CHAPTER 3

Virtual Reality as a Pedagogical Tool for Interdisciplinarity and Place-Based Education

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Abstract Place-based education (PBE) has long been recognized as a high-impact educational practice. It embeds learning in a multi-sensory context that nurtures active, praxis-driven, interdisciplinary, and collaborative learning. More recently, educators have begun to utilize digital media and virtual reality technologies in ways that seem to parallel PBE. Using phenomenological concepts, especially following Edmund Husserl and Alfred Schütz, this chapter explores what the parallels and differences might be between physical and virtual places, ontologically as well as in its pedagogical role in PBE. It also attempts to interpret the other chapters of the book in light of the philosophical implications.

Keywords Constructivism • Husserl • Ontology • Phenomenology • Place-based education • Virtual reality

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R. D. Lansiquot, S. P. MacDonald (eds.), *Interdisciplinary Perspectives on Virtual Place-Based Learning*,
https://doi.org/10.1007/978-3-030-32471-1_3

In this chapter, I will be using the philosophical perspective to anticipate and situate some of the themes in the book in terms of the role virtual reality (VR) plays in place-based educational (PBE) practices. Traditional PBE which renders "place" in physical terms will serve as a contrast. VR can be, and often is, used to mimic physical spaces—one can perceive, interact with, and navigate through a VR setting that is created to resemble a physical place. However, VR has unique features which go beyond physical-based PBE that I think should be exploited in their own right, even if these features fall short on realism compared to the physical world. VR's lack of realism can be taken as its virtue—it is created, can be deleted, modified, and tailored to suit the user's needs. These features give it a functionality for pedagogical purposes that is not possible in the "real" realm.

In this chapter, I will elaborate and describe recent scholarly reflections about what kind of a "being" VR is, accentuating its unique ontology as compared to the physical. I will then apply these reflections to the ways in which the authors in this book utilize VR in their own curricula. All of the authors use a range of digital tools in promoting the successful acquisition of learning outcomes that reflect the distinctive manner in which virtual media and tools support learning. These virtual media function as a concrete context that supports praxis-based, active, and collaborative learning which are the desirable outcomes of PBE. My focus will be the chapters that most exemplify a phenomenological approach.

To give a brief overview of the chapters in this book, in Stephen Moysey's and Kelly Best Lazar's, Sean MacDonald's, as well as Ting Chin's and Christopher Swift's chapters, virtual maps representing physical geological sites, environmental data, and community make-up, respectively, provide sensory cues that help students in the construction of concepts. They help students to think through the implications of economic and geographical data, as well as data about the community that influence the design of actual physical places. In Moysey and Lazar's chapter, photosphere and Oculus are also used to enhance the experience of replicated field sites, like the Grand Canyon. Christine Rosalia's and Jean Hillstrom's chapters highlight the efficacy of VR in promoting objectives that are psychological, which frames environments and realism in ways that are very different than how their topics are traditionally studied, such as studying external facts and statistics about immigration. They focus on the internal, subjective responses that are elicited by virtual environments and contexts, and demonstrate the efficacy of VR as a substitute for real ones. In Reneta Lansiquot, Tamara Cunningham, and Candido Cabo's chapter, gaming

provides a figurative yet concrete world which students aim to build by coding collaboratively. There is an objective set of rules that govern the work and guides problem-solving with clear objectives. And in Anne Leonard's chapter, the physical places that house archival material and the wealth of text-based virtual resources mediating the understanding of historical places helps to provide a bridge between physical places and their historical meaning. Following Ossi Ollinaho, I use the term "province of meaning" to refer to the way VR environments frame learning which arises out of but is bracketed from the "paramount reality" (everyday reality).[1] Whichever predominates in the center of our attention and concerns is the "zone of primary relevance." The idea of a "province of meaning" highlights the fact that a given VR inculcates in students distinctive underlying theses and a horizon of rules, game play, objects, and avatars, which may not be physical, but nonetheless objective (users can interact and collaborate with and around them, whereas a hallucination or illusion, by contrast, is a private, ephemeral phenomena).

The theoretical framework I utilize in discussing these topics is informed primarily by phenomenology. I believe that it is particularly helpful in understanding the unique learning acquisition process of PBE with its accompanying interdisciplinarity, both in terms of epistemology and pedagogical solutions. In discussing the approach, I will be mapping phenomenological concepts to parallel ideas in constructivism. In analyzing the use of VR as a "province of meaning" in the chapters that follow in this volume, I would like to focus in particular on the metrics of abstraction and specialization as a way of assessing the efficacy of VR in addition to more general cognitive skills. Of the many learning outcomes that a study of pedagogy could focus on, these two outcomes regard the breadth and depth of discipline-specific content knowledge which are key metrics in academic learning.[2]

3.1 The Phenomenological Approach and Constructivism

It is no coincidence that much of recent scholarship analyzing the ontological status of VR draws from phenomenology. First and foremost, I believe that phenomenology truly reflects the relationship between self and world, which in many ways is true of how we relate to VR. But it also has the added benefit of articulating the relationship in a way that provides the structural components requisite to understanding how we interact

with VR in its unique features as well. In a previous work, I articulated the many facets involved in this structure through reconstructing Husserl's epistemology as found in his *Ideas I* and *II*.[3] Let me provide a brief synopsis here of the relevant concepts.

Like all phenomenologists, Husserl believed that anything of the external world that enters into perception and cognition must of necessity conform to the conditions of that consciousness. To take a very simple example, humans and dogs have very different perceptual conditions—humans see a much greater range of colors than dogs, while dogs have a much greater range of smell perception. It would be fair to say that we are literally absent of the rich, varied realities of smell that is taken for granted by dogs. These differing conditions of perception, not to mention intellectual differences, affect how we see reality, as well as how we understand, analyze, and in other ways cognitively engage in the world. Recent scientific research by evolutionary psychologist, Donald Hoffman, explains that these differences in how we perceive the world evolved to aid survival and reproduction. As such, our perception is not at all concerned for a faithful depiction of the actual things themselves.[4] His work, as well as the work of a growing number of scientists,[5] refutes the anti-constructivist notion that the mind simply mirrors or passively reflects the external, unmediated thing. Husserl would agree with the idea that our reality is based as much on *how* we perceive as *what* we perceive, but this by no means implies that we cannot achieve objective knowledge.

In British and American philosophy, science is often defined by the formalistic, positivistic approach of analytic philosophy which seeks to equate empirical validity with things themselves and seeks to sever it from the realm of the mental and conventional. But as Thomas Kuhn wrote decades after Husserl in his famous work, *The Structure of Scientific Revolutions*, the paradigms of science are matters of convention as much as they seek to explain the physical universe.[6] Science is governed by norms, is tested by observation and experiment, which should be capable of being repeated by other scientists and are able to hold up to their critiques. This process ensures that the hypotheses of science, despite being merely "mental" stuff, maintain a standard of objectivity. I believe that the constructive process of learning is no different from this process. Students start with schemas that they acquire through their interactions in the life-world (paramount reality) and school, and bring those to bear when learning novel content. Through a process of testing and feedback from others, they become acculturated into the norms of any given discipline.

There is no one standard for all disciplines; each have shared assumptions and premises that govern what is acceptable or "true."

To get back to the phenomenological approach of Husserl's, let me reiterate a few key points as it relates to his constructive epistemology and learning. For Husserl, the transcendent object or the object prior to entering perception is not the object of our cognitions. By definition, we can only know an object once it enters into the sphere of consciousness. The way we perceive or know an object or idea is conditioned by the full array and complexity that make up a consciousness, including perceptual, social, psychological, and experiential considerations. But all perception has the basic structure of having a *noetic* component and a *noematic* component. Whatever exists in the "real" world exerts itself upon the mind as a thought-thing (*noema*) that is construed by the meaning-endowing processes of *noesis*. Husserl envisioned consciousness as a flashlight that has a ground zero (the fixed point at which the light begins) which emanates out to light an external world of things. The dark thing is the transcendent object; the lit thing is the *noematic* object. Consciousness has many rays by which it lights things, and these rays endow significations and meanings to what it lights as a constituent aspect of its very reality.[7] In Husserl's approach, our theses and meaning-endowing consciousness constructs perceptions and concepts as we acquire (construct) them, but he would also remind us that these cognitions are not entirely "subjective" as it is conditioned by heterogenic external physical and intersubjective realities that impose themselves upon our consciousness and resists it. This militates against a relativistic or solipsistic construal of the phenomenological approach.[8]

3.2 The Ontology of VR According to Phenomenology

This description of the way in which we perceive things in the external world also speaks to how we perceive VR for the obvious reason that VR is now a part of our lifeworld and we can have perceptual experiences of it. Though VR is coded and therefore a *made* reality, once it has been created, it can be perceived, and interacted with. Some scholars, like Ossi Ollinaho in "Virtualization of the Lifeworld," go further and point out that the digital world has shaped our everyday world in significant ways.[9] There are more complexities to the ontology of digital realities than its ability to mimic physical environments and objects, but let me begin with

discussing the obvious (perhaps) comparisons between VR and physical reality. I think this comparison is tempting because the expectation is set up by life experiences, as well as traditional PBE theories that the field experience of VR be *like* its physical counterpart. This is evident in some of the chapters contained here. Most often, what we notice is how VR fails to truly capture the full, rich experience that a physical context provides. Nonetheless, virtual PBE that aims to mimic the traditional PBE experience does still provide some of the same pedagogical benefits—it provides opportunities for students to be able to analyze and apply abstract concepts learned in books and the classroom to real-life context-based, concrete situations and problems.

Importantly, however, I think the ways in which the instructors in this book have utilized VR environments and tools demonstrate that VR has unique features that support learning outcomes in a way that also go beyond the parameters of traditional PBE. One key feature of VR is that its very existence is enabled through user participation and interaction, and therefore perhaps promotes active learning in a way that physical environments do not. The experience of VR is not just a context around which problems can be analyzed and solved, but its very existence is only possible through the activity of the user—computers must be turned on, the headset must be put on, the video game must be coded, and these activities are done for specific, intended outcomes. Indeed, Olga Gilyazoval writes that if we want to call VR an illusion, we should say that "the illusion is not a condition, but a consequence of the individual's involvement in the events."[10]

But I believe that the ontology of VR taken in itself is neither physical nor an illusion, which are the two sides of a shared dichotomy set up by traditional expectations. It has a unique ontological status. Joohan Kim in "Phenomenology of Digital Being" christens digital being with a new term, reflecting its unique ontology—the *res digitalis* to be distinguished from the Cartesian formulation of the dual being of reality, *res cogitans* and *res extensa*.[11] Kim believes that digital being exists somewhere between the mental and physical realms, and has features that can exhibit characteristics from both realms, but also has features that are independent from either. I would now like to draw upon several scholars attempting to characterize, analyze, and situate the ontology of the digital realm specifically with a focus on those features that apply to the pedagogical practices that are contained in the chapters of this book.

First of all, let me define and set the parameters of what I would include in the category of digital being. Following those who have already written on this topic, I define digital being as anything that can be interacted with that is the result of software which ultimately is generated by the computer which is the hardware. I would include as digital being virtual and augmented environments, which include realistic, fantastic, representational depictions; online discussion boards whose milieu is social; video games; and other digital media.

Unlike physical reality, VR is created, can be deleted, modified, can challenge the notions of place and time, can be duplicated precisely irrespective of time and place, and indeed could arguably live forever.[12] These unique features of VR can be exploited to entertain possibilities and innovations, experimentations, and risks. Not beholden to a physical reality that resists modification and whose modifications are permanent, students may use VR to make predictions about the future, as they did in my course *Weird Science*,[13] or see layers of rock which would otherwise be improbable to reveal on a geologic site as they did in Moysey's and Lazar's Earth Science course. And unlike illusions, VR is not just "in the mind" in a private, solipsistic space, but is publicly accessible, can be created and interacted with collaboratively. These features are analogous to the objectivity that we can attribute to constructed knowledge as constructivism sees it. VR is like constructed knowledge that is formed out of the accretion of interactions, experience, and work, regulated by norms, and which can be analyzed, questioned, and improved upon even though it is not a part of a physically real world. At the same time, it is not like a hallucination that is generated spontaneously without reason or rhyme, and which remains hidden to inspection and is not open to improvement or collaborations, like dreams.

3.3 The "Province of Meaning" and VR

The "world" and our conscious intentions and theses in regards to the *meaning* of that world are bound together in the phenomenological approach. Our perceptions and interactions with external reality depend upon the *noetic* contribution or the intentional meanings that we endow to it and which become a constituent component of that reality. Conditioning PBE experiences are the theses that are brought to the experience. When VR is the tool, it is always a part of the student's intentions that the experience is virtual, no matter how immersive the VR experience may be. For phenomenologists, a core notion at the heart of the

approach is the idea that consciousness consists of a self, a ground zero that is the source of the "illumination" of knowledge and meaning. But in the VR experience, everything happens "in front of the eyes,"[14] whether that be a simulated geological site, VR seen through Oculus, or even one's avatar which is supposed to represent the self.[15] The avatar may represent the self in a relational way, but obviously, even the avatar acts and moves "in front of the eyes" whereas our experiences, perceptions, and thinking happen "behind" them. I am the embodied thinking that looks out into a world; the avatar is the "body" upon which I project and pretend is the "I."

When we speak of immersion in the experience of VR, I believe that what is meant is how engrossed we can become in the experience, say, in a video game. But even in an intensely immersive state, I do not believe anyone would argue that we forget that VR is not actual reality. Indeed, it would be a frightening prospect if we are immersed in a violent video game to think that we are actually being shot at or holding a real gun. There is a clear ontological demarcation between the real and the virtual that is never crossed in the experience of VR.[16] A notable exception might be the psychological case as discussed by Rosalia and Hillstrom. Psychological dynamics can make it difficult to articulate what reality might even mean. For example, Bessel van der Kolk, a pioneer in Post-traumatic Stress Disorder (PTSD) research, put on the map the idea that when a PTSD victim is triggered, he or she experiences the original conditions of trauma as though it were happening in real time.[17] This alternate reality supersedes the actual reality, at least during the duration of being triggered. Because their chapters lie a bit outside of the phenomenological problematic, I will not be elaborating these chapters further when I discuss the chapters in the book below. My point here is that the experience of VR is typically accompanied by intended meanings that shape how we experience it, and at the heart of the experience of VR is the thesis that it is exactly virtual and not real.

To expand upon what I wrote about in my previous work on Husserl, I would like to bring in those writers on the ontology of VR that draw from Alfred Schütz who further develop Husserl's ideas. Ollinaho and Shunyang Zhao uses a distinction made by Schütz—"paramount reality" and "a province of meaning"—to discuss distinctions between our everyday reality and VR.[18] I believe that these are crucial notions that help us to understand the parallels and distinctions between real and virtual environments, but also highlights the fact that any reality is framed in the first place by a subject with his or her constellation of meanings, concepts, and experiences. "Paramount reality" is the default reality that we live in and do not

usually think about much. It is equivalent to the world of the personalistic attitude in Husserl, a world of our everyday concerns that stretches out like an indefinite horizon, some of which take sharper focus than others at any given time, depending on our concerns. Phenomenologists see this realm as the source of all general and disciplinary knowledge. I have previously written in depth about the relationship between common sense and specialized knowledge.[19] The reason why concrete places and situations are inherently interdisciplinary is because all modes of knowledge stem from the questions and concerns that we originally begin to develop throughout our lives lived in the common sense world. Though academic disciplines are more precise and technical, common sense sets the stage through its questions, and remains a touch point.

I think Ollinaho's rendering of the distinction between paramount reality and a province of meaning is particularly helpful in analyzing VR.[20] We sometimes suspend our engagement in our everyday reality for various reasons, and especially for work—we bracket the physical world through the framework of science to observe and test specific laws and theories; we stipulate an ontology of integers, say, in order to apply mathematical formulas; a child becomes immersed in a game of cops and robbers; we use code to create a virtual world which behaves nothing like the "real" world, and so on. In each case, there is a distinctive cognitive style, understanding of time duration, rules of engagement, and specific experiences of self and sociality.[21] In none of these cases do we forget that there is a "real" world out there—indeed, it is where we always come from and return to.

3.4 VR Projects as "Provinces of Meaning"

I would like now to turn to the chapters contained here to help think through this distinction and to exemplify VR projects as a "province of meaning" in a concrete way. It seems to me an apt way of labeling the way VR is used as a PBE tool in each case. As I said in the introduction, the learning outcomes I will be looking for in terms of what the authors report of the efficacy of VR are abstraction and specialization, which McPhail, for one, cites as indicators for the successful acquisition of field-specific knowledge. He believes that the knowledge we bring in from the familiar life-world should only be a starting point for the acquisition of academic knowledge, and not serve as its substitute. The goal of the instructor, he believes, should be to provide opportunities for students to abstract from everyday experiences and gain specialized knowledge with support and

feedback from the experts (instructors). Otherwise, students would be done a disservice by not giving them the opportunity to acquire the more focused knowledge of academic disciplines.[22]

Let me begin with "Guidelines for Using Virtual Reality as a Tool for Field-Based Learning in the Earth Sciences" by Moysey and Lazar. The authors believe that field experience, like visiting the Grand Canyon, is indispensable for acquiring the skills and knowledge needed to conduct research in the geosciences. Their interest in VR has to do with addressing the pragmatic limitations presented by traveling to physical field sites—they see in VR an economic and convenient solution to the financial and logistical obstacles that universities often face in supporting student field visits. They go on to analyze which types of technological devices they believe are the most promising, both in terms of their ability to capture the realism of field sites and more pragmatic concerns like cost and availability.

Their attitudes reflect the approach found in traditional PBE—there is an expectation that VR environments should be *like* the physical environment to promote desirable learning outcomes. Indeed, Moysey and Lazar seem to indicate that VR is typically a poor substitute for the real thing.[23] But I would like to make more thematically explicit their tacit acknowledgment that VR has unique contributions in studying these field sites. Many people visit the Grand Canyon every day, but do not necessarily achieve specific learning outcomes that geoscientists would want to acquire. Field sites might be valuable opportunities for learning, but equally important is the knowledge to be gained about those sites and the skills to acquire that knowledge. One of the main learning objectives for students according to Moysey and Lazar is to develop "professional vision," and in order to do this one must be trained to notice patterns and be able to pick out relevant features abstracted from the environment with increasing complexity, guided by the expertise of the instructor. This goal seems to reflect the learning outcomes of abstraction and specialization. In these two outcomes, VR seems to be as or more efficacious than the typical field site trip. The authors write, "[T]hus in some cases a lack of realism may be beneficial, as long as an unrealistic or inaccurate representation of the environment, user actions, or geologic processes would not lead to the formation of misconceptions or other barriers to learning. Likewise, the ability to portray varying degrees of realism in an environment could aid in developing a student's professional vision, e.g., by training a student to identify features and patterns in increasingly complex environments controlled by the instructor."[24] In other words, it is helpful to distill relevant

features from the environment to focus in on those features that geoscientists are interested in.

Later, in discussing the narrative and interactive functions of VR, they write that it supports differentiated and scaffolded learning effectively.[25] VR does not compare to the realism of a physical environment, but in narrowing down the field of vision to the "province of meaning" that is relevant for geoscience, it appears that VR can concentrate and amplify features of the environment that are important for the acquisition of expertise in the field. VR is a kind of reality that can be modified—extraneous features may be deleted, and relevant features highlighted. For example, 3D modeling terrain software is used quite common in the geosciences, and what it helps us to visualize would not be possible using the naked eye in a real environment.

MacDonald, in "Visualization and Analysis of Environmental Data," discusses the efficacy of mapping for learning and utilizing economic and environmental data. Maps in general have always been "virtual" in a sense. They provide an overview of significations and information as much as they visually stand in for physical places. It is therefore not a stretch to correlate the symbolic nature of the traditional map to the virtual one. Tung Fung et al. write in regards to virtual maps that "virtual environments may be considered as a new and developing geographic language that is 3-D, immersive and reality-transcending, arising out of languages… manifesting the meaning of the world."[26] Maps, even those on paper, are already a depiction of abstract meanings. In the case of MacDonald's class, students spend a good deal of time familiarizing themselves with maps of the city despite the fact that many of them have lived here all of their lives. Obviously, being immersed in a place does not necessarily give one the necessary perspective to analyze its data. Maps provide an abstract, informed perspective in which the outlines of the city are depicted alongside significant information—students are able to see relationships and correlations that economists observe and make inferences from. MacDonald writes, "In this way, virtual place can both *enhance* the study of physical space and overcome the limitations of access by enabling study in urban environments where physical observation of particular places is limited."[27] VR helps us overcome the limited perspective that we typically occupy in the lifeworld at any given moment—being embedded in a local environment, as far as our eyes can see. Students' lived experiences of the city might be a familiar base to start from, but economic analysis must abstract and differentiate from that.

Ting and Swift use mapping as well, but their approach differs from the previous two chapters in that they focus on data, not of the place itself, but of the community that surrounds the place of focus (i.e. the theater, which they actually do visit in person). Their objective is to demonstrate the role of the audience (the community) in the design of the theater. It would take us too far afield to reconstruct Husserl's ideas about the intersubjective nature of the perception of reality—that all along it had never been just the lone individual's confrontation with a singular object, but that perception was conditioned by the intersubjective "we" that shapes our experiences in full. He believes that subjects alongside other subjects together construct three-dimensional space and time for us to perceive the world as we do. Furthermore, it is our collective planning and work that actually build the places that populate our towns and cities. The "we" literally creates the world.[28] But the community's influence is invisible; it does not appear in the fabric of the physical places that we see and encounter. With VR, Ting and Swift make explicit the characteristics of the community that help to form and shape the development of a particular theater.

In Lansiquot et al.'s "Computational Thinking and the Role-Playing Classroom," the learning objectives are to support students in developing computational thinking and thesis-driven writing, as well as supporting general cognitive skills, like critical thinking, collaborative learning, creative expression, and communication skills. These are not discipline-specific, and it may be argued that they are more self-regulating and in less need of expert feedback for its successful acquisition, though social mediation by peers and instructors are always a part of the constructive process of learning.[29] Schunk writes, "[E]quilibration is an internal process (Duncan, 1995). As such, cognitive development can occur only when disequilibrium or cognitive conflict exists. Thus, an event must occur that produces a disturbance in the child's cognitive structures so that the child's beliefs do not match the observed reality. Equilibration seeks to resolve the conflict through assimilation and accommodation."[30] In other words, students have an inherent tendency to assimilate new knowledge in the first place, and in the second place, they do so according to old frameworks. One is awakened to new information by having the old frameworks challenged, which in turn sets the conditions for further assimilation, which in the end expands the original framework. Schunk believes that the classroom that encourages such a process uses big ideas, and allows students to do research-based, problem-solving projects in a collaborative setting.[31]

The authors of "Computational Thinking" design a curriculum exactly in this way—they assign students a coding project on Alice (a game-designing software) that aims to create a game world through collaborative effort. The authors are conscious of the correlation between the project and the way constructivists describe the learning process in general. They write, "Constructivism posits that learning is an active process where learners create new knowledge from their previous knowledge based on their perception of reality."[32] Though at times students struggle, the authors conclude that having a concrete end-goal is both motivating and supports the process of learning. The "province of meaning" here (the fantasy stories that are the basis for the coding and writing projects) results from the creative imagination of the students, and cannot exist without the collaboration and work of all those involved. In this way, the starting-points of the projects are also "virtual." But once the VR is created, it can be seen, navigated through by avatars, interacted with, and so on. Their collective work culminates in an objective environment for all of the participants and is not merely a private hallucination that is hidden. Ollinaho points out that though VR parallels physical reality, "[v]irtual worlds, however, offer different types of resistance which require different effort to overcome, they place different tasks, permit me to carry on through different plans than the 'real' world does."[33] VR's resistances and tasks are different from those of the lifeworld, but no less efficacious for learning. In this case, the fictional fantasy stories that engaged and motivated students helped set the conditions for demonstrably improved outcomes in coding and writing in the Problem-Solving with Computer Programming course, according to the authors.

3.5 Conclusion

In *School and Society*, John Dewey was an early promoter of PBE. He saw the traditional classroom as too formal and restrictive to support the concrete, experiential-based, active, and collaborative learning that he believed was possible and ideal.[34] Rather than sitting inside an isolated room away from the real world to memorize rote facts and numbers, he believed that a part of education should be to cultivate civic and ethic consciousness and to help students be aware of and know how to solve real-life problems. Since Dewey, much has been written about the value of PBE and what approaches work best. At least some educators understand that PBE is a high-impact educational practice, and many have adopted PBE as part of

their curriculum. But because the use of VR in the classroom is a more recent phenomena, not as much has been researched and written about in terms of its efficacy for learning. Indeed, if VR is used or discussed, it is frequently held up to the expectations we have of real, physical reality and often falls short. My goal was to bring out and discuss the unique features of VR for promoting learning objectives. VR tools and projects provide a concrete, experiential-based context in the way a physical place might. But VR also has unique features that liberate it from the limitations of actual reality. Actual reality is hard to edit, cannot be easily deleted, and has trouble depicting future possibilities, experimental ideas, and masquerading as fiction for periods of time. In VR, however all of those things can be entertained in a way that the chapters contained here demonstrates have been efficacious for learning overall.

Acknowledgments I would like to thank Salem Art Works in Salem, NY, for their writing residency in summer 2018 during which I reflected, researched, and planned this chapter. Being surrounded by craft and maker artists was a good reminder of what VR was *not*, which was a much-needed counter perspective. I would also like to thank Louis J. Colombo and Róbert Jack, both of whom have helped me think through problems and improve my writing in this particular piece as well as in others over the years. This is a long overdue thanks.

Notes

1. Ossi Ollinaho, "Virtualization of the Lifeworld," *Human Studies* 41 (2018):193–209. See the section "Province of Meaning" below.
2. There are critics of constructivism that are concerned for maintaining "objective" standards of disciplinary learning that these two metrics capture, such as Graham McPhail in "The Fault Lines of Recontextualisation: The Limits of Constructivism in Education," *British Educational Research Journal* 42, no. 2 (April 2016): 294–313; PennyVan Bergen and Mitch Parsell, "Comparing Radical, Social and Psychological Constructivism in Australian Higher Education: A Psycho-philosophical Perspective," *The Australian Educational Researcher* 46 (2019): 41–58.
3. Laureen Park, "Varieties of Place: A Phenomenological Analysis of Place-based Education," in *Interdisciplinary Place-Based Learning in Urban Education: Exploring Virtual Worlds*, ed. Reneta Lansiquot and Sean MacDonald (New York: Palgrave Macmillan, 2018).
4. Donald Hoffman, "Perception Deception," *Scientific American* 313, no. 5 75 (November 2015). Additionally, he has a forthcoming book on the topic that expands the argument.

5. For example, Christine Constantinople at NYU, Beau Lotto at University of London and Anil Smith at University of Sussex.
6. Thomas Kuhn, *The Structure of Scientific Revolutions* 3rd ed. (Chicago: The University of Chicago Press, 1996).
7. See *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy (Ideas II),* trans. Richard Rojcewicz and André Schuwer (Dordrecht: Kluwer, 1993), 20.
8. Husserl writes that philosophy is a "rigorous science." See Husserl, Edmund, *Logical Investigations*, trans. J.N. Findlay (NY: Humanities Press: 1970), 42. His is a *science* and not merely a "psychological" account.
9. Ollinaho, "Virtualization of the Lifeworld."
10. Olga Gilyazova, "The Relationship Between Virtual and Actual Reality: Phenomenological/Ontological Approach." *Journal of History Culture and Art Research*, 8, no. 1 (2019): 200.
11. Joohan Kim, "Phenomenology of Digital Being," *Human Studies* 24, no.1/2 (2001): 87.
12. In characterizing VR here, I draw from Kim, "Phenomenology of Digital Being" and Gilyazova, "The Relationship Between Virtual and Actual Reality."
13. Due to the lack of space, I will not be elaborating upon my own experiences with VR in the classroom, but I teach an interdisciplinary class with ten guest lecturers from different disciplines. The culminating project is a VR depiction of the future of humanity, including a virtual world which groups of students collaborate on, populated by avatars which each student designs individually. Students often create dystopias that serve as warnings against certain cultural trends. On occasion, students depict utopias that reflect a cleaner, more egalitarian future. Of course, none of these exist in the here and now, but reflecting on such possibilities helps students to clarify and crystallize their ideas what it means to be human.
14. Ollinaho, "Virtualization of the Lifeworld," 199.
15. Ollinaho, "Virtualization of the Lifeworld," 199.
16. I concur with Gilyazova when she writes, "Although the functional openness unlocks the ontological boundaries between the user and VR (to the extent of a deceptive feeling of absolute presence in the cyberspace), it is not able to eliminate the ontological nature of the boundaries" (Gilyazova, "Relationship Between Virtual and Actual Reality," 200).
17. Bessel van der Kolk, *The Body Keeps the Score* (New York: Penguin Books, 2014).
18. I have already referred to Giliazova's and Olihano's works, but I will also be referring to Shunyang Zhao's "Consociated Contemporaries as an Emergent Realm of the Lifeworld: Extending Schütz's Phenomenological Analysis to Cyberspace," *Human Studies* 27 (2004): 91–105.

19. Laureen Park, "A Study of Integration: The Role of *Sensus Communis* in Integrating Disciplinary Knowledge," in *Interdisciplinary Pedagogy for STEM: A Collaborative Case Study*, ed. Reneta Lansiquot (New York: Palgrave Macmillan, 2016).
20. Ollinaho, "Virtualization of the Lifeworld."
21. Ollinaho, "Virtualization of the Lifeworld," 198.
22. McPhail, "The Fault Lines of Recontextualisation," 304.
23. According to Stephen Moysey and Kelly Lazar, "[f]or example, the feeling of the sun on one's skin while walking down a trail in the Grand Canyon (regardless of whether pleasant or blistering) contributes to affect in a way that would be impossible to achieve within current commercial VR technologies." See Chap. 7, "Using Virtual Reality as a Tool for Field-Based Learning in the Earth Sciences."
24. Moysey and Lazar, "Using Virtual Reality as a Tool for Field-Based Learning in the Earth Sciences," 106.
25. Moysey and Lazar, "Using Virtual Reality as a Tool for Field-Based Learning in the Earth Sciences," 106.
26. Tung Fung, Yee Ling, Hui Lin, "From Paper Maps to Virtual Reality; a View from Hong Kong," *The Cartographic Journal* 41, no. 3 (December 2004): 263.
27. MacDonald, 71.
28. Husserl, *Ideas II*, 205.
29. Lev Vygotsky, a Russian Psychologist, put the idea of "social" constructivism on the map, but this idea is probably a part of all constructivist theories of knowledge to some extent.
30. Schunk, *Learning Theories*, 238.
31. Schunk, *Learning Theories*, 261–282.
32. Lansiquot, Cunningham, and Cabo, "Computational Thinking and the Role-Playing Classroom," 153.
33. Ollinaho, "Virtualization of the Lifeworld," 200.
34. John Dewey, *The School and Society* (Mineola: Dover Books, 2001), 22.

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