Variety of Interactions	Usability	1, 3, 5, 12	N2N: "When I think about how should I plant my garden and I haven't gone to the wiki, I've talked to people because the people who have that knowledge inside their heads, I don't think they have written it down and said, this is A to Z of how you do a perfect, you know, vegetable bed."
Deductive	Efficiency of Involvement	Usability	3, 5, 6, 12	N1O: "Nothing here is mandatory, even members' meetings, you don't have to come to a members' meeting. So, there's nothing is mandatory, really is being involved in the activities on site."
Deductive	Short-term Value Creation	Educational	5, 8, 9	N2N: "I've learned a lot since I've been here. But it, I guess it's not... There are certain training environments. So, we follow the concept of order management method..."
Deductive	Long-term Value Creation	Educational	5, 6, 8, 9	A1O: "We do some of those things which are for the broader community, and we certainly have an intention to be an education

				resource for the broader community. so, for instance we have groups of school children from the local schools who come through and look at some particular aspect of the village”.
Deductive	Connections to the World	Affective & Educational	9, 10, 11, 16	A1O: “We have had occasional speakers come to the village from wider networks; we had somebody from an intentional community in Italy a few years ago. That’s another education that goes on within the village”.
Deductive	Personal Identity	Affective	7, 8, 10, 11, 13, 15	A1O: “I think people who come to live in the village generally have those kinds of likeminded ideas ... They want the social community living, or they want the artistic living, or they want vegetable growing sustainability, permaculture kind of living ... because they get immersed in activities around the village, they broaden out from that first interest and they take on some of the other aspects ... they get attached to the social network that they develop in the village. And so, some of their identity is shaped by the social interactions they have within the village”.
Deductive	Communal Identity	Affective & Educational	1, 2, 4, 5, 14, 16, 17	A2N: “The culture of this community that has... which I would say is part of the identity is that... I'm going to be really honest. It had a very industrious culture. So, we do is the kind of primary statement like we do things, we build things, we create things. But when it came to conflict or the emotional side of community, there's definitely a gap there”.
Deductive	Belonging and Relationship	Educational	1, 2, 3, 5	A2N: “It took me about a year in Alice Springs to feel like I had some level of connections in that community, but when I got here, it's felt like it's very, very fast how

				I've connected into the community”.
Deductive	Complex Boundaries	Educational	1, 3, 5, 10, 17	N1O: “Nothing here is mandatory, even members’ meetings, you don't have to come to a members’ meeting. So, there's nothing is mandatory, really is being involved in the activities on site.”
Deductive	Evolution	Educational	14	A1O: “... we had a project running called the governance project. And there was a lot of discussion in the village at that time about this whole whether we use sociocratic decision making which is consensus building decision making or democratic processes and in fact we use this kind of muddling mixture of both. But they produced a report in the village that where they surveyed all of the different processes by which the village came to decision making”.
Deductive	Active Community-building	Educational	6, 8, 9, 16, 17	N1O: “There is a group on community building. It’s a very strong group. And it was I think the first group that was formed was that community building group, while the business development group was formed later on”.
Inductive	Community Structure	---	---	A2N: “They are building a sharing shed, but there is not really a hub here where people gather regularly like say in Findhorn where people eat together”. A1O: “It is more like an eco-neighborhood I suppose... We’re not a gated community... So, almost everything that we do within the village is for the benefit of the village. A few things that we do for the benefit of the wider community”. N2N: “It's like a startup company, isn't it? When you can all talk together, you don't do training.

				But then when there's 75 of you, you've already put in a baseline around how things are done.”
Inductive	Covid-19 & Lockdowns	---	---	A1O: “We had our first management committee meeting using zoom last week. So yes, technology is certainly supporting us particularly at this moment and time”. N1O: “I’d like to know more from you how we could use it (VR) particularly in this time of physical isolation and in future”. N2N: “I guess COVID-19 has bought a kind of a particular set of circumstances, which I think will be great for the village”.

8.4 Coding Scheme 2

Research Question 2

Type	Challenges when incorporating immersive technologies in ecovillages <u>THE NODES / CATEGORIES</u>	Issues raised while Question ... is discussed	Example <u>CODE(s)</u>
Inductive	Availability and Prevalence	19	A1O: “Since VR is a new technology, it’s relatively expensive to get headsets”.
Inductive	Lack of Knowledge	18, 21	N2N: “For me, it is s about having the 3d headset and it is kind of like a gaming experience, but I haven't seen anything that is used strictly for learning purposes”.
Inductive	Training Requirements	21, 22	A1O: “VR requires some kind of technological knowledge or training to understand how to navigate”.
Inductive	Over-Immersiveness	22	A1O: “I can imagine that some people might find it disorienting or make them feel a bit nauseous, you know what they’re experiencing

			visually is not matched by what they're experiencing".
Deductive	Lack of Authenticity	22	A2N: "I guess what I am saying is that when we go into VR, it can never replace how our cellular form needs to evolve and change. We need cell to cell connection for true integration in the body".
Deductive	Worldview	20, 22, 23	N1O: "We actually use quite a lot of technology. Right from the beginning, we've got quite a few IT people in the group, which is useful. N1O: "I love educational technology but not social media" A2N: "I just think at what cost is all of this technology have on the body. It's a huge cost. Huge and this is not part of the conversation in any of these developments of technology. People who develop technology are looking at the way of connecting but they're not, we're not considering how we connect".