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Understanding and Framing Virtual Learning Environments to Engage Adolescent Literacies

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UNDERSTANDING AND FRAMING VIRTUAL LEARNING ENVIRONMENTS TO ENGAGE ADOLESCENT LITERACIES

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Table of Contents

Introduction

Consider the following: it is present day, and Jeremy, 13, gets ready to go to school. Before breakfast, he checks his Facebook for status updates of his friends while navigating an interactive website, listening to music, and finishing his homework. On the way to school, he texts his friends to find out what they are doing after school while playing an online role-playing game. During his language arts class, Jeremy is at the computer lab and is supposed to be writing an informative essay, and does some of it, but gets caught up in a text message to another student explaining in detail how to convert word files into PDF format. The language arts teacher walks by Jeremy as he is messaging the other student, notices that his monitor displays a Facebook page, and, despite his explanation, docks participation points from Jeremy's grade. He does not even argue.

Yet how could he? Misuse and overuse of technology present important concerns, including the ability to stay on task. Facebook certainly can be a diversion, and Jeremy was off task. But just how off task was he? The lab assignment was to write an informative essay; in writing his concise, lengthy description of converting word documents to PDF format, he more than likely was satisfying a few language arts curriculum benchmarks at once, to say nothing of synthesizing information and adopting an instructional role to help another student. How, then, can teachers begin to understand and build upon the literacies Jeremy is familiar with?

Through exploration of virtual learning environments (VLEs), scholarly researchers and teachers acknowledge this discrepancy and, as a result, weigh the proper implementation of VLEs to current educational best practices in hopes that students and teachers achieve an understanding and implementation of literacies both inside and outside of the classroom. In our fast-paced, confusing information age, where students are socially predisposed to multimodal

literacy development, the movement to align VLEs to common classroom practices reflects the need to relate and utilize the emerging complex literacies of today's youth, especially adolescents and their educators, who need to learn how to incorporate multimodal play into a school setting (DeJaynes, Schmeir, & Vasudevan, 2010). The following subsections of this literature review hope to further illuminate this need through the role VLEs play in establishing connections with adolescent literacies.

In this literature review, VLEs refer to a controllable and interactive digital interface that is the imaginative or realistic depiction of real-world stimuli meant for educative purposes. Examples of a VLE stem from role playing games that embed social and literacy learning goals and multicultural awareness to curriculum-specific classroom virtual environments. Currently, VLEs use a vast multitude of educational frameworks; the point of this review will be to streamline these frameworks in the following subsections—philosophical, pedagogical, and finally methodological and technological—in light of best practices involving adolescent literacy development, which will draw strongly from DeJaynes, Schmeir, and Vasudevan's "multimodal pedagogy" (2010) and Dalgarno and Lee's pedagogy that conveys the unique learning affordances of VLEs (2010). The former refers to the mediation of "a wide variety of expressive modes, multiple audiences, and opportunities for collaborative as well as individual composition" (DeJaynes et al., 2010, p. 8).

The three subsections are arranged from general to specific: from philosophical groundings, to the resultant, current working pedagogies which inform the proper use and application (or methodology) of VLE technologies. Philosophical groundings in VLEs will be oriented towards literacy and language development; as such, VLE philosophies will involve discussion of constructivism as well as the concepts of "play", "game", and "immersion"

(Adams, 2004; Mikropoulos & Natsis, 2010; Ryan, 2001). The pedagogical section will cover DeJaynes' multimodal model as well as Dalgarno's pedagogical distinction between VLE best practices and those of traditional education, and the methodological subsection will chiefly consist of the application of Scopes'(2011) cybergogy. Other current VLE best practice methods as revealed by scholarly study will also be discussed, such as the concepts of reification and transduction (Mikropoulos & Natsis, 2010; Dalgarno & Lee, 2010). Finally, this literature review will address technological issues and differences in VLE implementation, and should leave the reader with a better understanding of what choices to make such as when, how, and if choosing, conducting, and crafting a VLE is feasible and pertinent towards one's individual needs, especially for adolescents and those interested in developing adolescents' literacies. Examples of such considerations are whether student-designed virtual environments should be used instead of pre-designed virtual environments (such as *Second Life*), and how to utilize specific affordances and strategies of VLEs. The term "affordances" will be defined and discussed with respect to VLEs in the subsection dealing with VLE pedagogy.

Yet what is a current viable definition of VLEs that incorporates educational best practices and is suitable for adolescent learners? From the literature, two necessarily emerge; a functional and an educational definition. Functionally, Bell (2008) suggests that VLEs are a "synchronous, persistent network of people, represented as avatars, facilitated by networked computers (para. 3)." In this case, "synchronous" refers to a VLE's cohesion and believability of its space and time in terms of the instantaneous relationships between individual users and their environment; additionally, "persistent" refers to the idea that systems within the VLE continue to exist with or without each individual participant, and an "avatar" is a digital manifestation of a real person that is used to navigate and experience a VLE (Bell, 2008. para. 4-7). In terms of an

educational definition of VLEs, Mikropoulos and Natsis (2010) submit the following: “A virtual environment is based on a certain pedagogical model, incorporates or implies one or more didactic objectives, provides users with experiences they would otherwise not be able to experience in the physical world and redounds specific learning outcomes”(p. 770).

These definitions present several evaluative questions. When considering functionality, is the immersive quality of the virtual environment reliable? In terms of Mikropoulos and Natsis’ (2010) definition, are specific educational models and goals implemented? More importantly, are experiences offered by the VLE uniquely engaging and therefore positively impact learning outcomes in a way that traditional education is incapable? These questions are reflective of this literature review’s purpose: to illuminate a direction for students and teachers in which the ultimate goal is the sound inclusion or integration of VLEs into a language arts classroom for adolescent students. It should be noted, however, that any learning environment is conducive to VLE implementation. Additionally, a topical archive of VLE providers and platforms (including both student-designed and public domain VLEs), keyword definitions, VLE best practice groups, and other resources are included in the Appendix.

Literature Review

Philosophical Groundings

The philosophical foundation of VLEs starts and ends with constructivism, which purports that there is a real world that we experience, and that “meaning is imposed on the world by us”, and that it is not independent of our individual and collective realities (Hoffman, Hollander, Osberg, Winn, & Rose, 1997, para. 4). This philosophy becomes especially involved in the “immersive” part of virtual immersion, which, as many sources suggest, cannot exist

outside of the involved experience of the willing participant (Dalgarno & Lee, 2010, p. 14; Dede, 1995, p. 6; Savin-Baden, 2010, p. 151, Scopes, 2011, p.6).

In order to properly understand VLE virtual immersion, one must start with "immersion". In the opening hypothetical, Jeremy was immersed in what Adams (2004) differentiates as three types of immersion: tactical, strategic, and narrative. Tactical immersion is physical and immediate, can involve all of the senses, and can range from the immersion needed to master Tetris to the sensory believability of VLE characters, objects, and environments. Strategic immersion can subsume tactical immersion and requires the user to observe, calculate, deduce, and otherwise critically think about their actions (Adams, 2004, para. 12). Finally, narrative immersion in VLEs is similar to that of novels and movies; here, the difference is that, aside just caring about the outcome of specific characters and situations, players integrate themselves as characters into the story (Adams, 2004, para. 16). These characteristics of immersion—especially narrative immersion—are difficult to describe without exploring Gerrig's (1993) metaphor of transportation:

> Someone (''the traveler'') is transported, by means of transportation, as a result of performing certain actions. The traveler goes some distance from his or her world of origin, which makes some aspects of the world of origin inaccessible. The traveler returns to the world of origin, somewhat changed by the journey (as cited in Ryan, 2001, p. 93).

Ryan (2001) gleans several philosophical underpinnings about literary narrative immersion from Gerrig's extended metaphor. "Means of transportation", as explained by Ryan (2001, pp.93), may be defined as any manner of text or vehicle with which one becomes immersed. "The traveler" does not only refer to the reader but how the text shapes the reader's identity. For

example, in Levy, O'Brien, and Orich's study (2009), students in an intermediate German class had to assume the role of detective to solve a mystery provided through a VLE (p. 6). To continue with Gerrig's metaphor, Ryan suggests that the traveler's "performance" refers to "reading as performance" where readers enable the emergence of "new lands" through their understandings of navigating a text. Referring again to the study conducted by Levy et al. (2009), the use of German language and students' reasoning played a crucial role in furthering the overall narrative in the VLE (p. 6). Ryan interprets Gerrig's idea that this textual land is "some distance" from a reader's "world of origin" to mean that that, although readers can bring their own knowledge and experiences to a text, it is ultimately the implicit and explicit rules of a text that help guide narrative immersion. For example, Levy et al. (2009) found that it was the need for students to find clues and solve a mystery provided by a VLE that provided the impetus for immersion; as a result, students reported that they enjoyed being "lost" in a VLE while solving a mystery (p. 15-16). Lastly, Ryan uses Gerrig's definition of "transportation" to posit that learning derived from textual worlds always applies to and helps aid understandings of an individual's real-world experiences, which is why Gerrig's metaphor of narrative immersion ends with the participant being "changed by the journey" (Ryan, 2001, p. 94). Levy et al. (2009) used a blind control group and a VLE group, and found that students from the VLE group reported greater understandings and involvement in Austrian architecture and culture than from the students in the control group, in which used traditional classroom methods (p. 16).

When talking about virtual environments specifically in terms of adolescents, VLE studies suggest a dichotomy between "play" and the desire for "'real world' contexts" (Cowan, 2010, p. 31; DeJaynes et al., 2010, p. 8). When crafting VLEs for the sake of language and literature, "play" has been theoretically defined as a sense of freedom of engaging in and

expanding upon different texts and literacies separately or together. The intention is that the fluidity of language and literature is what drives discovery, and it is this adventure that immerses participants. This freedom is brought about by characteristics inherent in VLE such as a lack of permanence and an overall lack of finality when engaging in electronic literature, or literature crafted through VLE interactions (Ryan, 2001, p. 202). Here, lack of finality pertains to a rethinking of seemingly immutable printed literature by freely manipulating and creating text, objects, characters, and environments that pertain to a specific work and using those findings to arrive at critical understandings (Ryan, 2001, p. 179). The lack of permanence in a virtual environment becomes especially important to help dislodge hang-ups students may have about experimentation. Studies have shown that once students' fears are removed and misconceptions are allayed, the sense of "play" takes over and VLE situations become game-like that immerse the player in the environment and its activities (Bailey & Moar, 2001; DeJaynes et al., 2010; Carbonell, Dailey-Herbert, Gijselaers, & Noteborn, 2012).

The reason for student-based experiential hesitation may be because the student's notion of "play" and that of language arts VLE differ. For example, in Bailey and Moar's (2001) longitudinal, school-based Vertex Project, researchers used a very nondescript VLE in which, initially, no instructions other than encouraging VLE exploration were given in order to observe students' initial reactions. Researchers observed that students initially tried to approach the VLE using their own understandings of "play", mainly in terms of contemporary video games. The students initially tried to see if there was a quest in which a player could win or lose, kill or be killed. When they did not find that, students quickly adapted and made extensive use of what "play" meant in VLE: creating avatars, finding and forming social groups with other avatars, and eventually creating texts, objects, and even whole environments (p. 9-12). Of considerable

interest to the researchers was the importance students placed in the need to collaborate with their peers and other avatars, especially when they began to create environments and objects, as they seem to realize the need to work together, that "they can't do it on their own" (Bailey & Moar, 2001, p. 14).

Aside the philosophical importance of constructivism and how it influences the concepts of virtual immersion, narrative immersion, and "play" is the establishment of "'real world' contexts". Cowan's (2010) study noted the discrepancy between in school and out of school experiences relating to demonstrated literacies and digital opportunities. Upon completion of a longitudinal study where students were observed in a VLE, Cowan found that students wanted to bring their home literacies to school, and that, on a whole, students lamented on how the lack of digital opportunities in school equated to a lack of "preparation for future jobs" (p. 31). Cowan relates the development of these "'real world' contexts" in a VLE to a sociocultural theory of literacy. In this theory, literacy develops through the communication and transmission of social and cultural values (Cowan, 2010, p. 29-30). In her study, Cowan (2010) noted that when her adolescent students drew upon both traditional and non-traditional literacies, the result was not just increased knowledge and skills but cultural "adaptation and hybridity", important in the "navigation of virtual worlds" (p. 42-43). Cowan also suggests that optimal development of student literacies in a VLE takes place during moments of collaboration and community, the adoption of different roles such as a leader, teacher, students, and observers, and that teaching and learning become "simultaneous and fluid, occurring *at the point of need*." (Cowan, 2010, pp. 41-42).

Working Pedagogies

Yet how can an instructor begin to develop an observational repertoire, based on a unique VLE pedagogy, which can identify these "points of need"? All of the previously discussed VLE philosophies and concepts—starting with constructivism, and branching to include ideas about immersion, "play", and sociocultural theory—help to inform the framework which researchers and instructors use to develop VLE pedagogies. VLE pedagogical discussion centralizes around current models best suited for a language arts class with adolescent students: multimodal pedagogies—or pedagogies developed from adolescent multimodal literacies (Cowan, 2010; DeJaynes et al., 2010)—and a pedagogy that attempts to distinguish VLE characteristics from that of a traditional classroom in hopes that specific VLE learning instances and outcomes can be fully understood (Dalgarno & Lee, 2010).

First, the implementation of multimodal pedagogies requires a reorientation of what it means to "compose". Reading and writing have always been a multimodal process; what VLE offers students and educators is the ability to make the processes visible and therefore make students aware of all the resources and modes necessary to not only compose but "open up new possibilities for what kinds of meanings can be conveyed" (DeJaynes et al., 2010, p.6). Although non-educational, an example of this might be a current fad called a Demotivational poster, where someone combines a picture with a caption meant to point out some humorous idea, the comedy of which normally comes from the provocative evocation of a type of person, situation, or ideology. Arguably a type of literacy all its own, this genre was conceived out of the creative multimodality of the online world.

Yet how can educators begin to integrate the need for this "creative multimodality" inside school? Examples outside of school suggest the necessary physical, theoretical, and mental

requirements for a multimodal VLE pedagogy. Youth Radio serves as an example. This group has developed a "pedagogy of collegiality" with K-12 students to help authenticate and achieve multimodal play (DeJaynes et al., 2010, p. 8). Both adults and adolescents work together to produce multimodal projects; experimentalist in nature, this pedagogy also establishes interdependence between youth and adults, as well as "both physical and figurative room to play with roles, composing repertoires, literacies, and goals" (DeJaynes et al., 2010, p. 8). DeJaynes et al. (2010) conducted three studies which attempt to apply the aforementioned multimodal ideologies, concluding that "profound act of teachers and students *knowing* each other through multimodal play in order to teach and learn together" is central to the functionality of a multimodal pedagogy (p. 22). The spaces where this takes place are face-to-face, over social networks and through VLEs, and involve the creation, sharing, and pursuant discussion and evaluation of multimodal projects, portfolios, journals, and culminating discussions (DeJaynes et al., 2010).

Although these aforementioned pedagogical ideals have proven beneficial in fueling the large array of commercially available VLE software, scholarly research still speaks about VLE educational outcomes in general terms and as equivalent to the learning outcomes of a classroom using traditional methods (Dalgarno & Lee, 2010, p.12). Hedberg and Alexander's (2009) study distinguishes VLE pedagogy from that of traditional education by suggesting that in a VLE, the use of the controllable virtual environment allows students the potential for a more rewarding educational experience than is otherwise possible (as cited in Dalgarno & Lee, 2010, p. 12). This control is afforded via the establishment of presence, which comes through increased representational and social fidelity, immediacy of control and discourse, and a higher level of "active learner participation" (Dalgarno & Lee, 2010, p. 13). Each of these characteristics

functions in an overall pedagogical process, the purported result of which is the learning benefits of VLEs.

In order to understand this pedagogical process, some terms need to be recast in order to suggest their interrelationship with other newer and older VLE pedagogical terminology. Dalgarno and Lee (2010) state that immersion and presence have classically been used to differentiate VLEs from other forms of educational technologies, and the terms used to be rather interchangeable; now, although debate still continues, presence has begun to refer to a user's subjective response to VLE stimuli, whereas immersion refers to its cause: the stimulus and its technology. Better understandings of presence have led to the development of the additional term "co-presence", or the "sense of 'being there together' with other geographically dispersed users" (Dalgarno & Lee, p. 13). This is not meant to be confused with "social presence", which involves the sense-driven interactions of a user with other non-playable characters and the environment. These terms afford a comprehensive perspective to the significance of "presence" in a VLE and therefore enable users to better partake in divergent presence-driven experiences (Dalgarno & Lee, pp. 13-14). Another distinguishing point to make is that three dimensional (3D) VLEs, or virtual environments that use 3D technology, enable embodiment—or the complete physical and visual control of an avatar via user—and therefore the immediacy of control and discourse. When coupled with the creation and use of an avatar in a VLE, the use of embodiment is a critical piece that more closely informs current understandings of the construction of online identities for VLE. Non 3D models—such as those afforded by means of a computer or projector with a 2D monitor or surface—that attempt to create user identity and presence through VLE immersion lead to disembodiment, meaning the physical and mental departure between the actions of users and their avatars. In turn, this makes full realization of

user identity more difficult and therefore the satisfaction of learning outcomes more dependent upon the fulfillment of presence and co-presence (Dalgarno & Lee, pp. 14-15). Despite this, use of a VLE necessitates the interdependence and interaction of all associated VLE terminology, the overall organization of which comes together when considering the argument of Dalgarno and Lee (2010): "it is essentially the fidelity of the representation, along with the types of interaction available within the environment, that will lead to a high degree of immersion and consequently, a strong sense of presence"(p. 13).

This argument implies three causes of identity construction, presence, and learning outcomes that stem from immersion: the controllable tools, fidelity and learner interactions, and the "vehicle" in which they operate, learning affordances. The term "learning affordance" was defined by Greeno (1994) as an environmental attribute of a VLE that is relatable to a user-based interaction or activity "by an agent who has some ability" (as cited in Dalgarno & Lee, 2010, p. 17), "agent" meaning an individual user. Learning affordances would not be possible without the proper use of the controllable tools: fidelity and learner interaction. Fidelity involves the believability of VLE input as understood through realistic, consistent, and smooth displays of the environment, its objects, representations of users, and environmental changes; learner interactions subsumes embodied actions and communication as well as the control and construction of objects, behaviors, and the environment (Dalgarno & Lee, 2010, p. 17). Use of fidelity and learner interactions can lead to the suspension of belief or be used to portray real-world stimuli; either way, its implementation specifically informs a VLE's unique learning affordances. User interaction with these objective and controllable constructs cause the realization of user identity and presence; within a VLE, a user's identity and presence are then stimulated with affordable learning tasks found in the environment.

Upon proper implementation, this stimulation between users and the VLE results in learning benefits unique to 3D VLEs: enhancement and improvement of spatial knowledge of the VLE physical domain, experiential learning via tasks impractical or impossible to conduct in the real world, “increased intrinsic motivation and engagement”, “improved transfer of knowledge and skills to real situations through contextualization of learning”, and finally a more rich and effective collaborative learning experience than is otherwise possible in a 2D VLE (Dalgarno & Lee, 2010, pp. 18-23). Whether 2D or 3D, however, several VLE studies have shown many benefits: improved peer collaboration (Bailey & Moar, 2001; Cowan, 2010; DeJaynes et al., 2010; Levy et al., 2009; Robertson & Good, 2003), the immediacy of knowledge transfer through context (Bailey & Moar, 2001; Cowan, 2010; DeJaynes et al., 2010), increased motivation and engagement (Bailey & Moar, 2001; Carbonell et al., 2012; DeJaynes et al., 2010; Patera, Draper, & Naef, 2008; Robertson & Good, 2003), as well as spatial knowledge improvement and enhancement (Carbonell et al., 2012; Hoffman et al., 1997).

Applicable Methodologies and Strategies

Yet even if an instructor implements a sound VLE pedagogy through an authentically driven philosophy, what current methodological best practice allows students to gain the benefits shown by research to result from VLEs? Because each VLE offers different learning affordaces, and because students subjectively experience a VLE in their own way, how can instructors maximize not only the attainment of VLE goals but thier transfer to a student’s content knowledge? There are numerous strategies specific and unique to VLEs that may help instructors effectively plan and implement VLE-based classroom goals (Mikropoulos & Natsis, 2010; Youngblut, 1998).

First, though, is the issue of transfer. What would be the point of adopting a VLE curriculum if teachers could not be sure if or how their students are learning? One problem traditional educational methods employ is the use of symbols "where symbolic representation might cause misconceptions" (Mikropoulos & Natsis, 2010, p. 774). One of the strategies specific to VLEs is natural semantics, which helps to remove the symbolic element and allow for experiential, immediate learning via discourse or object interaction. For example, in the context of language arts, an instructor could aid in decoding by allowing 3D persons and objects to represent different words and phrases. The first interactions that student avatars have with these 3D representations would be considered first order experiences. First order experiences are strategies that enable users to experience things, even dangerous ones, directly (Mikropoulos & Natsis, 2010, p. 774). This concept might be used to construct a visual simulation of a text that might otherwise be difficult to imagine or interpret, especially if it is climactic or sensory driven.

Yet what if a student needs to study an abstract concept? A useful strategy for this is transduction, which denotes "the use of interface devices to present information that is not readily available to human senses" (Youngblut, 1998, p. 2). An example of transduction in use might be found in the study of diction, such as when a teacher manipulates the vocal pitch of a non-playable character (NPC) in a VLE to indicate changes of tone and register. Another strategy is the use of size, which involves the physical manipulation of users and their environment (Mikropoulos & Natsis, 2010, p. 770); a teacher could increase or decrease the overall size or specific physical attributes of NPCs as they interact to convey different character. Sometimes, however, no concrete object exists for a real-world abstract concept. If this is the case, the strategy of reification might be important, which is the imaginative creation of visual

stimuli using abstract ideas or concepts (Dalgarno & Lee, 2010, p. 12). For example, teachers would practice this if they were to faithfully interpret and represent an idiom.

Use of these VLE strategies are important to help harness the unique features of VLE, but if instructors wish to devise a method of transferring from a traditional classroom pedagogy to VLE pedagogical best practices, a larger methodological framework developed by Scopes (2011), called the Cybergogy of Learning Archetypes and Learning Domains, may help with this difficult task. Scopes pulls the latest information on VLE learner affordances when he relates "two interacting components: learning archetypes and learning domains", systems necessarily aligned to traditional pedagogy to help make sense of the VLE input and output of students and teachers (Scopes, 2011, p. 7).

In terms of input, Scopes (2011) helps to strategize the pedagogical understandings of "immersion" as understood by Dalgarno and Lee (2010) by suggesting that "learning archetypes are the fundamental building blocks of educational activities whose locus is the plasticity of possibilities afforded by [VLEs]" (p. 6). Learning archetypes also serve as a "conceptual framework to support learning activities" (Scopes, 2011, p. 7), and provide a vehicle to understand the necessary methods for optimal VLE learning. Scopes identifies five classifications of learning archetypes (LAs): "role play", "peregrination", "simulation", "meshed", and "assessment and evaluation" (Scopes, 2011, p. 9). "Role play" occurs when a user assumes a role and, with it, an identifiable objective involving environmental interaction that is either asynchronous or synchronous, dramatized, or morphic—meaning that a user takes another form. An example of this was the detective roles Levy et al. (2009) developed for students in their CAVE study. In the study, the students were involved in a synchronous, dramatized role; the former was due to the fact that the VLE was structured around current

ongoing classroom developments, and that latter is because the fulfillment of VLE objectives led to the revelation of an ongoing narrative (Levy et al., 2009, p. 9). Suggestive through its nomenclature, "peregrination" involves the idea that situated learning can take place through the act of traveling in a VLE. Levy et al. (2009) found that it was the act of "finding one's way" and "trying to figure out where to go" in order to experience the structures and socialize that helped to fulfill the didactic goal of learning about cultural artifacts and customs (p. 15). Strategies such as first order experiences, natural semantics, size, transduction, and reification fall under the category of "simulation", and are used "for the purposes of imitation, enactment, exploration, rehearsal and evaluation" (Scopes, 2011, p. 9). Numerous studies have implemented the uses of simulation in various ways: for the purposes of developing user interaction and community (Bailey & Moar, 2001), to study the use of emotions when performing tasks (Carbonell et al., 2012), the role of cognitive demand (Hearrington, 2010), and to experience and understand another culture (Levy et al., 2009). "Meshed" signifies the malleable dynamics of creating user and user-to-NPC interaction. In Bailey and Moar's (2001) Vertex Project, the origination and development of user interaction was student-based. From VLE inception, students began forming relationships, then groups to complete projects, and eventually formed divergent communities that recognized boundaries and would visit one another (p. 12, 14-15).

"Assessment and evaluation" represents as-needed formative and summative assessment strategies, of which every study made deliberate use. These came both inside and outside the VLE and in the form of pre and post assessments (Carbonell et al., 2012; Hearrington, 2010), questionnaires (Levy et al., 2009), and qualitative notation and interviews (DeJaynes et al., 2010, Cowan, 2010).

The crafting of a particular activity using the archetypes will require implementation of the learning domains (LDs): cognitive, dexterous, social and emotional (Scopes, 2011, p. 8). Use of the LAs should be in tangent, and sometimes in synergy, with the LDs, and Scopes (2011) advocates that the more parts of the LDs used per task can help aid in learner outcomes (p. 8). Scopes posits that instructors need to become observant and receptive to the level of implementation students demonstrate with specific LDs; as a result, Scopes (2011) has developed a Blended Taxonomy of Learning Domains Showing Associated Learning Outcomes (p. 10). Previous taxonomies were utilized, such as Bloom's cognitive as well as incomplete psychomotor domains, Goleman's model of emotional intelligence (as cited in Scopes, 2011), and Wang and Kang's (2006) social domain. Implementation levels range from "one" being low to "six" being high; an example comes from the emotional domain. At the basic level comes the ability to "internally acknowledge one's own emotion"; following this, "using emotion" , "understanding self", "understanding others", "self regulating", and finally "influencing" (Scopes, 2011, p. 11). Applying LA and LD use together, Scopes (2011) provides an example of using a meshed design strategy. Using a group work strategy, student users are given the specified emotional learning outcome of influencing others (level six). Such a goal requires intrapersonal understanding (level two in the cognitive LD), precision development (level three of the dexterous domain), and social networking, which is level five of the social domain (Scopes, 2011, pp. 11-12). Both specifically and on a large scale, these VLE methodologies provide a framework with which VLE technological classifications can be based.

Applicable Technologies

Before sound application of VLE technology can be made to current scholarly pursuits of VLE best practice, one must first attain a holistic perspective of its various systems. A better picture of the various VLE systems and an understanding of best practice will help instructors prevent and prepare for possible technological or organizational problems or issues. When considering its systems, VLE input technology can either be 3D or 2D experiences, public domain or pre-developed (PDVLE), such as *Second Life*, *Sim Life*, and *ActiveWorlds* (Bailey & Moar, 2001; Savin-Baden, 2010) or student produced (SPVLE), such as the *Vertex Project*, and *CAVE* (Bailey & Moar, 2001; Levy, O'Brien, & Orich, 2009; see Appendix). Whether PD or SP, all VLE technology includes a developer, an intended audience or facilitator, uses some sort of input display or controls, performs or allows for a certain type of usage—whether it be immersion evaluation, exhibition, subjective usability or effectiveness evaluation—and supports the development of courses or learning objectives (Youngblut, 1998, p. 17). An adaptation of this VLE technology taxonomy was used in the creation of an archival table that lists and supports the further inclusion of all types of VLEs (see Appendix).

In terms of its component parts, 3D and 2D VLE include the use of monitors, enclosed and open projections, gloves, headsets (for visual, audio, and haptic immersion), head trackers (for visual and spatial reality augmentation), styluses, and wands—such as the wand used in Nintendo's Wii (Mikropoulos & Natsis, 2010, pp. 773-774; Savin-Baden, 2010, p. 148). Currently, however, only 3D VLE models make use of haptics or "the use of technology that creates a sense of touch, such as vibration or movement, in order to enhance visual engagement in immersive virtual worlds" (Savin-Baden, 2010, p. 148). Differences in technology inputs result in different educational outcomes (Mikropoulos & Natsis, 2010; Dalgarno & Lee, 2010).

Dalgarno and Lee (2010) stress that the lack of an embodied 3D experience that uses extended input technology, such as head trackers and styluses, will lead to a "trivial" experience with VLE that does not reflect the distinguishing VLE pedagogy (p. 25). Mikropoulos and Natsis (2010) go further to say that even with the inclusion of 3D inputs, it is only when "immersion systems are combined with intuitive interaction by the use of head trackers, styluses, and wands (that can) maximize positive learning outcomes"(p. 777). Mikropoulos and Natsis apply a ten year empirical analysis of VLE to suggest that neither approach conclusively demonstrates an increase in learning affordances or educational outcomes (p. 774). Users, however, are prone to like the traditional virtual desktop inputs, such as a keyboard, joystick, mouse, and monitors, but this might be due to students' and teachers' background in personal computers and video games (Mikropoulos & Natsis, 2010, p.774).

Yet even if users' background understanding in a VLE is high, and they are engaged, learning tasks can fail to be achieved. Difficulty with technology engagement can stem from either the user or the environment. At times, visual or audio aspects or the language use of a VLE can distract a student as well as a "lack of computer competency" (Mikropoulos & Natsis, 2010, p. 773). Savin-Baden (2010) takes the idea of user incompetence further when she suggests that unfamiliarity or "misplaced pedagogical assumptions" inform the causes of user mistakes (p. 164). One of the most common responses is to complain, and there are some global issues to complain about, but there are misconceptions as well. In her book, *A Practical Guide to Using Second Life in Higher Education*, Savin-Baden helps to distinguish these issues. Complaints and common assumptions centralize around the real problem with *Second Life* (SL): that it and many of its users are "pedagogically ill-informed" (p.164). SL technologies and their pedagogical issues are currently trying to be resolved; user awareness and application of best

practices, however, simply require a proactive approach. For example, some users take extremes; on one end, some are overoptimistic or under-cautious by asserting that SL and "real life teaching" are rather similar, that it is easy to implement types of learning. Others condemn SL, suggesting that it is too dangerous, lewd-prone, contains too many bullies and other social pressures. Sill others are apprehensive, and question SL methodological effectiveness and the extent of their own role as users (Savin-Baden, 2010, pp.165-171).

Conclusion

The question of a user's role in a VLE—the students and teachers' respective roles, their implementation, interaction and navigation of virtual worlds—is understandable, especially when it is based upon the "pedagogically ill-informed" nature of users and VLE developers. This confusion is augmented by the extremely vast mixing and conflation of VLE information and ideas. Many terms attempt to define, subsume, and even subvert VLEs: asynchronous education, augmented reality, desktop virtual reality, distance education, education virtual environments, electronic learning, interactive learning environments, internet-based learning environments, multi-user virtual environments, narrative interactive learning environments, nontraditional education, serious games, virtual classrooms, and web-based instruction, a list that is by no means exhaustive (Bailey, 2001; Björk & Jussi, 2005; Carbonell et al., 2012; Cowan, 2010; Dalgarno & Lee, 2010; DeJaynes et al., 2010; Hanson & Shelton, 2008; Hearrington, 2010; Jonassen, 1994; Mikropoulos & Natsis, 2010; Savin-Baden, 2010; Scopes, 2011). There seems to be some wariness and apprehension caused by the overabundance of unknown factors or prevailing questions about VLEs; Savin-Baden (2010) remarks that this wariness never really goes away (p. 163).

What can change is an understanding of a user's awareness towards the overall philosophy, pedagogy, methods and technologies involved in VLEs, which can make aiming for intended learning outcomes a much more dexterous venture. Students and teachers using a VLE would do well to remember its constructivist nature, that an "inhabited" avatar cannot necessarily escape its user, and vise-versa (Dalgarno & Lee, 2010; Dede, 1995; Jonassen, 1994; Savin-Baden, 2010). When the fidelity of representation and user interaction are properly controlled, immersion takes place and allows users to experience presence and identity in a VLE (Dalgarno & Lee, 2010; Mikropoulos & Natsis, 2010). Although the path of immersion is different per VLE, the end result must be the same: enablement of a user's VLE presence and identity, elements of learner engagement essential to an effective VLE.

In considering the use of these elements in the pedagogical framework necessary for the development of adolescent literacies, the concepts of "play" and the need for real-life experiences inform multimodal pedagogy, where textual meanings and cultural intertwining give rise to creative multimodal experiences (DeJaynes et al., 2010; Cowan, 2010). This multimodal pedagogy, when coupled with an understanding of unique VLE learning affordances (Dalgarno & Lee, 2010) can inform how to use Scopes' (2011) learning archetypes and achieve the desired educational outcomes, identifiable through Scopes' Blended Taxonomy of Learning Domains Showing Associated Learning Outcomes (pp. 8-10). Both PDVLEs and SPVLEs alike can be used as a vehicle to achieve these educational outcomes.

Finding the right VLE implementation software, hardware, developer, platform, and support organizations, however, can be a tedious task. Some necessary questions arise: does the VLE support a constructivist, sociocultural, and multimodal nature? Does it provide an opportunity to implement real-world experiences into its environment or for students to create

their own VLEs? Does it afford strategies that are unique to VLE, such as transduction, reification, the manipulation of size, first order experiences, autonomy, free navigation, role-playing, peregrination, simulation, and meshing? It is important to understand that, due to the implementation of specific learning outcomes, VLEs currently being used by instructors do not maximize all of their unique features (Mikropoulos & Natsis, 2010, p. 774); as a result, instructors need to be aware of how the shaping of learning outcomes influences VLE affordances. Because an understanding of this relationship is only now starting to emerge through scholarly study, the basis for situating VLE use within the context of the development of adolescent literacies—as well as any other subject—should stem from the aforementioned questions, but start, as always, with the student.

References

Adams, E. (2004, July). *The designer's notebook: Postmoderism and the three types of immersion*. Retrieved from the Gamasurta website: www.gamasutra.com/view/feature/130531/http://the_designers_notebook.php

Bailey, F., & Moar, M. (2001). The vertex project: Children creating and populating 3D virtual worlds. *Journal of Art and Design Education, 20*(1), 19–30.

Bell, M. (2008). Toward a definition of "virtual worlds". *Journal of Virtual Worlds Research, 1*(1). Retrieved from http://journals.tdl.org/jvwr/article/view/283/237

Björk, S., & Jussi, H. (2005). *Patterns in game design*. Hingham, MA: Charles River Media.

Carbonell, K.B., Daily-Herbert, Gijselaers, W., & Noteborn, G. (2012). The role of emotions and task significance in virtual education. *Internet and Higher Education, 15*(3), 76-183. doi:10.1016/j.iheduc.2012.03.002

Cowan, J. (2010). Webkinz, blogs, and avatars: Lessons learned from young adolescents. In D.E. Alvermann (Ed.), *Adolescent's online literacies: Connecting classrooms, digital media, & popular culture* (pp. 5-26). New York, NY: Peter Lang Publishing.

Dalgarno, B., & Lee, M. (2010). What are the learning affordances of 3-d virtual environments? *British Journal of Educational Technology, 41*(1), 10-32.

Dede, C. (1995). The evolution of constructivist learning environments: Immersion in distributed, virtual worlds. *Educational Technology, 35*(5), 46-52.

DeJaynes, T., Schmeir, S., & Vasudevan, L. (2010). Multimodal pedagogies: Playing, teaching and learning with adolescents' digital literacies. In Alvermann, D.E. (Ed.), *Adolescents' online literacies: Connecting classrooms, digital media, & popular culture* (pp. 5-26). New York, NY: Peter Lang Publishing.

Hanson, K., & Shelton, B. E. (2008). Design and development of virtual reality: Analysis of challenges faced by educators. *Educational Technology & Society, 11* (1), 118-131.

Hearrington, D. (2010). Evaluation of learning efficiency and efficacy in a multi-user virtual environment. *Journal of Digital Learning in Teacher Education, 27*(2), 65-75.

Hinrichs, R. & Wankel, C. (2011). Preface. In R. Hinrichs & C. Wankel (Eds.) (2011). *Transforming virtual world learning: Cutting-edge technologies in higher education.* Bingley, UK: Emerald Group Publishing Limited.

Hoffman, H., Hollander, A., Osberg, K.M., Winn, W., & Rose, H. (1997). The effect of having grade seven students construct virtual environments on their comprehension of science.

Human Interface Technology Laboratory. Retrieved from http://www.hitl.washington-.edu/publications/r-97-6/

Jonassen, D. H. (1994). Thinking technology: Toward a constructivist design model. *Educational Technology, 34*(4), 34–37.

Levy, R., O'Brien, M.G., & Orich, A. (2009). Virtual immersion: The role of CAVE and pc technology. *CALICO Journal, 26* (2), 1-26.

Mikropoulos, T.A. & Natsis, A. (2010). Educational virtual environments: A ten-year review of empirical research (1999–2009). *Computers & Education, 56*(1), 769-780.

Patera, M., Draper, S., & Naef, M. (2008). Exploring Magic Cottage: A Virtual reality environment for stimulating children's imaginative writing. *Interactive Learning Environments, 16*(3), 245–263.

Robertson, J., & Good, J. (2003). Using a collaborative virtual role-play environment to foster characterization in stories. *Journal of Interactive Learning Research, 14*(1), 5–29.

Ryan, M. (2001). *Narrative as virtual reality: Immersion and interactivity in literature and electronic media*. Baltimore, MD: Johns Hopkins University Press.

Savin-Baden, M. (2010). *A practical guide to using Second Life in higher education*. New York, NY: Open University Press

Scopes, L. (2011). A cybergogy of learning archetypes and learning domains: Practical pedagogy for 3d immersive virtual worlds. In Hinrichs, R., & Wankel, C. (Eds.), *Transforming virtual world learning: Cutting-edge technologies in higher education* (pp.3-28). Bingley, UK: Emerald Group Publishing Limited.

Wang, M.J., & Kang, J. (2006). Cybergogy of engaged learning through information and communication technology: A framework for creating learner engagement. In M.S. Khint & D. Hung (Eds.), *Engaged learning with emerging technologies* (pp.225-253). New York, NY: Springer.

Youngblut, C. (1998). *Educational uses of virtual reality technology*. Institute for Defense Analysis (IDA Document D-2128). Retrieved from http://www.hitl.washington.edu/-scivw/publications.html

Appendix
An Archive of VLE Providers, Platforms, Resources, and Tools

Several literature reviews and handbooks have commented on the complexity, interrelationship, and immensity of VLE-related information and tools (Dalgarno & Lee, 2010; Mikropoulos & Natsis, 2010; Savin-Baden, 2010). In light of this, there has been an attempt to recast and thereby transform commonplace VLE thinking, planning, and development to mirror educational best practices (Hinrichs & Wankel, 2011). Aside the transformative approach, Hinrichs and Wankel (2011) suggest that educators who are synchronizing VLEs with classroom pedagogy must include an understanding of the "new learning community", whom they refer to as the "stakeholders": enablers (visionaries, administrators, faculty), builders (learners, designers, testers, implementers), facilitators (helpers, evaluators, visitors, guests) and chroniclers (VLE writers and marketers) (p. xxx).

As a result, I wanted educators to understand the relevancy of SPVLEs and PDVLEs within the context of current VLE best practices, and have combined Hinrichs and Wankel's categorization of the "new learning community" (2011) with Youngblut's (1998) content-specific classification of PDVLEs (p. 17) and SPVLEs (p. 45) by crafting a VLE archival table (see page 40). Both the PDVLE and SPVLE sections include: its enabler, builder, a description of the VLE, the supported class or learning objective, its intended facilitators or audience, and launch date. In addition, to help support the ongoing educational building and usage of VLEs, this appendix includes a glossary, list of groups and conferences, and journals.

Appendix Table of Contents

Conferences

- Eurographics Symposium on Virtual Environments (EGVE)
- International Association for Development of the Information Society (IADIS)
- International Conference on Artificial Intelligence in Education (AIED)
- International Conference on E-Learning and Games, Edutainment (EGE)
- Joint Virtual Reality Conference (JVRC; hosts EGVE)
- Second Life Community Conference (SLCC)

Cyberbullying Rescources: Journals and Publications

- CyberPsychology & Behavior

Cyberbullying Resources: Websites

- FearNOT!
- Wilostar3D

Educational Best Practice Groups and Organizations

- Educators' VR series
- Educause
- Mobile Aeronautics Education Laboratory (MAEL)
- SimTeach
- SLED (Second Life Educators List)
- SLRL (Second Life Researchers List)
- Virtual Education – Science and Math of Texas (VESAMOTEX)
- Virtual Reality in the Schools
- Virtual Worlds Best Practices in Education (VWBPE)
- Virtual Reality Roving Vehicle (VRRV)/Nebrasks, Phase I and II

- VR Concentration, M.A. in Education
- VR in Education

Journals

- Association for the Advancement of Computing in Education (AACE)
- Computers & Education
- Education and Information Technologies
- Educational Technology & Society
- Interactive Learning Environments
- International Journal of Computer-Supported Collaborative Learning
- Journal of Computer-Mediated Communication
- Journal of Interactive Learning Research
- Journal of Virtual Worlds Research
- Presence: Teleoperators and Virtual Environments
- Virtual Reality

Keyword Definitions

- **asynchronous education** – The pedagogical mismatch between a VLE and the classroom in which it is employed.

- **augmentation** – Any interaction a user experiences towards virtual reality stimuli in which causes the virtual immersion of a person in reality or the ubiquity of an avatar in a VLE to include a perceived presence in reality (Savin-Baden, 2010, p. 151). An example of the latter is telepresence, where users project their image through a monitor to make others feel their presence in reality.

- **augmented virtual reality** – A user's psychological disposition towards virtual reality presence though immersion.

- **augmented reality** – A person's psychological disposition towards perceiving the presence of a VLE object or character in reality.

- **autonomy** – A user's feeling of individuality for their respective avatars within a VLE, afforded through presence, free navigation, interaction, and first order experiences.

- **blended teaching** – Instructional methods that incorporate multiple methodologies, such as distance education, e-learning, and traditional methods.

- **content management system (CMS)** – A collection of procedures used to manage workflow in any collaborative environment, of which VLEs are subsumed.

- **deployment** – "Engaging the [VLE] community over time and making improvements to sustain the interaction" (Hinrichs & Wankel, 2011, p. xxviii)

- **desktop virtual reality** – Any 2D VLE in which can be accessed from a computer that uses a 2D monitor.

- **distance education** – The pedagogical implementation of means other than reality-based face-to-face interaction in order to conduct a course. Distance education typically involves the use of e-learning platforms, of which VLE is subsumed.

- **distance learning platform** – The system with which teachers use to create an online space in which separates teachers from students, and students from other students. VLEs can be used to incorporate distance learning.

- **Education Virtual Environments (EVE)** – A term that is synonymous with VLEs.

- **electronic learning (e-learning)** – Educational instruction that includes all forms of electronically supported learning and teaching, of which VLEs are subsumed.

- **Face-to-Face (F2F)** – Any interaction based upon at least two people and/or users. This interaction can occur in reality, virtual reality (such as between two avatars in a VLE), augmented virtual reality (such as between an avatar or NPC in a VLE and a user in reality), or augmented reality (such as between users' virtual presence in reality and the people they communicate with in real-time).

- **first order experiences** – A user's immediate, first-hand interaction with virtual reality stimuli. First order experiences are especially beneficial when such a stimulus is dangerous, unrealistic, or improbable to witness in reality.

- **free navigation** – The ability to, through the control of an avatar, move about a VLE without the means of a predefined path.

- **immersion** – The use of fidelity and user interaction to afford a user's sense of presence in a VLE (Dalgarno & Lee, 2010, p.13).

- **instruction technology** – All the tools, strategies, and approaches that inform educational instruction which can be electronic-based, of which VLEs are subsumed.

- **Interactive Learning Environments (ILE)** –A VLE that is based on the interactivity of users and non-playable characters.

- **internet-based learning environments** – Educational spaces that use or incorporate internet-based tools and approaches.

- **Multi-User Virtual Environment (MUVE)** – A term "used to denote the difference between MMORPG (Massive Multiplayer Online Role Playing Games) that are games-based, and environments such as *Second Life* which are not usually seen as games" (Savin-Baden, 2010, p. 177).

- **Narrative Interactive Learning Environments (NILE)** – VLEs designed to simulate a narrative so that users, through interaction and peregrination of the VLE, can become immersed.

- **natural semantics** – A teaching methodology that "bypasses the traditional learning of an abstract symbol system, which is then used to describe the real world, and passes straight into direct experiential education" (Mikropoulos, 2010, p.774).

- **NPCs (non-playable characters)** – Characters created for a virtual setting for both games and educational purposes; users normally interact with NPCs to help build a sense of presence.

- **nontraditional education** – Educational pursuits that have different pedagogical foundations from traditional classroom education, and as a result, different curriculum frameworks, of which VLE education has been subsumed.

- **online systems** – Any VLE that uses or is connected to the internet to afford its functionality.

- **presence** – Users' subjective reaction to their interaction with VLE stimuli and/or other VLE users (Dalgarno & Lee, 2010).

- **reification** –The creation of visual, audible, and/or haptic stimuli using abstract ideas or concepts that do not take concrete form in the reality.

- **synchronous education** – The integration of VLE pedagogy to the classroom in which it is employed.

- **teleconferencing** – Technology that affords a user's presence through electronic-based virtual projection in order to interact with other people in reality (Steur, 1992).

- **telepresence** – A user's presence felt through teleconferencing (Steur, 1992).

- **text-based** – Any computer application in which the primary input and output device is the use of text and not graphics or sound, of which certain VLEs are subsumed.

- **virtual toolkit** – Virtual hardware requisite to the proper creation of 3D VLEs. Can include navigational tools, tracking devices, and projection devices.

- **transduction** – The "...use of interface devices to present information that is not readily available to human senses. For example, variations in the intensity of some sound could be used to portray levels of radiation..." (Youngblut, 1998).

- **transition** – A shift "in a learner experience caused by a challenge to the person's life world" through the use of a VLE-based interaction (Savin-Baden, 2010, p. 180).

- **v-Terial** – The "subjective and un-quantifiable point in an individual's perception where the virtual blends with the material in a form of synergy" (Scopes, 2011, p. 6).

- **videoconferencing** – See teleconferencing.

- **virtual classrooms** – An online public or private, 2D or 3D system that embodies the design and functionality of an educational classroom.

- **Virtual Group Learning System (VGLS)** – A type of VLE, this system is specifically designed to promote user collaboration.

- **Virtual Reality Learning Environment (VRLE)** – A term synonymous with VLE.

- **virtual reality technology** – The hardware and software required to implement a virtual reality.

- **virtual worlds** – A term that can refer to a VLE but can also include virtual gaming or social networking.

- **web-based instruction** – Teaching and learning that is attributed to or supported by the internet.

Scholarly Studies and Literature Reviews

Ackermann, E. (1996). Perspective-taking and object construction: Two keys to learning. In Y. Kafai, & M. Resnick (Eds.), *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp. 25–35). Mahwah, NJ: Lawrence Erlbaum Associates.

Bailey, F., & Moar, M. (2001). The vertex project: Children creating and populating 3D virtual worlds. *Journal of Art and Design Education, 20*(1), 19–30.

Barab, S., Sadler, T., Heiselt, C., Hickey, D., & Zuiker, S. (2007). Relating narrative, inquiry, and inscriptions: supporting consequential play. *Journal of Science Education and Technology, 16*(1), 59–82.

Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, J. D. (1992). Theory into practice: How do we link? In T. M. Duffy, & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp.17-34). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bowman, D. A., Hodges, L. F., Allison, D., & Wineman, J. (1999). The educational value of an information-rich virtual environment. *Presence: Teleoperators and Virtual Environments, 8*(3), 317–331.

Boyle, T. (1997). *Design for multimedia learning*. Upper Saddle River, NJ: Prentice-Hall, Inc.

Bricken, W. (1990). *Learning in virtual reality* (Technical Report No. HITL-M-90-5). Retrieved from University of Washington, Human Interface Technology Laboratory website: http://www.hitl.washington.edu/publications/m-90-5/

Brown, J. S. (1989). Toward a new epistemology for learning. In C. Frasson, & G. Gauthier (Eds.), *Intelligent tutoring systems: At the crossroads of artificial intelligence and education* (pp. 266–282). Norwood, NJ: Ablex.

Cheung, K., Jong, M., Lee, F., Lee, J., Luk, E., & Shang, J. (2008). FARMTASIA: an online game-based learning environment based on the VISOLE pedagogy. *Virtual Reality, 12* (1), 17–25.

Cooper, T. (2007). Nutrition game. In D. Livingstone, & J. Kemp (Eds.), *Second life education workshop* (pp. 47–50). www.simteach.com/slccedu07proceedings.pdf

Cunningham, D. (1993). Tools for constructivism. In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), *Designing environments for constructive learning*. New York, NY: Springer.

Dalgarno, B., & Lee, M. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology, 41*(1), 10–32.

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science, 323*(5910), 66–69.

Dede, C., Ketelhut, D., Nelson, B. (2004). Design-based research on gender, class, race, and ethnicity in a multi-user virtual environment. Paper presented at the American Educational Research Association, San Diego, CA http://muve.gse.harvard.edu/muvees2003/documentsAERADede04.pdf

Di Blas, N., & Poggi, C. (2007). European virtual classrooms: building effective "virtual" educational experiences. *Virtual Reality, 11*(2), 129–143.

Dieterle, E., & Clarke, J. (2008). Multi-user virtual environments for teaching and learning. In M. Pagani (Ed.), ***Encyclopedia of multimedia technology and networking*** (2nd ed). Hershey, PA: Idea Group, Inc.

Goncalves, N. (2005). Educational use of 3d virtual environments: primary teachers visiting a romanesque castle. In A. Mendez-Vilas, B. G. Pereira, J. M. Gonzalez, & J. A. M. Gonzalez (Eds.), *Recent research developments in learning technologies* (pp. 427–4331). Badajoz, ES: FORMATEX.

Hedberg, J., & Alexander, S. (1994). Virtual reality in education: defining researchable issues. *Educational Media International, 31*(4), 214–220.

Helsel, S. (1992). Virtual reality and education. *Educational Technology, 32*(5), 38–42.

Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: a review of the research. British Journal of *Educational Technology, 41*(1).

Hokanson, G., Borchert, O., Slator, B. M., Terpstra, J., Clark, J. T., Daniels, L. M., et al. (2008). Studying Native American culture in an immersive virtual environment. In P. Díaz, I. KinshukAedo, & E. Mora (Eds.), *Proceedings of the eighth IEEE international conference on advanced learning technologies* (pp. 788–792). Santander, ES: IEEE.

Holmes, J. (2007). Designing agents to support learning by explaining. *Computer & Education, 48*(4), 523–547.

Johnson, A., Moher, T., Ohlsson, S., & Gillingham, M. (1999). The round earth project: Collaborative VR for conceptual learning. *IEEE Computer Graphics and Applications, 19*(6), 60–69.

Jonassen, D. H. (1994). Thinking technology: Toward a constructivist design model. *Educational Technology, 34*(4), 34–37.

Jonassen, D. H. (1999). *Computers as mindtools for schools: Engaging critical thinking*. Upper Saddle River, NJ: Prentice Hall.

Kameas, A., Pintelas, P., Mikropoulos, T. A., Katsikis, A., & Emvalotis, A. (2000). EIKON: Teaching a high-school technology course with the aid of virtual reality. *Education and Information Technologies, 5*(4), 305–315.

Ketelhut, D. J. (2007). The impact of student self-efficacy on scientific inquiry skills: An exploratory investigation in river city, a multi-user virtual environment. *Journal of Science Education and Technology, 16*(1), 99–111.

Ketelhut, D. J., Dede, C., Clarke, J., Nelson, B., & Bowman, C. (2008). Studying situated learning in a multi-user virtual environment. In E. Baker, J. Dickieson, W. Wulfeck & H. O'Neil (Eds.), ***Assessment of problem solving using simulations***. Mahwah, NJ: Lawrence Erlbaum Associates.

Lee, E.,Wong, K., & Fung, C. (2010). How does desktop virtual reality enhance learning outcomes? A structural equation modeling approach. *Computers & Education, 55*(4), 1424–1442.

Ligorio, M.B., & Van Veen, K. (2006). Constructing a successful cross-national virtual learning environment in primary and secondary education. *AACE Journal, 14*(2), 103–128.

Machado, I., Brna, P., & Paiva, A. (2005). Tell me a story. *Virtual Reality, 9*(1), 34–48.

Mantovani, F., & Castelnuovo, G. (2003). Sense of presence in virtual training: Enhancing skills acquisition and transfer of knowledge through learning experience in virtual environments. In G. Riva, F. Davide, & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurement of user presence in synthetic environments* (pp. 167–181). Amsterdam, NL: Ios Press.

Marshall, P., Rogers, Y., & Scaife, M. (2005). PUPPET: Playing and learning in a virtual world. *International Journal of Continuing Engineering Education and Life-Long Learning, 14* (6), 519–531.

Merrill, D. (1992). Constructivism and instructional design. In T. M. Duffy, & D.H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 99–114). Hillsdale, NJ: Lawrence Erlbaum Associates.

Mikropoulos, T. A. (2006). Presence: a unique characteristic in educational virtual environments. *Virtual Reality, 10*(3), 197–206.

Mikropoulos, T. A., & Bellou, J. (2006). The unique features of educational virtual environments. In P. Isaias, M. McPherson, & F. Banister (Eds.), Proceedings e-society 2006, International Association for Development of the Information Society, Vol. 1 (pp. 122–128). IADIS.

Mikropoulos, T. A., Chalkidis, A., Katsikis, A., & Emvalotis, A. (1998). Students' attitudes towards educational virtual environments. *Education and Information Technologies, 3*(2), 137–148.

Mikropoulos, T. A., & Strouboulis, V. (2004). Factors that influence presence in educational virtual environments. *CyberPsychology & Behavior, 7*(5), 582–591.

Neale, H. R., Brown, D. J., Cobb, S. V. G., & Wilson, J. R. (1999). Structured evaluation of virtual environments for special-needs education. *Presence: Teleoperators and Virtual Environments, 8*(3), 264–282.

Nelson, B. (2007). Exploring the use of individualized, reflective guidance in an educational multi-user virtual environment. *Journal of Science Education and Technology, 16*(1), 83–97.

Nelson, B. C., & Ketelhut, D. J. (2008). Exploring embedded guidance and self-efficacy in educational multi-user virtual environments. *International Journal of Computer-Supported Collaborative Learning, 3*(4), 413–427.

Nelson, B., Ketelhut, D. J., Clarke, J., Dieterle, E., Dede, C., & Erlandson, B. (2008). Robust design strategies for scaling educational innovations: The River City MUVE case study. In B. E. Shelton & D. A. Wiley (Eds.), *The educational design and use of computer simulation games* . Rotterdam, The Netherlands: Sense Press.

Pantelidis, V. (1993). Virtual reality in the classroom. *Educational Technology, 33*(4), 23–27.

Papastergiou, M. (2009). Exploring the potential of computer and video games for health and physical education: a literature review. *Computers & Education, 53*(3), 603–622.

Pasqualotti, A., & Freitas, C. M. D. S. (2002). MAT3D: a virtual reality modeling language environment for the teaching and learning of mathematics. *CyberPsychology & Behavior, 5*(6), 409–422.

Patera, M., Draper, S., & Naef, M. (2008). Exploring magic cottage: a virtual reality environment for stimulating children's imaginative writing. *Interactive Learning Environments, 16*(3), 245–263.

Richard, E., Tijou, A., Richard, P., & Ferrier, J. L. (2006). Multi-modal virtual environments for education with haptic and olfactory feedback. *Virtual Reality, 10*(3), 207–225.

Robertson, J., & Despa, J. O. (2002). Ghostwriter: educational drama and presence in a virtual environment. *Journal of Computer-Mediated Communication, 8*(1). http://jcmc. indiana.-edu/vol8/issue1/robertson/robertson.html

Robertson, J., & Good, J. (2003). Using a collaborative virtual role-play environment to foster characterization in stories. *Journal of Interactive Learning Research, 14*(1), 5–29.

Ross, S. M., & Morrison, G. R. (1997). Getting started in instructional technology research (3rd ed.). Bloomington, IN: Association for Educational Communications andTechnology.

Ross, S. M., & Morrison, G. R. (2004). Experimental research methods. In D. H. Jonassen (Ed.), Handbook of research on educational communications and technology (2nd ed). Mahwah, NJ: Lawrence Erlbaum Associates.

Roussos, M., Johnson, A., Moher, T., Leigh, J., Vasilakis, C., & Barnes, C. (1999). Learning and building together in an immersive virtual world. *Presence: Teleoperators and Virtual Environments, 8*(3), 247–263.

Roussou, M., Oliver, M., & Slater, M. (2006). The virtual playground: an educational virtual reality environment for evaluating interactivity and conceptual learning. *Virtual Reality, 10*(3), 227–240.

Salzman, M. C., Dede, C., Loftin, R. B., & Chen, J. (1999). A model for understanding how virtual reality aids complex conceptual learning. *Presence: Teleoperators and Virtual Environments, 8*(3), 293–316.

Sardone, N. B., & Devlin-Scherer, R. (2008). Teacher candidates' views of a multi-user virtual environment (MUVE). *Technology, Pedagogy and Education, 17*(1), 41–51.

Selverian, M. M., & Hwang, H. S. (2003). In search of presence: a systematic evaluation of evolving VLEs. *Presence: Teleoperators and Virtual Environments, 12*(5), 512–522.

Sharda, R., Romano, N. C., Jr., Lucca, J., Weiser, M., Scheets, G., Chung, J.-M., et al. (2004). Foundation for the study of computer-supported collaborative learning requiring immersive presence. *Journal of Management Information Systems,* 20(4), 31–63.

Shim, K.-C., Park, J.-S., Kim, H.-S., Kim, J.-H., Park, Y.-C., & Ryul, H.-I. (2003). Application of virtual reality technology in biology education. *Journal of Biological Education, 37*(2), 71–73.

Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers & Education, 44*(3), 343–355.

Steuer, J. (1992). Defining virtual reality: dimensions determining telepresence. *Journal of Communication, 42*(4), 73–93.

Tuzun, H., Yilmaz-Soylu, M., Karaku, T., Inal, Y., & Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers & Education, 52*(1), 68–77.

Virvou, M., & Katsionis, G. (2008). On the usability and likeability of virtual reality games for education: the case of VR-ENGAGE. *Computers & Education, 50*(1), 154–178.

Virvou, M., Katsionis, G., & Manos, K. (2005). Combining software games with education: evaluation of its educational effectiveness. *Educational Technology & Society, 8*(2), 54–65.

Whitelock, D., Brna, P., & Holland, S. (1996). What is the value of virtual reality for conceptual learning? Towards a theoretical framework. In P. Brna, A. Paiva, & J. A. Self (Eds.), Proceedings of the European conference on artificial intelligence in education (pp. 136–141). Lisbon: Edicoes Colibri.

Whitelock, D., Romano, D., Jelfs, A., & Brna, P. (2000). Perfect presence: what does this mean for the design of virtual learning environments? *Education and Information Technologies, 5*(4), 277–289.

Winn, W. (1993). A conceptual basis for educational applications of virtual reality (Report No. TR-93–9). Human Interface Technology Laboratory, Washington Technology Center.

Winn, W., Hoffman, H., Hollander, A., Osberg, K., Rose, H., & Char, P. (1999). Student-built virtual environments. *Presence: Teleoperators and Virtual Environments, 8*(3), 283–292.

Winn, W., Stahr, F., Sarason, C., Fruland, R., Oppenheimer, P., & Lee, Y.-L. (2006). Learning oceanography from a computer simulation compared with direct experience at sea. *Journal of Research in Science Teaching, 43*(1), 25–42.

Winn, W., & Windschitl, M. (2000). Learning science in virtual environments: the interplay of theory and experience. Themes in Education, 1(4), 373–389.

Ye, E., Fang, Y., Liu, C., Chang, T.J., & Dinh, H.Q. (2007). Appalachian tycoon: An environmental education game in second life. Retreived from the SimTeach website: http ://simteach.com/SLCC06/slcc2006-proceedings.pdf

Yun, R., Xi, H., & Li, Y. (2006). The experiment of improving students' spatial ability by using VGLS. In Z. Pan (Ed.), *Advances in artificial reality and tele-existence* (pp. 467–473). Berlin, Germany: Springer-Verlag.

VLE – name and description	**Enabler (developers, admin., faculty)**	**Builder (learners, designers, testers, implementers)**	**Supported Learning Objectives/ Classes**	**Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators**	**Launch Date (end date or PD for present day)**
PDVLEs: Platforms, Environments, and Providers					
PDVLE Environments					
Alien Rescue – a problem-based learning environment enriched with cognitive tools to assist in solving a complex problem within the environment	developer - UT Austin & Texas A&M designed in accordance with the National Science Education Standards	UT Austin and Texas A&M faculty.	Students take on the roles of scientists to solve a complex problem within the environment. Students must find the appropriate plant for six different alien species using information about the solar system and the particular aliens' habitat.	Public use: middle grades students as facilitators adopting roles as scientists.	Early 2000s (PD)
Barnsborough – an Active Worlds VLE developed by literacy instructors, the exploration of which has	Active Worlds	Barnsley MBC literacy instructors and administrators.	Barnsborough is designed for the development of student literacies. Barnsborough offers distributed	Private: Students of Barnsley MBC language arts classes, acting as an audience, facilitators and evaluators of VLE content.	2006 (PD)

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become rooted to classroom literacy coaching routines using structured open-ended and multi-layered narratives.			cognition, collaborative problem-solving, a constellation of literacy practices, exploration of multimedia and multimodal texts, and negotiated meanings and values.		
FARMTASIA – the first online game-based learning environment that involves near-real life, situation-based learning as well as collaboration and competition in an interactive VLE.	Sun Microsystems	FARMTASIA staff	Objectives: to make the game as realistic as possible so that students learn in a near-real life environment that enables situated learning. Developers wanted to make facilitation of tasks feasible and therefore the opportunity to inject challenge, curiosity, control, competition, and cooperation more possible.	Both students and teachers as facilitators; tasks are also given to prompt student evaluation of the pre-designed VLE.	Early 1990s (PD)
FearNOT! – students (8-12) learn through interactive VLE narrative about	developer - ECIRUS; faculty hosts - Heriot-Watt University;	ECIRUS staff	Through establishing VLE-based situations, students are to	Students as an audience and facilitators of the interactive narrative.	2002 (2005)

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strategies for coping with bullying issues	University of Hertfordshire		select a coping strategy and explain why it is the best course of action. The NPC either accepts or rejects the advice based on the strategy's success.		
Ghostwriter – a narrative-based VLE meat to inspire the multimodality of student literacies using the manipulation of a narrative that requires student avatar discourse and interaction.	faculty host - University of Edinburgh developer - Epic Megagames	Epic Megagames systems: UnrealEd, Unrealscript, Unreal Engine	Students and teachers conduct a narrative-based VLE through reconstructing a narrative, the process of which is meant to engage multimodal literacy development and an understanding of user presence in a narrative-based VLE.	Private: students as role-playing facilitators of an open-ended narrative, and as evaluators of narrative immersion.	2000 (2001)
Immune Attack – students navigate a vessel through a 3D virtual cardiovascular system while attempting to save a patient by retaining her non-functional immune cells.	developers - Federation of American Scientists; University of Southern California; Brown University; Escape Hatch Entertainment	Escape Hatch Entertainment	Students learn about immunology and the cardiovascular system through manipulating components and being involved in an ongoing VLE-based narrative.	Public use: students as both an audience and facilitators.	2009 (PD)

VLE – name and description	Enabler (developers, admin., faculty)	Builder (learners, designers, testers, implementers)	Supported Learning Objectives/ Classes	Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators	Launch Date (end date or PD for present day)
Maxwell World – 3D VLE of electric fields and has various saved states of electronic fields with which students can interact through visual, audio, and spatial means.	developer - University of Houston, George Mason University, NASA JSC	university admin.: University of Houston, George Mason University	evaluation of the effectiveness of the VLE to remediate misconceptions about electric fields and to teach concepts of electric fields. Compared effectiveness of another VLE, EM Field. Further intended learning objectives were to test for retention of material over time.	Private; students acted both as an audience and as facilitators.	Spring 1996 (1997)
Second Life – an online virtual world that enables users to create, host, and interact within open and closed virtual environments. More recently, SL has increased its capacities and abilities to conduct VLEs.	Developer: Linden Research, which hosts SL groups, university organizations, and in-world tools and groups.	Linden Research, In-world designers, editors, gamers, general users, students and teachers.	A wide variety of supported educational outcomes are possible. For instance, SLED (Second Life Education) enables CMS classes while SLOODLE can be used to establish specific VLE objectives.	Public: general use, universities, networks, administrations, developers, gamers, learners, researchers, and teachers.	2003 (PD)
Virtual Gorilla Exhibit – A VLE-based habitat used to observe, travel through, create,	developer - Georgia Institute of Technology: GVU Center	university faculty and students	For students to learn about the effect of zoo construction and organization on	Private: students as facilitators.	1996 (1997)

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delete, or modify design elements to experiment with the effect of zoo construction and maintenance on gorillas and their habitat.			gorillas and their habitat, with informal inquiry into the effectiveness of VLEs to achieve this task.		
WolfQuest – a VLE built to realistically depict the Minnesota Zoo; students take on the avatar of a wolf in the VLE.	Eduweb; Minnesota Zoo	Eduweb	Through VLE immersion and the supplementation of a database of information about wolves, students learn about wolf pack behaviors as well as ecology. Students are encouraged evaluate their experiences through multimodal means.	Middle school students as facilitators and evaluators of the VLE.	2005 (PD)
PDVLE Platforms					
3D Gamemaker – a pre developed platform built by The Game Creators, 3D Gamemaker enables users to create "a uniquely playable game without needing any	The Game Creators, Ltd.	Independent designers, teachers and students.	Although not education-based, 3D Gamemaker has been used to create VLEs and VLE-related tasks.	Public platform: anyone that wants to craft a 3D-based virtual environment.	1999 (PD)

VLE – name and description	Enabler (developers, admin., faculty)	Builder (learners, designers, testers, implementers)	Supported Learning Objectives/ Classes	Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators	Launch Date (end date or PD for present day)
programming knowledge or artistic skills at all".					
CAVE – A 3D VLE platform that uses an enclosed room within a larger room and 3D projections to create embodiment within a VLE, created for universities and virtual product enhancement.	Electronic Visualization Lab at University of Illinois, Chicago; University of Illinois Board of Regents.	OpenSG, OpenScene Graph, OpenGL Performer	In education, to stimulate VLE embodiment for purposes of environmental interaction and co-presence interaction.	Public use: product enhancement testers, engineers, university faculty and students as evaluators, audiences, and facilitators of 3D VLEs.	1992 (PD)
Moodle – an open source course management system (CMS) and platform that utilizes VLE-based technology to create collaborative and interactive VLE communities.	Moodle staff, volunteers, teachers, contributors.	CMS teachers, mainstream teachers, students	Designed "to manage and promote learning" via content management system (CMS)-based courses, blended teaching, and individual activity modules.	Public use: teachers using CMS and blended teaching practices.	2001 (PD)
RPG Maker – a game-based virtual environment creator with tools designed to create narrative immersion	Developer – Enterbrain, Inc.; marketer – Degica, Ltd.	Game developers, public.	The purpose is to enhance the abundance of RPG creativity through feasibility. RPG maker has been used to craft VLEs with	Public: creative gamers, students, and teachers.	N/A (PD)

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found in VLEs.			specific literacy-based outcomes.		
SLOODLE (Simulation Linked Object Oriented Dynamic Learning Environment) – open source project from the resulting integration of SL with Moodle. Create CMS-based VLEs and blended teaching in SL and other VLEs.	Eduserve, SJSU School of Library and Information Science, Moodle Staff, Peter Bloomfield.	Moodle Staff, SL staff, instructors conducting courses using CMS and/or blended teaching.	A good tool to start up and continually develop a CMS in a VLE that supports distance education or blended teaching.	Public or private: teachers/instructors and students in a classroom-based VLE. Both teachers and students function as an audience and as facilitators.	2006 (PD)
PDVLE Providers					
Blaxxun – provider of general use community-based virtual environment platforms	Franz Buchenberger and other Blaxxun associates	Blaxxun staff, partners.	Developed VLE technologies for university projects, community-based.	General public, private contracts, university projects. Users were generally audience-based evaluators of created environmental content or facilitators of virtual community events.	1995 (2002)
Eduweb – a company that creates VLEs intended to merge learning theory, digital media, and entertainment for prospective educational clients.	Scholarly research informs the fundamental approach of Eduweb pedagogy. Eduweb is made up of long-time educational	Eduweb staff	Eduweb's objective is the perfect marriage of VLE and school-based learning theory in order to provide clients with rewarding, unique VLE-based	Public use: school administrations, educational organizations, teachers who wish for Eduweb to develop a specific VLE.	1996 (PD)

VLE – name and description	Enabler (developers, admin., faculty)	Builder (learners, designers, testers, implementers)	Supported Learning Objectives/ Classes	Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators	Launch Date (end date or PD for present day)
	developers and teachers.		experiences otherwise unavailable in reality.		
Fable Vision – creates VLEs and other virtual based interactive tools, narratives, and games for education-based clients.	Peter H. Reynolds, university partnerships	Fable Vision staff	Satisfactory of educational clients' respective e-learning needs, some of which are 2D VLE-based. Fable Vision is dedicated to helping all learners reach their full potential and to tell "stories that matter".	Public use: A wide array of students as facilitators and an audience.	1996 (PD)
Open Simulator – an open source multi-platform, multi-user 3D VLE server. Allows for single-or-multiple developers and builders.	Overte Foundation – manages, supports, and promotes Open Simulator and the wider VLE ecosystem.	Admin., Developers, Users.	Although not affiliated with any educational group, OpenSim has been used to craft VLE-based classrooms and for blended teaching. Would require a separate CMS.	Open to the public: administrators, developers, users act as facilitators of VLEs. OpenSimulator supports public and privately operated VLEs.	2008 (PD)
TEA (The Education Arcade) – through research and development, crafts game-based VLEs and other e-learning	A large consortium of research informs the pedagogical foundations of crafting game-based VLEs.	TEA staff	To provide game-based VLEs that "demonstrate the social, cultural, and educational potentials of videogames".	Public use: students of all ages as an audience and facilitator of game-based 2D and 3D VLEs.	2008 (PD)

VLE – name and description	Enabler (developers, admin., faculty)	Builder (learners, designers, testers, implementers)	Supported Learning Objectives/ Classes	Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators	Launch Date (end date or PD for present day)
tools through game-based learning and the educational needs of players.			VLEs touch on mathematics, science, history, literacy, and language learning		

SDVLEs: Platforms, Environments, and Providers

SDVLE Environments					
Alice – an innovative 3D programming VLE used to help introduce students to programming such as creating the animation to tell a story, playing an interactive game, or creating a video.	Providers, engineers - Oracle, EA Games Affiliated Org. – National Science Foundation	EA Games; students	To successfully introduce young students to programming functions and language.	Young, adolescent students as facilitators and creators of programs within a VLE.	1999 (PD)
Quest Atlantis Project – a 3D multi-user VLE with more than 50,000 students in 22 states and 6 continents. Quest Atlantis attempts to bridge the fictional world of Atlantis with the real world of Earth through each child's interpretation using VLE technology.	developer - Atlantis Remixed team sponsors, affiliated groups - ARX Grant, National Science Foundation, NASA, MacArthur Foundation, Gates Foundation, public	Atlantis Remixed provides the VLE; students' provide VLE-powered interpretations of the Atlantis narrative.	Quest Atlantis attempts to situate education, entertainment, and multi-user virtual environments around the development of child and adolescent literacies through a VLE and corresponding unit plans, storyline, and a	Public educational use - teachers as facilitators; students as facilitators and creators.	N/A (PD)

VLE – name and description	Enabler (developers, admin., faculty)	Builder (learners, designers, testers, implementers)	Supported Learning Objectives/ Classes	Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators	Launch Date (end date or PD for present day)
	schools		narrative programming toolkit meant to foster a student's recreation of the basic storyline.		
River City MUVE – a VLE that depicts a disease-besieged 19th century town. Middle grade students and teachers utilize 21st century skill sets to restore this VLE town via 21st century standards.	Platform provider - Active Worlds Faculty Hosts - Harvard University; Arizona State University, curriculum content derived from National Science Education standards, National Education Technology standards	River City administrators, students and teachers.	River City intends that both middle school teachers and students work together to creatively apply their multi-disciplinary, 21st century skills to help restore and revise a VLE that depicts an issue-ridden, dilapidated town.	Private use: teachers and students as collaborating facilitators.	2004 (PD)
SPVLE Platforms					
ActiveWorlds – virtual environment platform used educationally since the beginning for institutions, universities, classes, teachers, and students, all of	Int'l partnerships, univ. affiliates, education-based organizations, business instruction technology organizations.	ActiveWorlds, users: university faculty, students and teachers, general public.	Launched Active Worlds Educational Universe (AWEU), created by ActiveWorlds educational participants (students and teachers) to help direct the	General public: university faculty, public and private school faculty, teachers, administrators, and students, acting as both an audience and as facilitators.	1995 (PD)

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which have continually expanded and improved upon the 1000 + individual virtual environments.			educational focus of one's goals, be it VLE classrooms, community projects, and creative blended-teaching or VLE-based curriculum design.		
Division ProVision100 – proprietary 3D immersive system that allows students to create and experience their own virtual environment using wands, headsets, and a tracking system for the participant's head and hand.	affiliated groups - HIT Lab, Virtual Reality Roving Vehicle (VRRV) project	students	Intended objectives can be class related or lesson focused, but should reflect understanding of the design process, esp. the educational value of the environment when defining the objects, behaviors, interactions, and events.	Students as VLE designers and facilitators.	1997 (1998)
SPVLE Providers					
3DVista – owns the widest array of free 3D virtual tour software, applicable towards any tour-based virtual immersion.	3D Vista Staff	Users and developers	Although not education-based, 3DVista has been used by students to create virtual tours, such as interpretations of stories and scientific experiments.	Public use – users and developers who wish to host virtual tours using virtual environmental software.	1999 (PD)

VLE – name and description	**Enabler (developers, admin., faculty)**	**Builder (learners, designers, testers, implementers)**	**Supported Learning Objectives/ Classes**	**Public or Private VLE/Provider/ Platform; Intended Audience/Facilitators**	**Launch Date (end date or PD for present day)**
Croquet (open sources) – a facilitative project meant to provide and promote continued development of Croquet open source software, which supports VLE-based communication.	developer - Open Cobalt	Croquet is platform and device independent, and depends upon other VLE-based builders.	Croquet has been used to help facilitate student-generated VLEs.	Developers, users, public and private, education-based VLE facilitators or creators.	2007 (PD)
HIT Lab (Human Interface Technology Laboratory) – provides opportunity to construct SPVLEs using a vast array of 2DVLE and 3DVLE software.	affiliated university - College of Built Environments , Pacific Northwest Center for Construction Research and Education	Through research, validates and facilitates the pursuit of student-developed VLEs as well as improvements to 2D and 3D VLE building technologies.	In terms of VLEs, conducting studies about best practices in VLE creation and facilitation, such as the differences and advantages of using 2DVLEs versus 3DVLEs.	Private: researchers, teachers and students as VLE creators and facilitators.	1990 (PD)