A critical review of the application of Kolb's experiential learning theory applied through the use of computer based simulations within virtual environments, 2000-2016

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by

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Abstract

This integrative research review aims to examine the application of Kolb’s theory of experiential learning through the use of simulations within virtual learning environments. It will first cover the framework of experiential learning as stated by Kolb, a learning theory that is finding new life within the context of simulations, role-playing games (RPGs), massive multiplayer online role playing games (MMORPGs) and virtual environments. This analysis was conducted by making use of combined research strategies that focused specifically on both qualitative and quantitative reviews that utilized Kolb’s experiential learning theory (ELT) within the context of the application of computer based simulations in virtual environments used to facilitate learning. The review was guided by three principle questions: From the year 2000 to 2016, which research studies that examine the use of simulations to facilitate learning, use experiential learning theory as its foundational theoretical approach? Of the works that were selected, which studies were computer based simulations in virtual environments and demonstrated firm connections between Kolb’s ELT and the results of the study? And lastly, within the final group of studies identified, what patterns emerge through the application of Kolb’s ELT within the context of computer based simulations in virtual environments?

Keywords: experiential learning, Kolb, simulations, virtual learning environments

“Experience without theory is blind, but theory without experience is mere intellectual play.”
~Immanuel Kant
Introduction

Originally, David A. Kolb professor of Organizational Behavior at Case Western Reserve University established the foundations for experiential learning theory in *Experiential Learning: Experience as the Source of Learning and Development* (Kolb, 1984). This popular learning theory contends that learning is gained through experience and is still widely discussed to this day. Given the recent rise of educational simulations and games, role-playing games (RPGs), massive multiplayer online games (MMORPGs) and virtual reality (VR) that offer participants a life-like and in some cases, totally immersive experience; this theory could be argued as having gained a higher degree of relevancy in these areas. The possibility that one may be able to learn from virtual experiences could lead to a shift in the current educational paradigm of teaching/learning. Due to the fact that these technologies are playing an ever-increasing role within the classroom, the notion that one learns through experience must be reviewed.

ELT as a comprehensive theory of learning seeks to provide a foundation for effective instruction/design that goes beyond learning outcomes and seeks to focus students on discovering what specific processes enhance their learning abilities individually (Kolb, 2005a). Within ELT, the notion that the process of learning is a skill in itself and not merely contained to a specific subject domain, is at its foundational core.

The catalyst for this research partly derived from works by Holden (2014) and by Games and Squire (2011), which examine learning acquisition through gameplay. The notion that effective learning can take place through playing, discussing, and observing gameplay has been the subject of additional work by Stevens, Satwicz and McCarthy (2008). With individuals participating in simulated worlds within virtual environments on a daily basis, the impetus to study these experiences becomes increasingly more relevant. Assuming that this trend is
expected to continue, the act of determining the positive and negative qualities of learning acquisition through virtual and simulated experiences, compared to traditional real world learning through experience is worthwhile endeavor worthy of examination.

**Summary of Kolb’s Theory of Experiential Learning**

Essentially speaking, experiential learning theory’s fundamental foundations reside in concepts of learning through experience posited by John Dewey (1938). It was this “theory of experience” put forth by Dewey (1938) wherein ELT can trace its roots. Although these ideas of Dewey’s were created close to eight decades ago, his identification of the shortcomings of traditional education in its failure to identify a clearly defined acknowledgement of the learning process through experience still remain relevant to this day.

Kolb (1984) further expounded on the experiential learning foundations that Dewey had previously laid out. This ideological foundation provided by Dewey (1938) was incorporated within a synthesis of ideas resulting in Kolb’s (ELT). Through thorough analysis and scholarly pursuit, Kolb (1984) was able to provide a comprehensive theory of learning that attempts to further understand the process of learning through experience. “Learning is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p.38).

Within Kolb’s ELT, this experienced is achieved through a four-part cycle that wherein experience is processed within the individual learner. They include concrete experience (CE), reflective observation (RO), active experimentation (AE), and abstract conceptualization (AC) (Kolb, 1984). Kolb (2005a) explains this four-part cycle and the role that it plays in learning:

Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes that is responsive to contextual demands. This process is portrayed as an idealized learning cycle or spiral where the learner “touches all the
bases”—experiencing, reflecting, thinking, and acting—in a recursive process that is responsive to the learning situation and what is being learned. (p.194).

In addition to the four-part cycle, the secondary component of Kolb’s ELT establishes four distinct learning styles (Kolb, 1974). These personalized learning styles demonstrate specific personal preferences towards portions of the four-part experiential learning cycle and are “influenced by personality type, educational specialization, career choice, and current job role and tasks” (Kolb, 2005b, p.4). According to Kolb (1984, 2005b), one’s learning style can have a major impact on personal preference for how learning takes place within Kolb’s learning cycle and can even influence preferences regarding occupation and task choice.

It appears that Kolb’s work into the field of experiential learning is not merely an attempt to organize thoughts regarding the process of human learning, but rather an attempt at establishing partially confirmable process of learning linked through experience. “To learn is not the special province of a single specialized realm of human functioning such as cognition or perception. It involves the integrated functioning of the total organism—thinking, feeling perceiving and behaving” (Kolb, 1984, p.31).

This sentiment was later confirmed by biologist James Zull in The Art of Changing the Brain: Enriching Teaching by Exploring the Biology of Learning, Zull (2002) who goes on to suggest that experiential learning is a mechanism that includes various forms of experience and manifests in four areas of “experiencing, reflecting, thinking, and acting” (Zull, 2002, pp.18–19). It is Zull’s (2002) work into the field of neuroscience that supports the science behind ELT.

With hard science behind the theory, Kolb, (2005b) further expands it to include notions regarding an individual’s own inherited predispositions and personalized interpretations of qualia
Kolb (1984, 1999). The concept that one’s own personal experiences help influence individual preference for a specialized learning style. Kolb (1984, 1999) is at the foundational core of ELT. For Kolb (1984), “learning is the major determinant of human development, and how individuals learn shapes the course of their personal development” (p.195)

The Four Parts to Kolb’s Experiential Learning Cycle

Concrete Experience (CE)

The learning ability of concrete experience (CE) is centered on the learner’s real-life experience that tales place throughout the learning process (Kolb, 1984). Essentially, it is the act of learning through doing. This learning ability is juxtaposed with the learning ability of abstract conceptualization (AC) (Kolb, 1984). According to Kolb (1984), in order for learners to be effective they must be able to approach their concrete experience in a particularly open manner. Kolb (1984) notes that learners “must be able to involve themselves fully openly, and without bias in a new experience” (p. 30).

Observation and Reflection (RO)

The learning ability of reflective observation is the act of reflecting on past experiences and observations (Kolb, 1984). Essentially, it is the act of learning through observation and reflection. This learning ability is juxtaposed with the concept of active experimentation (AE) (Kolb, 1984). According to Kolb (1984), in order for learners to be effective in the implementation of this learning ability, they must be able to be flexible in their ability to transition “from actor to observer” (p.31).

Formation of Abstract Concepts and Generalization (AC)
The learning ability of abstract conceptualization (AC) is the act of formulating concepts that combine observations and experiences into a cohesive theory of understanding Kolb (1984). This learning ability allows for learners to apply previous experience earned in the micro sense, to be translated into the realm of the macro. In order to be effective using this particular learning ability, learners “must be able to create concepts that integrate their observations into logically sound theories” (Kolb, 1984, p. 30).

**Active Experimentation (AE)**

The learning ability of active experimentation (AE) is the act of the implementation of abstract concepts, as evolved through experiences, observation and reflection Kolb (1984). This learning ability is juxtaposed with the learning ability of reflective observation (RO) (Kolb, 1984). Essentially, it is the act of applying knowledge from one’s experience gained through the other learning abilities for use in experimentation. The learning ability of active experimentation seeks to move the learner from “specific involvement to general analytic detachment” (Kolb, 1984, p.30).

**The 4 Foundational Learning Styles of Experiential Learning Theory by Kolb**

**Diverging: feeling and watching – (CE/RO)**

According to Kolb (2005b), people who possess these two dominant learning styles of Concrete Experience (CE) and Reflective Observation (RO) are, “best at viewing concrete situations from many different points of view” (p.197). Through additional research into this specific learning theory, (Kolb, 2005b), we can see that the people who possess this specific learning style often have a predisposition for enjoying the collection of data, are intrigued by other people, can be creative and sensitive, and quite apt at brainstorming. Additionally, Kolb
(2005b) notes, that individuals who possess these two learning styles “tend to specialize in the arts” (p.196). These acts of experience through CE and RO can help facilitate understanding through this divergent learning style (Kolb, 2005b).

**Assimilating: watching and thinking – (AC/RO)**

Individuals that possess this assimilating style as a dominant learning ability are said to excel at being able to take in a large amount of information, and successfully provide an analysis that formats the total sum of the information into a succinct and discerning manner (Kolb, 2005a, p.3). According to Kolb (2005a) these individuals who possess this dominate learning ability tend to have an affinity for concepts and abstract notions, while also opting to be less person focused at the same time. With this being said, this type of individual’s preference tends to be for dealing with the world of ideas while foregoing more social engagements (2005a). It is of little surprise that Kolb (2005a) recognizes that this particular individual would have a general predisposition for placing the importance of having “logical soundness” over that of “practical value” (p.5).

The fields of expertise that would be most receptive to individuals that possess AC and RO as dominant learning abilities are the areas of science and information Kolb (2005a). In terms of more traditional learning environments, individuals with this specific dominant learning ability tend to prefer “readings lecture, exploring analytical models and having time to think things through” (Kolb, 2005a, p.5).

**Converging: doing and thinking – (AC/AE)**

This learning style is referred to as a “converging” style by Kolb (2005a, 2005b) and is dominated by the learning abilities of AC and AE. These individuals are noted as being pragmatic in their ability to find real-world uses for concepts and theories that exist only in the
abstract (Kolb, 2005a). With a preference for pursuing more mechanical endeavors and an aversion to areas that or more person-centered, individuals with this particular learning style have an uncanny knack for obtaining resolution and elucidation on specific issues (Kolb, 2005a).

The area of expertise that most individuals with this dominant learning style would be suited for include the areas of “specialist and technology fields” (Kolb, 2005a, p.5). In terms of more traditional learning environments, individuals with this specific dominant learning ability tend to prefer to interact with “[n]ew ideal, simulations, laboratory assignment and practical applications” (Kolb, 2005a, p.5).

**Accommodating: doing and feeling – (CE/AE)**

The learning style referred to as the “accommodating style” is said to be individuals that mainly learn through hands-on experience. They possess dominant learning ability of CE and AE which tends to make them deal with the world through their own interpretations, as opposed to relying on reason or logic. Partially for this reason, these particular individuals can depend on others for insight instead of relying on their own interpretation. These approaches are said to be best suited for areas like sales and marketing. In more traditional learning contexts these individuals tend to prefer “to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project” (Kolb, 2005a, p. 5).

**The Four Additional Distinct Experiential Learning Styles by Hunt**

The previously stated learning styles were the original styles that were first proposed by Kolb (1984). An additional five learning styles were later added to Kolb’s learning skills inventory (LSI) (Kolb, 2005b). The four additional learning styles of Northerner, Easterner, Southerner and Westerner were added to the LSI by Hunt (Abby, Hunt, & Wesier, 1985; Hunt 1987).
Subsequently, another learning style entitled the Balancing learning style, was also added by Mainemelis, Boyatzis, and Kolb (2002). The addition of these five learning styles to the original four helped to further provide more specific learning style variations “by dividing the two normative distributions into thirds” (Kolb, 2005b, p.15). These extra learning styles serve to provide a more accurate description of personalized learning styles within the ELT theoretical framework.

**The Northerner**

According to Hunt (1987) learning style of the Northerner focus on their own concrete experiences (CE) while simultaneously applying equal focus to both active experimentation (AE) and reflective observation (RO) (p.155). The advantages of this style are an increased aptitude for high levels of participation, while being at home with the acts of both action and reflection (Hunt, 1987). This individual’s experiential learning cycle tends to move from “feelings to reflection” to “action” (Hunt, 1987, p.155). The result of the implementation of this particular learning style is that the Northerner lacks a continuous flow of experience, due to the fact that they are “not informed by the foundation of AC meaning” (Hunt, 1987, p.155).

**The Easterner**

The learning style of the Easterner reside mainly in reflective observation (RO) while simultaneously applying equal focus to feeling through concrete experience (CE) and contemplation through abstract conceptualization (AC) (Hunt, 1987, p.155). The positives of this learning style are the ability for deep thought supported by the propensity for feeling both focused and acting directly out of a theory based application of experience (Hunt, 1987).

For Hunt (1987), the downside to possessing this learning style is that Easterners “have trouble putting plans into action” (p.155). As a result, these learners can be predisposed to
becoming entangled within their own thoughts and unable to progress their learning to the point of action (Hunt, 1987). This can have the effect of their ideas being predicated solely on the basis of their own feelings, and not on the basis of one’s own actions.

**The Southerner**

The learning style of the Southerner focuses on thinking that is achieved through the parts of Kolb’s learning cycle of abstract conceptualization (AC) and reflective observation (RO) (Hunt, 1987, p.155). The positive attributes of this learning style are the advanced development of theoretical and investigative skills that are supported by experience gained through contemplation and effort (Hunt, 1987). Additionally, Hunt (et. al, 1984) found that individuals with a Southerly pattern are “not in touch with their feelings” and reflect on their actions without the benefit of emotional feedback and “[a]s a result, future ruminations about the subject can result in “…mechanical and sterile” (p.155) reformulations of one’s views.

**The Westerner**

The learning style of the Westerner emphasizes action through active experimentation (AE) while simultaneously harmonizing the act of feeling through concrete experience (CE) and deliberation through abstract conceptualization (AC) (Hunt, 1987). The positive traits attributed to the learning style are high level action abilities that are founded both by conceptual analysis and visceral experience (Hunt, 1987). For Hunt (1987), the learning style of the Westerner moves one’s own awareness “to conceptualizing without sorting out the concrete experience” (p.155). As a result, this learning style can face problems with clarity regarding the initial conceptual framework; with “little possibility to correct it through reflection” (Hunt, 1987, p.155).

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**A “Balancing” Learning Style** Mainemelis, Boyatzis, and Kolb
The Balancing learning style is essentially the balanced inclusion of all four learning abilities of abstract conceptualization (AC), concrete experience (CE), active experimentation (AE), and reflective observation (RO). According to results of Kolb’s (1999) research, learners that possess this learning style have a greater aptitude for adaptability through the Adaptive Skills Inventory (ASI). It appears that by finding equity between learning abilities, a learner increases their aptitude for adaptive flexibility on the Learner Skills Inventory. The correlation was the most substantial between the learning cycles of abstract conceptualization (AC) and concrete experience (CE), compared that of active experimentation (AE) and reflective observation (RO). Additionally, these findings conveyed that learners who possess the specialized learning style of Balancing display more aptitude in the proportionate skill area of the Learning Skills Profile (LSP). Moreover, the study also noted that although specialized learning styles were found to convey less “adaptive flexibility” on the Adaptive Skills Inventory (ASI) (Kolb, 2005a, p. 198), specifically in the area of abstract conceptualization (AC), they did not provide same results regarding the concrete experience (CE) portion of Kolb’s learning cycle.

**Methodology**

**Analytic Framework for the Review**

The analytical framework for this review was that of an integrative research review. The type of method utilized was initially developed by Smith, Hayes, and Shea (2017) and was adapted to examine the role of theory as applied through the use of computer based simulations within virtual environments. The method makes use of a mixed approach that takes into account, both qualitative and quantitative studies. Further justification for choosing this particular framework can be briefly expressed by work on integrative research methodology conducted by Whittemore and Knafl (2005), “[t]he integrative review method is the only approach that allows...”
for the combination of diverse methodologies” and “has the potential to play a greater role in evidence-based practice” (p.546).

As previously stated, the analytical method developed by Smith (et.al 2017) which was adapted for this review, took note of the importance of utilizing both qualitative and quantitative reviews while conducting research. More specifically, Smith (et. al 2017) cited Szmigiel and Lee (2014) regarding their five-step research method that includes “research question formulation, data collection, data evaluation, data analysis, and interpretation and reporting” (p.37). The first round of coding was developed accordingly in alignment with this adapted method.

The first step that was taken was to formulate the guiding questions that provided the framework for the review. Secondly, a search was performed that provided results that pertained directly to the keywords utilized by the search. Each result was considered a source of data under this mixed methods approach and was created as such in an effort to include as many studies as possible.

In the subsequent areas of the review, the questions that provided the guiding framework for examination and analysis will be established, along with search methods and analytical approach used within. Lastly, the results and discussion of findings will follow.

Guiding Questions

The underlying questions that guided this review were:

1. Which research studies that examine the use of simulations to facilitate learning, use experiential learning theory as its foundational theoretical approach?
2. Of the works that were selected, which studies were computer based simulations in virtual environments and demonstrated firm connections between Kolb’s ELT and the results of the study?

3. Within the final group of studies identified, what patterns emerge through the application of Kolb’s ELT within the context of computer based simulations in virtual environments?

**Search Strategy**

During the course of the research, four separate databases were utilized to conduct searches to determine relevant studies to be used. EBSCO, Education Source, Educational Administration Abstracts, Science Direct and, Google Scholar. Three different main search terms were used to guide the research: 1) experiential learning; 2) Kolb; and 3) simulation. Additional variations of the key words were also used, including the possessive (Kolb’s), plural (simulations) and the addition of the word “theory” (experiential learning theory). By using AND these terms were also combined using a Boolean search function available to each database (See Appendix A for a diagram detailing the search).

The search functions that were implemented within each database included only peer reviewed journal articles, seminar papers, and books. These searches only included works that are published in English. The specific timeframe that was searched were the years 2000-2016; this research was conducted in the spring of 2017.

At first, this particular query resulted in 53 different results. Most of these studies focused on experiential learning as applied to higher education, adult education, and professional development. Additionally, a small minority of studies focused on elementary and high school education. The second round of selections included papers that directly applied Kolb’s experiential learning theory through the implementation of simulations within virtual
environments. Works that did not meet these conditions were excluded from the review. This included several studies that examined Kolb’s ELT as applied to simulations, but said simulations did not occur within virtual environments and were excluded.

Analytical Approach

In order to address the initial two questions directing this review, content analysis was conducted that coded all of the articles involved. The coding strategy utilized was adapted from Smith, Hayes, and Shea (2017) and was adjusted to answer the guiding questions in the review. In an effort to decide which articles had Kolb’s experiential learning theory as its established theoretical foundation, the adapted coding system from Smith (et. al, 2017) was used.

This coding system was previously created by Smith (et. al, 2017) and can be found within this study, entitled “Theoretical basis” (Table 1). It was used to analyze the role of Wenger’s Community of Practice (CoP) and was adapted and adjusted for this study in order to examine the role of Kolb’s ELT. As per the coding recommendations of the aforementioned study, when an article was found to have Kolb’s experiential learning theory as the theoretical foundation, including when it was either used exclusively or used in combination with other learning theories, that study was then coded as a “1”. If it was determined that Kolb’s experiential learning theory was cited or mentioned but was not established as the conceptual foundation for the study, it was assigned a “0”.
Table 1

*Theoretical foundation coding scheme*

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of theoretical foundation</td>
<td>1</td>
<td>Kolb’s ELT formed the conceptual framework for the study, either solely or jointly with other theories</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Kolb’s ELT is referenced or mentioned but did not provide the conceptual basis for the study.</td>
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</tbody>
</table>

Later, in an effort to determine solid connections between Kolb’s experiential learning theory and the results of the studies (Guiding question 2), the same coding system developed by Smith (et. al, 2014) was once again adapted and adjusted for use with Kolb’s ELT. This coding system (Table 2) is entitled “Theoretical linkage.” By taking special note of the important role that theory plays within the study of teaching/learning Smith (et. al, 2014), the specific coding system used throughout this study was designed accordingly.

An article was designated a “2” when the results of study were shown to be distinctly linked to Kolb’s experiential learning theory. A study was designated a “1” when it was deemed that the findings of the study were moderately or somewhat linked to Kolb’s experiential learning theory. Lastly, a study was designated a “0” when the findings of the study were deemed to have no discernable connections to Kolb’s experiential learning theory.
Table 2

*Theoretical linkage coding scheme*

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of connection between ELT and analysis/findings</td>
<td>2</td>
<td>Analysis/findings are clearly connected to Kolb’s ELT and the study examines computer based simulations in virtual environments</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Analysis/findings are somewhat or partially connected to Kolb’s ELT somewhat linked to Kolb’s ELT</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Results of study are not connected to Kolb’s ELT</td>
</tr>
</tbody>
</table>

**Findings**

**Guiding question 1.** *Which research studies that examine the use of computer based simulations to facilitate learning, use experiential learning theory as a foundational theoretical approach?*

Coding that was conducted involving the 53 research articles based upon the parameters of the guiding question 1, resulted in 23 studies that focused on computer based simulations and also had Kolb’s experiential learning as its foundational theoretical framework either solely or in conjunction with additional learning theories. The remaining 30 studies did make use of experiential learning theory either in citation or in passing but was not the foundational framework for the study.

Within those 23 works, the earliest study that specifically makes an attempt to apply experiential learning theory within the context of computer based simulation to facilitate learning dated back to the year 2000. Of these 23-selected works, they consisted of a total of eight quantitative studies, four literature reviews, three qualitative studies, three exploratory research studies, 2 mixed reviews, two case studies and one framework proposal.
Guiding question 2. Of the works that were selected, which studies were computer based simulations in virtual environments and demonstrated firm connections between Kolb’s ELT and the results of the study?

During the second round of coding, the 23 works that were found as having experiential learning theory as its foundational framework as applied to computer based simulations. These were further scrutinized in order to ascertain the level of connection between Kolb’s learning theory and the results of their analysis. A total of 5 studies that fell within the parameters laid out in the second guiding research question. Within these works, Kolb’s ELT was the foundational theoretical framework as well as being the ideological basis for interpretation. The 23-excluded works neglected to base the study’s findings and analysis within Kolb’s ELT, due to either its omission or perfunctory usage.

Guiding question 3. Within the final group of studies identified, what patterns emerge through their application of ELT through computer based simulations within virtual environments?

In order to focus on the third proposed guiding question which specifically attempts to identify recurring themes within Kolb’s experiential learning theory, the works contained within the final round of coding were subjected to intense analysis (see appendix B).

The subsequent section of this paper examines the six-main pattern/themes that resulted from the research, as well as their possible future applications and potential for additional research.

Virtual environments have advantages in addressing the learning needs of millennials, generation Z and the gaming generation.

Within the final group of five studies that met the conditions for research question two, both Jarmon (2009) and Barab (2005) speak specifically about a new generation learners that are
directly influenced by the internet. Barab (2005) quotes Katz (2000) and Prensky (2000) when referring to the “video game generation “and notes that “…some advocates of game-based learning suggest that educational video games are the only way that educators can adequately reach them” (Barab, 2005, p.86). Additionally, when speaking of the educational advantages of virtual worlds and their appeal to the millennial generations learning preferences Jarmon (2009) stated:

Virtual worlds are also often purported to have other instructional benefits, such as allowing for creativity within a rich media environment, providing opportunities for social interaction and community creation, facilitating collaboration, increasing a sense of shared presence, dissolving social boundaries, lowering social anxiety, enhancing student motivation and engagement, and accommodating millennial generation learning preferences (p.170).

The need to design simulations/games that will play to the strengths and weaknesses of these digital citizen learners will be a crucial facet in attempt to facilitate successful learning outcomes for future generations. In the words of Barab (2005), “[n]ew technologies, especially the Internet, offer much potential as vehicles for intercultural collaborative inquiry, allowing us to develop global perspectives on local issues and to find complex approaches to complex problems.” (p.104). This sentiment is further discussed in the following portion of the paper entitled “Virtual environment experience as real-world concrete experience (CE).”.

This author contends that the need to design simulations/games for individuals of the millennial and Z generations will become more and more of a serious issue as we move away from learners who are considered to be digital immigrants and transition to learners that are a part of the first generation of full-fledged digital citizens. Below are some specifics as to what simulations within virtual environments have to offer the next generation of learners.

*Virtual environment experience as real-world concrete experience (CE).*
Seeing as how the researchers are attempting to adjust learning theories that hope to harness the technological familiarity of millennials and generation Z, simulations bridge the experiential divide that exists between virtual experience and concrete experience (CE) in the real world. Virtual environments allow for collaboration between individuals that are separated by physical geographic locations and may not share the same culture and language. Furthermore, although learner’s experiences take place in a virtual environment, the experiences themselves are not any less real as an individual agent, than those that occur in the real non-virtual world.

The majority of the works within this study cited Kolb’s ELT as applied through simulations as being connected to real world experience (CE). Four out of five of the final studies remaining after the second guiding question were in agreement regarding their sentiments on this issue of simulated experience being comparable to real world experience. Through the application of simulations within virtual environments, learners have the opportunity to participate in experiences that are both personal and relevant (Chen 2005; Jarmon 2009; Konak 2013; Wu 2016). This concept is summed up by Jarmon (2009) when referring to the virtual world of Second Life, “[a]s an open virtual environment, SL has the capacity to include such experiential performative elements in salient ways”. Moreover, when speaking on the use of RPGs with in the classroom Wu (2016) notes that they “can be used as a pedagogical and simulation tool for practical experience from the standpoint of game use” (p.118).

As for the specific learning cycle of concrete experience (CE) within Kolb’s ELT, simulations appear to provide relevant concrete experience to its users with very little difference from that of real-world experience. With that being said, this study must recognize that in the case of virtual environments there is still debate as to whether there is a clear advantage to guided and non-guided types of simulations.
Two of the five studies in the final round of coding made specific mention of guided and non-guided activities (Chen 2005; Konak 2013). The study by Chen (2005) examined the issue the most extensively of the two studies and the researchers came to the same conclusion of Clark (2005) which found that guided simulations offered an advantage for simulation users over non-guided methods. Additionally, Chen (2005) determined that “learners benefit most from the VR (guided exploration) mode, irrespective of their learning styles” (p.138).

With the rapid and continual advancement of technology, it is the recommendation of this author that designers keep in mind the possible capabilities of future simulations, having the power to impart useful and practical knowledge that was previously only attainable through real-world experience. Simulations within virtual worlds can literally transcend space and time, making educational experiences accessible to the masses in ways that were never be previously imagined. For many learners of the future, the differentiation between simulated experience and real-world experience could become moot; instructional designers and teachers will need to design accordingly.

*Virtual environment experience allows for active experimentation (AE) without major real-world consequences.*

The idea that learners can actively experiment within the virtual world without fear of drastic real-world consequences was explicitly addressed in four out of five of the studies included within the second research question (Barab 2005; Jarmon 2009; Konak 2013; Wu 2016). Learners participating in simulations within virtual environments are free to make mistakes without suffering major real-world repercussions. Within Wu (2016), the study’s participants took part in an RPG designed around the process of engineering software development. It was specifically noted that learners appreciated an environment that allowed
mistakes to occur without major incident. One student in particular, “S25” was quoted as saying “he felt he could explore the practical knowledge via RPG use” (p.1182).

Additionally, Jarmon (2009) notes this idea of experimentation without real-world consequences within their conclusion. While referring to the use of Second Life within project based learning Jarmon (2009) states that “…the SL environment that facilitated experiential learning through concrete experiences and active experimentation […] included the capacity to allow users to test hypotheses by applying them to an actual project and doing something active (Kalyuga,2007) without some of the risk and cost of the real world,” (p.179).

Furthermore, this sentiment was reinforced by Konak (2013). The researchers who conducted the study looked at the usage of virtual computer labs (VCLs) and their role in information security education. “On virtual computers, students can practice advanced skills and perform complex tasks which are not usually allowed on campus computers and networks” (p.11). In this instance, this specific subject area cannot be conducted outside of a virtual learning environment and actually requires a virtual environment to be able to participate in the concrete experience (CE) and active experimentation (AE) portions of Kolb’s learning cycle.

It is for this reason, allowing learning, experimentation, and practice to take place in a virtual environment without the same level of real-world consequences that this author recommends further research into the effects this concept has on the particular learning cycle of active experimentation (AE).

*The value of providing reflective observation (RO) through de-briefing*

Altogether, each of the final five studies selected after applying research question two, were all in agreement regarding the important role of reflective observation (RO) in experiential
learning through simulations within virtual worlds (Barab 2005; Chen 2005; Jarmon 2009; Konak 2013; Wu 2016). Kolb’s learning skill of reflective observation (RO) was achieved through means that exist outside of the virtual environments and based within activities and materials within the physical world.

Both Chen (2005) and Wu (2016) refer to additional materials that exist in the real-world that helped promote student reflection. These materials served as guidance for students and were instrumental in assisting students in their future interactions with the simulation within the virtual environment. “The results from the interviews showed that students further learned from the supplementary materials (i.e., reference books in the library)” (Wu, 2016, p.1183). Chen (2005) also makes note of “conventional material” and how its successful application “requires more of Kolb’s characteristics of reflective observation and abstract conceptualization” (p.138). By reflecting and observing materials that provide guidance to the learner within the real-world, this portion of Kolb’s learning cycle (reflective observation; RO) can help learners make sense of their experiences in the virtual world.

Moreover, the other studies Barab (2005); Jarmon (2009) and Konak (2013) all specifically acknowledge the importance of reflective observation (RO) but through using other real world means like group exercises (Konak, 2013), reflective class discussions (Barab 2005; Jarmon 2009) and use of reflective journals (Jarmon 2009). Konak (2013) also specifically recommends the use of hands on learning activities that involve “collaborative learning strategies” (p.21) in order to help promote reflective observation (RO).

All in all, these studies demonstrate that Kolb’s reflective observation (RO) is a major component in the learning cycle and that experiencing this part of the learning cycle tends to
occur outside of the virtual world. Due to this conceptual consensus, this author suggests further study of Kolb’s learning skill of reflective observation (RO) and the role it plays as an independent experience outside of the virtual world.

**Project and problem based learning support abstract conceptualization (AC) in virtual environments**

Both Jarmon (2009) and Konak (2013) speak specifically about the advantages of using simulations in virtual environments that otherwise, “due to the prohibitive cost, time, insurance factors, and the physical distance between the collaborators and general public audience” (Jarmon 2009, p.180), could not have taken place. Additionally, Konak (2013) also acknowledges that the learning/teaching of certain subjects (in this case, cyber security) that could not take place within the real world due to institutional restrictions imposed by colleges, can in fact, take place within virtual environments. This concept is further strengthened by the fact that these virtual environments are areas in which students can deal with simulations that allow learners to collaborate effectively (Konak, 2013).

Both Jarmon (2009) and Konak (2013) make note of the ability for communal collaboration that virtual environments can provide. Virtual worlds can help promote greater learner understanding in part, “because of social and technological capabilities for engagement in social interactions with people from various fields across geographical distances” (Jarmon, 2009, p.170). This peer interaction helps with the synthesis of personal experience and observation into the formulation of a cohesive theory of understanding and as a result, should be considered for future study within this framework.

As for the notion of learner collaboration and more specifically the previously mentioned benefit to virtual environments referred to as “intercultural collaborative inquiry” (Barab, 2005,
p.104), was not specifically addressed within any of the final five works. Due to this reason, this concept could serve as the focus of future research which could possibly yield valuable information on the subject.

**Virtual environments have the potential to promote high levels of student motivation**

Dealing with the issue of student motivation, four out of five of the final works selected after applying guiding research question number two addressed this notion (Barab 2005; Jarmon 2009; Konak 2013; Wu 2016). More specifically, Barab (2005) acknowledged the base level of motivational inspiration that simulations/games can have. While Jarmon (2009) recognizes that virtual environments can have the effect of “enhancing student motivation and engagement” (p.170).

Furthermore, both Konak (2013) and Wu (2016) explicitly noted higher levels of motivation among students after the implementation of virtual environments in order to facilitate learning. Most notably Konak (2013) found a strong correlation between the implementation of a virtual learning environment and increased student motivation which ultimately lead to finding a “strong positive relationship between the increased interest and perceived competency development” (p.21).

Seeing as how student motivation can play a major role in any learning area, the possibility to increase student motivation that, in turn, could lead to an increase in successful learning outcomes is reason enough for additional study.

**Discussion and Conclusions**

In this literature review, analysis demonstrated that only a handful of publications before 2016 utilized Kolb’s experiential learning theory as its foundation to research the possible effects
on learning through computer based simulations in virtual environments. It also provided information on current research trends and made suggestions for the future application of ELT foundations. The following paragraphs will attempt to summarize the work’s overall findings, conclusions and recommendations for future research.

One important finding was that the results of the literature review supported previous analyses by Kebritchi (2008), and Wu (et. al, 2012) in finding that experiential learning theory is a major influence within educational simulation/game design. Additionally, this study supports the notion that the majority of the studies examining simulations cite Kolb’s ELT as being a major theoretical influence on content development. However, in the end only 29 of the studies were cited after applying guiding question one (which research studies that examine the use of computer based simulations to facilitate learning, use experiential learning theory as a foundational theoretical approach?). These 29 studies explicitly stated that Kolb’s ELT was the foundational theoretical framework for the study described by research question one.

Furthermore, just five studies were found to have met the requirements set by guiding research question two (of the works that were selected, which studies were computer based simulations in virtual environments and demonstrated firm connections between Kolb’s ELT and the results of the study?). The reason for the small amount of studies that fit the criteria may be due to the fact that the topic itself is very specific in nature. For this reason, the amount of studies that made into the final round of coding were quite limited.

While only one of these works within the final group of remaining studies specifically examined the role of Kolb’s learning styles, all five specifically made extensive note of the effects on individual portions of Kolb’s learning cycle concrete experience (CE), reflection and observation (RO), active experimentation (AE), and abstract conceptualization (AC). As a
result, it is the recommendation of this author for future virtual environment simulation research to examine the roles of Kolb’s learning styles and go beyond merely addressing Kolb’s experiential learning cycle.

The patterns that emerged in the final round of analysis, guided by research question three (within the final group of studies identified, what patterns emerge through their application of ELT through computer based simulations within virtual environments?) demonstrated that Kolb’s ELT can be applied successfully within virtual environments. The use of Kolb’s learning cycle within virtual environments was effectively applied through (concrete) virtual experience (CE), allowed for active experimentation (AE), which in turn was reinforced through abstract conceptualization (AC) and solidified through the help of reflective observation (RO) (from real-world sources). Teachers/instructional designers that wish to incorporate virtual environments into their lessons may find they can achieve positive learning outcomes by using Kolb’s ELT and more specifically Kolb’s experiential learning cycle (ELC). With that being said, there is still much room for further research and analysis on the subject as a whole.

The limitations of this review included the very specific nature of the inquiry. These limitations were further exacerbated by the final resulting works encompassing a very limited sample size. In order to remedy this problem, a greater body of research that deals with much larger sample populations needs to be attempted. Furthermore, with certain technologies (most notably virtual reality) still being developed but not yet widely used within teaching/learning, the corpus of literature available on the subject as approached with Kolb’s ELT is limited at best. Hopefully, with the further development of advanced virtual technologies motivation to explore this area will increase.
In summation, it was this author’s intention to try to assist with current and future attempts at research that seek to implement their own use of Kolb’s ELT framework when examining simulations within virtual environments. It can be said that this theoretical foundation shows much promise in its future application within the area of virtual environments. It is this author’s wish that this small study will serve as a catalyst for the future application of Kolb’s ELT through the examination of its effects on student learning through simulations within virtual learning environments.
References

Papers with one asterisk were eliminated during the analysis conducted for RQ1, i.e., "theoretical foundations" coding.

Papers with two asterisks were eliminated during the analysis conducted for RQ2, i.e., the "theoretical linkage" coding.

Papers with three asterisks remained at the end of two rounds of coding. Their analysis/findings illustrated the strongest connections to Kolb’s theory. These are analyzed in the review conducted for RQ3 and are detailed in Appendix B.


**Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. The Internet and higher education, 8(1), 13-24.**


Appendix A

Search Topics Used to Conduct Literature Search

<table>
<thead>
<tr>
<th>Topic 1</th>
<th>Topic 2</th>
<th>Topic 3</th>
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<tbody>
<tr>
<td>learning style</td>
<td>Kolb</td>
<td>simulations</td>
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<td>gaming</td>
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<td>games</td>
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<td>virtual</td>
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<td>concrete experience</td>
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<td>reflective observation</td>
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<td>abstract conceptualization</td>
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<td>active Experimentation</td>
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## Appendix B

Characteristics of the Final Group of 5 ELT-grounded Research Studies

<table>
<thead>
<tr>
<th>Authors \ Discipline</th>
<th>Research Approach</th>
<th>Focus</th>
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<tbody>
<tr>
<td>Barab, Thomas, Dodge, Carteaux, &amp; Tuzun, (2005). ETAP</td>
<td>Project Proposal</td>
<td>Explores the creation and implementation of game based learning using immersive virtual environments in the game <em>Atlantis Quest</em>.</td>
</tr>
<tr>
<td>Chen, Toh, &amp; Ismail (2005) ETAP</td>
<td>Quantitative</td>
<td>Examines the role of Kolb’s Learning Styles in students from Malaysia using immersive 3-D environment driving simulations.</td>
</tr>
<tr>
<td>Jarmon, Traphagan, Mayrath, &amp; Trivedi, (2009) ETAP</td>
<td>Qualitative</td>
<td>Explores the role of Kolb’s ELT within the virtual environment of <em>Second Life</em>; through a course in interdisciplinarity communication.</td>
</tr>
<tr>
<td>Konak, Clark, &amp; Nasereddin, (2014) IT Security</td>
<td>Quantitative</td>
<td>Explores the role of Kolb’s ELT to develop hands-on activities for a cyber-security class using virtual computer laboratories (VCLs).</td>
</tr>
<tr>
<td>Wu, Yan, Kao, Wang, &amp; Wu (2016) ETAP</td>
<td>Mixed</td>
<td>Examines ELT through the use of a role-playing game (RPG) for an engineering software development class.</td>
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