Teaching Virtually: A Framework for Secondary Educators

Working in Virtual Reality Curriculum

by

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Abstract

This theoretical paper proposes a possible framework for using virtual reality (VR) as a way to facilitate teaching and learning for understanding. The author uses McLuhan's concept of the medium as the message, media literacy education's strategies, and Darling-Hammond's concepts of teaching for understanding in constructing her framework. The paper ends by using the framework to analyze a hypothetical interaction in the cinematic virtual reality experience "How Do We Love Thee?" which the author designed for use in secondary English classrooms.

Keywords: *virtual reality, VR, secondary education, VR framework, learning, secondary English, high school*

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“The medium is the message” Marshall McLuhan declared in 1968. McLuhan’s seminal text of the same name points out the very real difficulty with decoding messages of the then cutting edge visual (magazine), auditory (radio), and cinematographic (television and motion picture) mediums. McLuhan’s work specifies the manipulating of consumers to part from their money. His was a declaration that also served to challenge educators to teach their students how to decode the medium in order to analyze the message – a skill necessary to create critical consumers and thoughtful creators of information. In 2018, even with the creation of media literacy as a discipline, even with Renee Hobbs and the National Association of Media Literacy Educators (NAMLE) advocating for Media Literacy Education (MLE), educators, as a whole, have failed to rise to the challenge.

Fifty years after McLuhan’s warning, in an age of information and technology, educators can no longer ignore the need of media literacy education for themselves and their students. To do so would be to abdicate even more autonomy to external influences; not only that, to abdicate responsibility to teach students to be critical consumers of media would be immoral. Teachers have an obligation to prepare students for life – for the skills based and the aesthetic (Franklin, 1749[[1]](#footnote-1); Greene, 1978, 1995, 1998, 2001; Noddings, 2013); to not do so is immoral and unethical.

Immoral because ignoring the need for media literacy leaves an entire generation of students without the skills to interpret the barrage of messages modernity throws at them; unethical because, regardless the subject specialty, that subject is conveyed through the medium—absent the knowledge of how to decode the medium, true understanding of the underlying principle cannot be grasped. Thus, it is every educator’s responsibility, regardless their subject or level, to help their students become masters of decoding the media in which the knowledge is presented.

In order to teach students how to decode the messages, educators must understand the medium in which it is delivered and have strategies, either of their own or adapted of others, for teaching the medium in which the message is conveyed – this is the first step in teaching analysis of a particular form. While there are classes in college on graphic design and cinematic techniques, information on both are readily available to educators on YouTube (for example, Scott Bradley's ["Intro to Film Technique and Terminology"](https://www.youtube.com/watch?v=oFUKRTFhoiA) (2010) or Gareth David's series [*Beginner's Guide to Graphic Design*](https://www.youtube.com/watch?v=oFUKRTFhoiA) (2016)]; however, there is little on how to decode immersive virtual reality (VR). In the retrospective of his career, Bailenson (2018) provides an accessible non-academic explanation of the VR studies he has conducted or on which he has assisted, and he provides three guides for creating VR—be certain it needs to be in VR, avoid creating cybersickness, and keep the user safe (pp. 250-258)—but he does not provide a guide for teaching VR. Unlike Bailenson whose main focus in on VR application, Hobbs (2016) focuses on VR as a new medium for teachers and students to use and, because of this focus, hangs her educational construct of VR around a media literacy framework.

This framework, while adapting components of media literacy education, seeks to go a step further in understanding VR experiences by considering both MLE and VR creation to provide secondary educators a strategy for analysis of immersive virtual reality environments so that they may use this new medium as a way to foster student understanding of what Perkins calls "lifeworthy learning" (2014).

## Immersive Virtual Reality Environment Defined

The first step in analyzing VR is defining it. First, VR is an immersive experience where the user is transported to another environment, either via computer generated code (typically [Unity](https://unity3d.com/) or [Unreal Engine](https://www.unrealengine.com/en-US/blog)) or with cinematic VR captured with a 360 camera (such as the [Odyssey](https://gopro.com/news/here-is-odyssey) or [Jaunt ONE](https://www.jauntvr.com/technology/jaunt-one/)). The feeling of being-in-the-experience is called presence. The more immersive the experience, the greater a user's sense of presence. Thus, VR must create presence.

Further, in order to enter VR, the user must have a head mounted display (HMD[[2]](#footnote-2)) which completely blocks out the present world and serves to take them visually into the programmed one. Technology has developed to a point where a VR user’s visual, auditory, and haptic perception can be altered to such a degree that the user’s brain believes that she is in a different space than the one she is physically occupying; for example, she may be physically standing in a room at Tribeca Film Festival, but she is experiencing presence at a Syrian Air Raid through the program "Hero" (Corey Carbonara, 2018, Personal Interaction; Cherylnn, 2018). This provides a second and third aspect of VR: use of a HMD and creation of experience—in the case of *Hero,* the experience created empathy for those in an air raid, and in the case of medical programs such as [OSSO VR](http://ossovr.com/), the experience provides the experience of virtual practice for real surgeries which can lead to better skill transfer (Gallegher et al., 2013; Shimmer et al., 2013; Sirimanna & Gladman, 2017).

Thus, for the purposes of this framework, VR will be defined as an experience that immerses the participant in another experience through the use of a HMD.

**Types of VR**

Before exploring how VR as this paper defines it (immersive via a HMD), assists teachers in teaching for understanding, three distinct types of educational VR should be defined.

**The Old: Virtual Reality Learning Environments (VRLEs).** VRLEs are computer generated virtual environments, such as [Second Life](http://secondlife.com/) (SL[[3]](#footnote-3)), that a user enters by means of an avatar and experiences through a computer screen. Chau et al. (2013) document increased student learning through completing constructivist tasks in SL. Studies by Loureiro and Bettencourt (2011) and Morgan (2013) both use SL as both a virtual classroom and interactive learning environment; both studies report increased student engagement and learning (see also Procter, 2012; Rousseu et al., 1999)

**The New: Virtual Reality (VR).** VR, as outlined above, is a computer generated immersive virtual environment that has been used for the last 30 years in military applications—flight simulation, space exploration, medical training (Lockheed Martin, n.d.; Schmitt, Agarwal, & Prestigiacomo, 2012)—and, more recently, in commercial automobile design (Patrascu, 2018; Zotomayor, 2018).

**The Newly Accessibly: Cinematic Virtual Reality (CVR).** Like VR, CVR is completely immersive. However, unlike VR, CVR does not require a programming language to create; it simply requires a 360 camera and access to a stitching program (a service, such as Google's JUMP, that uses an algorithm to match the images in order to create a viewing sphere). Also, unlike pure VR, the image rendered is, if the HMD is of sufficient quality, as crisp as a photograph, further adding to the illusion of transportation to a parallel reality.

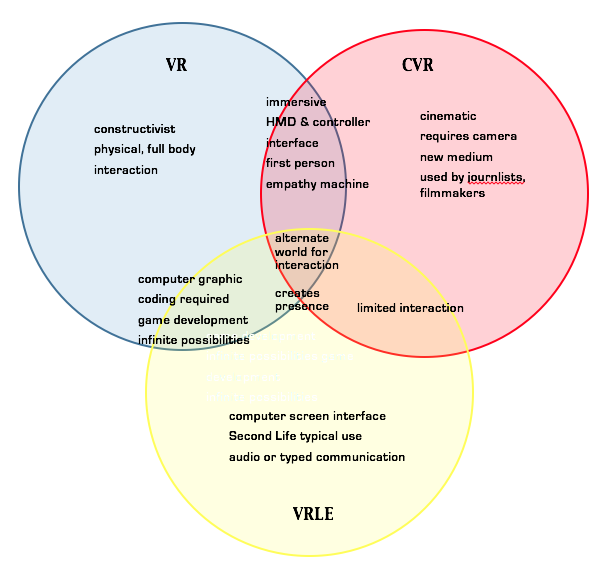
**A Venn Diagram of VR Types**

Figure 1. VR, CVR, VRLE Venn

Though virtual reality now occurs in three types (VRLEs, VR, and CVR), this paper will focus on VR and CVR exclusively and denote both through the term "virtual reality" or "VR."

**Researched VR Impact on Learning**

There are ample studies that document the impact of VRLEs on student learning and information retention (Bishop, 2001; Bustillo et al, 2015; Crosier et al., 2002; Hachaj & Barnaniewicz, 2015; Hauptman & Cohen, 2011; Huang et al., 2010; Jarmon et al., 2009; Loftin et al., 1998; Lorenzo et al., 2013; Mikropoulos & Natisis, 2011; Parkinson & Hudson, 2002; Quintana & Fernández, 2015; Roussos et al., 1999; Wojciechowski & Cellary, 2013; Zacharias, 2006), but few on the impact of VR on student learning (Bailenson, 2018), and even fewer on secondary student VR learning.

However, the reason there is so little research published on the impact of VR on students, secondary or post-secondary, is that, until recently, VR study was cost prohibitive. Bailenson (2018) notes that "until about 2014, head mounted displays and the computers required to run VR were still too expensive and difficult to use outside of research labs like mine [Stanford Virtual Human Interaction Lab]" (p. 28). Digital production and VR technology development were so rapid that Bailenson (2018) comments on its effect on hardware cost saying, "By January 2015, our lab's state-of-the-art HMD, the one that cost more than some luxury cars, had been replaced by developer models of consumer HMDs like the Oculus Rift and the Vive. These were smaller and lighter, worked just as well, and cost 1/100 of what we had been using" (p. 29). Because VR has become cost effective, other universities have joined Stanford and MIT in creating VR/AR/MR labs (i.e., San Diego State University's [VITaL](https://its.sdsu.edu/vital-the-future-of-immersive-learning-at-sdsu/) and Baylor's [Virtual Reality Lab](http://blogs.baylor.edu/medialab/vr/)). This slow proliferation of VR spaces at universities continues to grow, and, as Bailenson (2018) observes, "we understand better how to leverage its [VR's] unique affordances, we can expect to see more unusual and novel applications that open our minds and hearts—not only to other people, but to ourselves" (p. 106). As these "unique affordances" appear and "more unusual and novel applications" appear, research and its refinement will, hopefully, lead to more thorough understanding of how to harness VR for impactful learning for understanding.

**Proposed Learning/Teaching Strategies for VR**

Smith's 2015 work *Master the Media: How Teaching Media Literacy Can Save Our Plugged-In World* was in press before the VR explosion – as such, it does not address the decoding of VR media. However, Smith (2015) does provide the following helpful comment on a media literacy approach to education that can be applied to the VR framework. Smith (2015) states, "Think of it this way: media literacy is critical thinking, and critical thinking is good for us" (p. xiv). Her suggestion connects to the last of Luke and Freebody's (1999) role of the reader in interacting with the text as a critic. Of being a text critic, Luke and Freebody (1999) write, "Readers *critically* *analyze and transform texts* by acting on knowledge that texts are not ideologically natural or neutral; they represent particular points of view while silencing others. They also influence people's ideas, and their designs and discourse can be critiqued and redesigned in novel and hybrid ways [Luke & Freebody, 1999; emphasis ours]" (cited in Pearson, Civetti, & Tillson 2008, p. 73). These same observations – that the experience represents "particular points of view" and "also influence people's ideas"—are applicable to and should be utilized when using VR as a medium of instruction. Further, because of the immediacy of VR's immersive experience, the overwhelming sense of presence that VR can create, users and teachers must be hyper-vigilant in decoding VR experience.

Outside of the secondary classroom, VR is being used in entertainment—in gaming, with Sony's PlayStation VR the gateway game system (Lamkin, 2018); in movies with film festivals creating VR categories (i.e., Tribeca, Sundance, Cannes); in UX with live and recorded events (VR Music Festival); and in sporting events (i.e., [Next VR](https://nextvr.com/?gclid=Cj0KCQjwibDXBRCyARIsAFHp4fqi1_HEKZitCabhty4Rl407jZL457NIoC2EvvHDid_ewZJfgsKMQ08aAtpXEALw_wcB) and [VR NBA](http://www.nba.com/vr#/)). Beyond entertainment, VR is harnessed for pain management (Jones, Moore, & Choo, 2016), for PTSD treatment (Rizzo et al., 2015), to fight stress ([Healium](https://www.tryhealium.com/), 2018), and for a host of industrial design and training applications [i.e., Audi design (Patrascu, 2018), Lockheed Martin space engineering (Edison Tech, 2017), US Olympic ski team training (Takahashi, 2018), military medical training (Sui et al., 2016)]. Inside of the secondary classroom, it has been used in teaching physics (Wicaksono, Wasis, & Madlazim, 2017) as well as virtual field trips (Snelling, 2016). The rise of VR applications and the reality of Google Cardboard, a monetarily accessible HMD, make VR an educational inevitability. Hobbs (2016), the foremost expert in media literacy, says the following about VR in education

By combining the features of gaming and digital media to support learning, VR/AR offers us a 21st century return to Dewey's dream of learners immersed in real world actions, learning from experience and reflection on action. After all, if transformative learning experiences are what enable people to reach their full human potential, VR/AR may stimulate new appreciation for restoring immediacy and intimacy to experiential learning, in its mediated and active form. (p. 24)

What Hobbs neglects to mention in her hopeful notice about VR (2016), and what Bailenson, one of the leading experts in VR, emphasizes in his retrospective (2018), is that VR is a non-mediated medium, a medium that impacts the brain as though the created experience were real.

As a non-mediated medium, the need for a framework from which to understand it is that much more essential. The one offered here is by no means definitive and should be augmented, altered, or abated as secondary VR instruction become more commonplace. Further, any VR framework should be tailored, just as media literacy instruction should be, to the distinct age of the students and foci of the discipline.

## Virtual Reality Framework

The goal of this framework is to provide a guide for teachers to mediate VR content so that they can use this new medium as a tool to further teach for understanding (Darling-Hammond, 2008). Darling-Hammond (2008) provides six cross-disciplinary recurring themes that assist in teaching for understanding:

**Active, in-depth learning.**

**Authentic, formative assessment.**

**Opportunities for collaboration.**

**Attention to prior knowledge, experience, and development.**

**Knowledge organized around core concepts and connections.**

**Development of meta-cognitive skills.** (pp. 196-198, original emphasis).

VR experiences can address all of these themes during one experience. First, by its nature VR promotes **active, in-depth learning**. Whether VR or CVR, users are in control of what they see and hear, they have the option of focusing on whatever they wish. Further, in VR, with the help of hand held controllers or haptX gloves, users can manipulate the objects in the room and move through the space, thus engaging with the content as they interact with the experience[[4]](#footnote-4). **Authentic, formative assessment** can be had with the use of HMD built in analytics that motion capture everything the user/student is doing – body movement, eye focus, VR actions. Additionally, depending on the program used, the teacher can either watch the student's actions in the environment on a screen outside the environment or she can don a HMD and enter the world with the student and with others to provide **opportunities for collaboration**. Moreover, because of the medium, these collaborative opportunities can occur in any educational environment—at the foot of the Pyramids of Giza to discuss geometry, in space to experience Newton's Third Law of Motion, in Emily Dickinson's room to discuss her poetry, or underwater at the Great Barrier Reef to explore its ecosystem. However, to create these experiences as opportunities to foster in-depth learning, educational experts need to be aware that the possibilities exist for such learning. Once they are aware, teachers can begin applying their content and pedagogical knowledge and their classroom experience to determining whether or not this new medium, VR, is a tool to help them teach for understanding.

That a need for such application in VR exists is evident. Bailenson (2018) points to the deep learning gap noting that educational VR produces an "attitude change—"learners "will care more about the lesson topics and will more likely agree with the point of view of the lesson but," according to Bailenson, they've "only found small if any changes in the retention of facts" (p.238). Because of the lack of improved transfer of knowledge over other less immersive instructional methods, Bailenson (2018) points to the need for creating

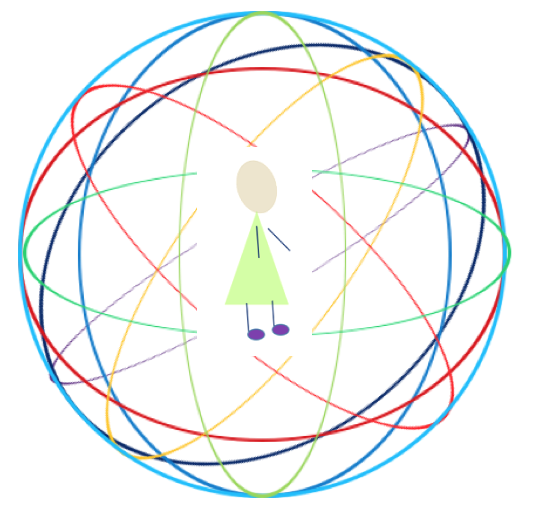
experiences that don't require narrative, or the presentation of facts, at all. If we want to fully unlock the potential of VR learning, the lesson should simply emerge from the experience as an active process of discovery. Or a VR experience should alternate between doing and telling, periods of discovery followed by narrative to encapsulate the discoveries. (p. 239)

While edutech companies and pure tech giants such as Google and Microsoft have been trying to fit VR into a truly educative experience, according to Bailenson, they have failed. I suggest that this may be because the designers and computer programmers do not have the educational experience needed to think teacherly enough to create what is needed to make VR a powerful tool for understanding. It is up to practicing teachers to do this.

As lessons are conceived of in VR, two more elements of teaching for understanding, giving **attention to prior knowledge, experience, and development,** and keeping **knowledge organized around core concepts and connections** should be considered. VR is the tool, how its used will determine its effectiveness, and, in order for practicing teachers to effectively use VR to enhance student learning, understanding of VR is necessary. This framework is one way of facilitating that understanding.

**Framework Described**

The framework is designed from the center out, with the student at the center of a sphere composed of a series of nesting spheres similar to a set of Russian nesting dolls. Each sphere is embedded with elements that contribute to the make-up of that layer. Because the framework is for virtual reality, the image should be thought of as three dimensional with the student floating in the middle of the inner sphere a bit like Michaelangelo’s drawing of a man suspended in the middle of a circle. Here, as in virtual reality, the student has the option to move about the sphere and bring the objects that impact their learning on that particular day closer to them which would increase their impact on their learning in VR. Figure 2 is a visual representation of the different layers surrounding the student.



**INNER SPACE/VR CONTENT –**

elements of the immersive experience

**INDIVIDUAL LINES –**

unique elements to consider regarding VR

**INNER POINT –**

student interface

**OUTER POINT –**

context of experience

VR: Immersive Learning Framework Visual

Figure 2. VR: Immersive Learning Visual by A. Gardner

Though imperfect, Figure 2 conveys the essence of how to understand VR learning experiences. First, the student/learner is at the center of the experience, completely immersed in whatever reality is being viewed. The spherical encasement, the experience, has two points of contact in the experience – the inner point which serves as an interface between the student and the experience, and the outer point which represents the context of the VR experience. The individually colored lines represent the different elements, listed below as layers, that constitute VR. They are also the elements that should be considered, in whole or in part, when reflecting on the immersive experience. Finally, there is the space inside the sphere, the content, the VR world, that must be addressed. Before addressing how these elements interact, seeing the detailed elements might be helpful:

**Detailed List of VR Experience Elements**

* **Center – Student** 
  + prior experiences
    - education ability
    - technological acumen
    - interests
  + socioeconomic status
  + family life
    - parental situation
    - birth order/siblings
    - economic status
    - geographical stability
  + school social status
    - group identification
      * position in group
    - courses taken
    - grade level
* **Inner Layer – Experience Interface**
  + HDM used
    - tethered v. standalone
    - computer delivery v. phone delivery
    - integrated headphones v. earbuds
  + Spatial Audio enabled?
  + Haptic feedback system?
  + Individual v. Group
* **Outer Layer – Societal Integration of VR**
  + Where used?
  + How viewed?
  + Curricular Considerations
    - course type
    - teacher introduction
    - content covered
    - pre- & post-VR activities
* **Inner Space/VR World – VR Content** 
  + Who created?
    - Educational background
  + What company created?
    - Company mission statement
    - Company subsidiaries or Company subsidiary of
  + Purpose of VR creation?
    - educational
    - entertainment
    - because it could be done
    - immersive quality
  + Technology used?
    - computer generated content
    - filmed content
  + Senses impacted & how impacted
  + Type of content
    - individual or social
    - interactive or passive

This is by no means an exhaustive list of considerations, but they are some of VR's key features. The individual considerations are designed to help students and teachers critically analyze the elements of VR in their classroom.

Each of the individual component parts – Inner Point, Outer Point, Individual Lines, and Inner Space – combine to create the whole VR experience. They are, therefore, four considerations for the VR Framework, with each one interacting with the other to create a unique and potentially powerful learning experience for students. In detailing this interaction with students, **development of meta-cognitive skills** can occur.Though each layer is separate, each impacts, to varying degrees, student learning in the VR environment, the interaction of which is perhaps best explained with a hypothetical example.

**Framework in Action: The Case of "How Do We Love Thee?"**

In order to frame this hypothetical example, one understanding that is important to have from the outset is that VR as a learning tool is only as good as the programmed content and its use in the classroom. Since there is no data on VR's impact on student connection to literature, a gap I hope to fill with my own research, this example is, for now, hypothetical. It has been chosen since I am intimately familiar with the content, having conceived of the idea, co-authored the script, and executive produced the experience (now in post-production). With that noted, it should serve as an example of how the framework will work.

**How Do We Love Thee? Described.** How Do We Love Thee is a 20-minute cinematic virtual reality experience about Elizabeth Barrett Browning aimed at secondary English students. In the experience, the user/student takes on the role of Pen Browning's girlfriend on a journey to a celebration of his late mother, Elizabeth Barrett Browning. There the student will meet his father, Robert Barrett Browning, and a handful of Elizabeth's family and friends. The experience was filmed in the Elizabeth Barrett Browning Salon at the Armstrong Browning Library (ABL) on April 15, 2018, using the GoPro's CVR camera the Odyssey, and will have accompanying spatial audio (meaning when the viewer turns her head, the sound adjusts to her position). Though the viewer is stationary, she has full control over where to look and on what to focus.

The curricular purpose of the experience is to provide students with an understanding of who Elizabeth Barrett Browning was as a whole individual and not just as the trope of a woman who defied her family to marry at 40 and traipse off to Italy after having written one of the most famous love poems in English literature, "Sonnet XVIII: How Do I Love Thee?" It is hoped that through gaining such an understanding in the immersive experience of VR, one that fosters empathy in its users (Bailenson, 2018; Dooley, 2017; Seinfeld et al., 2018), students will develop a closer connection with the poet and, through that connection, a fuller understanding of her work. Though the immersive experience does much to facilitate the empathy, student freedom to focus on their own interests – be it the set designed with Elizabeth's tastes or one particular conversation over another – should also contribute to their connection with the poet. Student agency in this experience is essential to their response to the experience and their transfer of their learning from VR to classroom discussion.

**Student Experience**, what the student brings to the interaction, is essential. In this CVR experience, there is no teacher, so the student is left to pull on her own memories to help navigate the situation – students who have been to parties or in a relationship or, ideally, both, will have an easier time framing the experiencing and understanding the narrative over those who have not. Further, a student who is familiar with VR may enter the experience more at ease than those who have not and, therefore, more able to focus on the content instead of the fact that it's VR. However, since the experience is digital, any user overwhelmed by the tool itself can return to the content and revisit the narrative, hopefully learning more about Elizabeth Barrett Browning in the process.

**Inner Layer – Experience Interface.** Because VR requires a HMD and audio input, the quality of both will impact the quality of the immersion. Google Cardboard, the most ubiquitous viewer in education, is hand-held and limited to the quality of the phone streaming the content. Further, it is non-foviated, making every image a fixed depth of field which could add to user eye strain and fatigue and possible cybersickness from any artifacts created while the user turns her head. These aspects will have a negative effect on the overall lesson and could interfere with learning. In contrast, someone using a high end HTC VIVE Pro will have foviated vision, the highest quality clarity and audio possible, as well as freedom to use her hands – all of these elements conspire to make the learning experience pleasurable.

**Outer Layer- Societal Integration of VR.** Here the impact on how the student accepts the learning is sociological. If the environment is negative or the student self-conscious about appearance in the required HMD, then learning will be negatively impacted; however, if the environment is supportive and enthusiastic about the use of VR, students should respond positively and their learning should be enhanced. This is no different from traditional learning methods.

**Inner Space/VR World.** Here content is essential and should be critically analyzed. As in media literacy education, the questions asked here serve to get at the underlying creators of the content and their purpose in its creation (Hobbs, 2011). The answers to who created it, what technology was used, and what content was chosen impact every student uniformly. For example, if the person creating How Do We Love Thee was the director of the ABL, then the entire experience might be seen as a propaganda tool to garner more visitors; this inference is the same regardless the student. The answers whose impact does vary based on student are the answers to the questions about purpose, senses impacted, and type of content. A student who likes learning about poetry might have a more favorable experience than one who is science driven; a kinesthetic student might not gain as much as a visual and auditory learner because motion within the environment is limited to head swivel; a person familiar with the Victorian Era may focus more on the objects on the set over the dialogue and miss some of the content.

More than the impact of the questions on the viewer is the impact of the content. I suggest, then, that teacher choice of generative topics (Blythe, 1998) and lifeworthy topics (Perkins, 2014) are essential if VR is to be a powerful tool in the teaching arsenal and not just a novelty.

**Just the Beginning**

It is imperative that teachers begin to instruct their students on how to decode VR because contemporary industry is making VR a staple of the future. April 3, 2018 Mozilla launched Firefox Reality, an internet browser specifically dedicated to use in VR; 5G wireless is being tested in the market and will be ubiquitous in 2019; and, finally, the Oculus Go shipped May 1, 2018 for $199 and allows unrestricted access to VR – no computer required. With all of these factors, VR is becoming indelible. How educators choose to respond will determine our students' ability to successfully understand, analyze, and navigate the information of the future. This framework is one tool that seeks to help teachers help their students do just that.

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1. "As to their STUDIES, it would be well if they could be taught *every Thing* that is useful, and *every Thing* that is ornamental: But Art is long, and their Time is short. It is therefore propos'd that they learn those Things that are likely to be most useful and *most ornamental*. Regard being had to the several Professions for which they are intended" (Frankliln, 1749). Here Franklin notes the need for both the aesthetic and the practical and the need for both. The end of learning "Things that are likely to be most useful and *most ornamental*" should lead to "*true Merit*" as he concludes here: "The Idea of what is *true Merit*, should also be often presented to Youth, explain'd and impress'd on their Minds, as consisting in an *Inclination* join'd with an *Ability* to serve Mankind, one's Country, Friends and Family; which *Ability* is (with the Blessing of God) to be acquir'd or greatly encreas'd by *true Learning*; and should indeed be the great *Aim* and (\* [**29**](https://www.archives.upenn.edu/primdocs/1749proposals.html#29)) *End* of all Learning." This "*true Merit"* can be likened to

   [↑](#footnote-ref-1)
2. HMDs vary in cost and quality. They range from the do-it-yourself fold up one to the educational market standard Google Cardboard for VR phone apps to the recently released $899 HTC VIVE PRO for untethered commercial and upscale consumer use. What all HMDs have in common is that they completely visually immerse the user in the experience; further, whether with earbuds or with integrated audio, each HMD also aurally transports the user to the experience. [↑](#footnote-ref-2)
3. [SL](http://secondlife.com/), or Second Life, is a virtual 3D platform on the internet where people can mimic all of the behaviors and interactions that occur in real space. Educationally, it is the platform used most for VRLEs as anyone can enter and use public spaces or create any desired environment for that interaction. According to Ryann Shelton, a doctoral student at Baylor and a former student who attended a discussion class in SL, the SL discussions were richer and more helpful than online discussion board (personal conversation, 2016) [↑](#footnote-ref-3)
4. VR experiences start with the user wearing a HMD with either built-in speakers or a jack for headphones. Once hooked up, the auditory and visual elements sync and the user enters the VR world – a video game, a soccer match, a movie, or a purposefully constructed environment such as a chemistry lab for experimentation or an operating room to practice bypass surgery – by way of an avatar. They see in a first person point of view and what they do in real space is done in virtual space. VR is left by unplugging. [↑](#footnote-ref-4)