REALITY VS VIRTUAL REALITY: AFFECTIVE DOMAIN LEARNING OUTCOMES IN MEDICAL ANATOMY TEACHING

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Abstract

Even after 43 years of anatomy teaching I continue to be deeply moved whenever I view a cadaver or hold a heart or brain in my hand. New teaching methodologies are increasingly using virtual world teaching, interactive models, educational games and Avatars. Through this wave of virtual reality education are important affective domain learning outcomes at risk?

During the mid to late 1900s, Bloom and his colleagues recognised that learning could be divided into three categories or domains; cognitive (knowledge), affective (attitude) and psychomotor (skills). The highest level of affective domain learning outcomes involve the “development in one’s personal and civic life a code of behaviour based on ethical principles consistent with democratic ideals”.¹ Domains of professionalism in relation to medical practice include ethical practice, reflection/self-awareness, responsibility for actions, respect for patients, teamwork and social responsibility.²

So, what is the impact of studying anatomy through dissection? In answering this question, most anatomists and students will talk about the value in learning anatomy and of understanding function. While this is true, I believe it goes far beyond this simplistic view. Studying the human body or cadaver can be an emotional experience, sharing the grief of the family following the death of the person they loved as well as a source of wonder at the beauty and perfection of the human body. We are reminded of how much we take life for granted as we go about our day to day activities. In other words, it puts life into perspective. Medical training all too often remains grounded in the biomedical model, with the cognitive domain overshadowing the psychosocial development and needs of learners.³

Some of the unique aspects of cadaveric dissection include the realistic nature of this teaching medium that allows students to grasp a clear visuo-spatial picture of the organization of human body, experience the texture of human tissues, witness and comprehend pathological conditions while learning the normal and compare the normal vs pathological.⁴ Student views range from “enhances my respect for the human body” to “makes learning of anatomy more interesting”. Our results suggest that the more thorough, enduring and contextual learning experience provided by cadaveric dissections are better appreciated in clinical workplaces where the knowledge could be applied to clinical situations.

This paper presents an overview of current views regarding affective domain learning outcomes and anatomy teaching methodologies. It highlights the likely importance of the use of human body parts and of dissection in the development of various domains of professionalism in relation to medical practice. As educators should we be more mindful of what learning outcomes might be threatened through replacing reality with virtual reality?

Keywords: Anatomy, dissection, affective domain, virtual reality, humanising, empathy, professionalism.

1 INTRODUCTION

Information technology now pervades almost every aspect of our students’ lives and when they reach university they are not only proficient in its use but are also ready to engage with it as part of their professional training. Many current senior medical practitioners studied anatomy through didactic

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lectures, chalk boards and cadaver dissection. While lectures and dissection still exist in the 21st century, our students are more familiar with an amazing range of technological advances including mobile devices with which they communicate through a variety of social media platforms and access applications that allow them to interact with 3D virtual reality [1-3].

Students are also studying by accessing an enormous number of MOOCs or Massive Open Online Courses offered by educational institutions worldwide, including human anatomy [4, 5]. Many of these courses are components of existing degree programs. Academics are also exploring the use of 3D gaming technology to engage students “not only as consumers of serious games, but as authors and creators” in their “contructionist approach to anatomy education” [6]. Students are also accessing digital badges whereby they accumulate accomplishments and skills that can be earned in various learning environments [2]. Some digital badge platforms allow organizations to create, issue, earn and display digital badges on members’ websites, social media pages, and resumes.

During the mid to late 1900s, Bloom and his colleagues recognised that learning could be divided into three categories or domains; cognitive (knowledge), affective (attitude) and psychomotor (skills). The highest level of affective domain learning outcomes involve the “development in one’s personal and civic life a code of behaviour based on ethical principles consistent with democratic ideals” [7].

Domains of professionalism in relation to medical practice include ethical practice, reflection/self-awareness, responsibility for actions, respect for patients, teamwork and social responsibility [8], however, to what extent can virtual reality effectively address affective domain learning outcomes?

This paper presents an overview of current views regarding the use of virtual reality in medical education and the role of reality versus virtual reality in the acquisition of affective domain learning outcomes by students studying anatomy.

2 ADULT LEARNING THEORY - ANDRAGOGY

In the 1970’s and 80’s Malcolm Knowles’ approach to adult learning pedagogy (andragogy) recognised the importance of six characteristics: (a) self-directedness; (b) need to know; (c) use of experience in learning; (d) readiness to learn; (e) orientation to learning; and (f) internal motivation [9].

In the 1980’s Kolb sought to show, through his nine-region learning style type grid based on active experimentation, concrete experience, reflective observation and abstract conceptualization, and his learning cycle, that human learning is both experiential and a reflective process [10]. Kolb’s model has been criticised through claims that there may be stages in the model that are not sequential and that not all learners will follow the same sequence [11].

In discussing experiential learning theory, Kolb and Kolb recognised that “learning involves the integrated functioning of the total person - thinking, feeling, perceiving, and behaving” [10]. They draw attention to the importance of learning spaces in adult learning that “extend beyond the teacher and the classroom” to include “socialization into a wider community of practice that involves membership, identity formation, transitioning from novice to expert through mentorship, and experience in the activities of the practice”.

In a recent review of the contribution made by Peter Jarvis to understanding of adult education, Patricia Gouthro highlighted Jarvis’s views on the importance of trying to better understand the “tacit, experiential process of learning that occur at both conscious and unconscious levels”, and to make sense of our policies and practices that impact upon adult learning experiences… and… how political factors within a global capitalist economy shape learners’ experiences and opportunities” [12].

3 AFFECTIVE DOMAIN LEARNING OUTCOMES

During the mid to late 1900s, Bloom and his colleagues recognised that learning could be divided into three categories or domains; cognitive (knowledge), affective (attitude) and psychomotor (skills) [7]. The highest level of affective domain learning outcomes involve the “development in one’s personal and civic life a code of behaviour based on ethical principles consistent with democratic ideals” [7].

Krathwohl et al [7] developed an affective domain taxonomy based on a hierarchical set of categories and subcategories to represent a continuum of internalisation. This taxonomy has underpinned multiple studies since it was published. The five categories and associated sub-categories (shown in Table 1) serve to highlight the development of affective domain learning outcomes. Within these categories there are varied words and descriptors for affective domain learning activities/outcomes described in the literature.
Table 1. Affective domain taxonomy; categories and associated sub-categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Receiving (attending)</td>
<td>Awareness; Willingness to receive; Controlled or selected attention</td>
</tr>
<tr>
<td>2. Responding</td>
<td>Acquiescence in responding; Willingness to respond; Satisfaction in response</td>
</tr>
<tr>
<td>3. Valuing</td>
<td>Acceptance of a value; Preference for a value; Commitment</td>
</tr>
<tr>
<td>4. Organization</td>
<td>Conceptualization of a value; Organization of a value system</td>
</tr>
<tr>
<td>5. Characterization by a value or value complex</td>
<td>Generalized set Characterization</td>
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In 1981, a refinement of this learning taxonomy acknowledged the need to distinguish between different types of learning: (a) cognitive learning (knowledge); (b) skill learning; and (c) affective learning (feelings and attitudes) [13] cited by Carter [14]. “This taxonomy distinguishes, as Bloom’s does not, the fundamental difference between knowing how to do something and being able to do it” [14].

Reflective learning in medicine and the process of professional identity formation is more than reflection for improving practice (and skills), it facilitates a way of “being” and hence “becoming” a physician [15]. Wald modified the AMEE definition of reflection [16] to include affective components. Reflection is a metacognitive process including connecting with feelings that occurs before, during, and after situations with the purpose of developing greater awareness and understanding of self, other, and situation, so that future encounters with the situation including ways of being, relating, and doing are informed from previous encounters.

Various reviews and research projects have discussed a wide range of learning outcomes that are achievable through the use of virtual reality either alone or as an adjunct to other learning and teaching modalities including 2D technologies and face to face experiential activities. Krathwohl et al [7] recognised that hesitancy associated with grading affective domain measures is related to inadequacy of appraisal methods and possible biases from students’ manipulation of comments. However, what affective domain learning outcomes, that are important to the health professions, including medicine, do educators struggle to implement and/or assess using Virtual Reality software?

Work by Carter [14] may help clarify this question. His analysis of personal qualities that impact on knowledge and skills might provide some guidance:

a) Mental characteristics: openness; agility; imagination; creativity
b) Attitudes and values: things; self; people; groups; ideas
c) Personality characteristics: integrity; initiative; industry; emotional resilience
d) Spiritual qualities: appreciation; response.

The wide interpretation and use of words to reflect the affective domain is demonstrated in the following selection of published works: attitudes [7, 17]; appreciations [7, 17]; behaviours [10, 18]; emotional evolvement [7, 18-20]; enjoyment [20]; ethics [21, 22]; feelings [20]; human reaction, response [7]; internalisation [7]; interest [17]; moral judgements [22]; motivation [20, 23, 24]; perceiving [10]; perceptions (moods) [20]; presence [24]; reflection [6, 15, 25]; respect [23]; responsibility [22, 25]; self-awareness [25]; self-confidence [20]; socialisation [10, 19, 25, 26]; teamwork (collaboration) [25-28]; thinking [10]; and values [7, 18, 20, 22].

4 ADULT LEARNING, DIGITAL TECHNOLOGIES AND THE HEALTH PROFESSION

During the early phases of the development of digital technologies it was recognised that, while there were many ideas concerning how immersive virtual reality (VR) could facilitate learning, there were significant challenges in understanding how to use this technology to support the learning of abstract concepts [29]. The exponential development of digital technologies, during the third millennium, including social media, have had enormous impacts on learning and teaching in a wide range of disciplines, including the health profession.
In a 2007 review, Boulou et al discussed three-dimensional (3-D) virtual worlds and their educational potential to medical/health librarians and educators with particular emphasis on Second Life (http://secondlife.com) as perhaps the most popular virtual world platform in use at the time, with an emphasis on social interaction [30]. By 2011, Second Life had become the most popular 3-D multiuser virtual environment in use in education [31].

A ten-year critical review of empirical research on the educational applications of Virtual Reality (VR) revealed that learning goals are being incorporated into Educational Virtual Environments (EVEs) in science, mathematics, and social science disciplines and that while visual representations predominate, there are some projects including intuitive interactivity [26]. A few studies reported positive results on users’ attitudes and learning outcomes. Mikropoulos et al also found that EVEs demonstrated collaboration and social negotiation amongst participants as well as between participants and avatars [26]. Dalgarno and Lee noted potential learning benefits of 3-D virtual learning environments including “the facilitation of tasks that lead to enhanced spatial knowledge representation, greater opportunities for experiential learning, increased motivation/engagement, improved contextualisation of learning and richer/more effective collaborative learning as compared to tasks made possible by 2-D alternatives” [23].

Virtual Reality can help develop learning outcomes including presence, motivation, cognitive skills, and reflective thinking [24]. Reality augmented by a virtual element in a learning space has the potential to provide “exciting opportunities for designing innovative learning environments that hopefully make learning more interactive, effective, relevant and powerful especially for younger learners” [32]. Learning through 3D games development technology supports retention of content as well as improved computing skills and reflective learning in addition to enhanced software development skills [6]. Virtual reality is an increasingly important component of simulation-based education helping students prepare for clinical placements [5, 33, 34]. The addition of 3D learning tools can also positively influence long-term retention of gross anatomy material and has been advocated as a beneficial supplement for anatomy courses [35]. Early exposure to a variety of digital technologies, including virtual reality during medical student training “would help to prepare them for technology supported patient care in the future” [4].

Procedure-based skills, communication, leadership, and team working can be learnt, be measured, and have the potential to be used as a mode of certification to become an independent practitioner. A review of current techniques reveals that simulation can successfully promote the competencies of medical expert, communicator and collaborator [27]. Maja Djukic and Marc Triola have designed a virtual IPE curriculum in which students were paired with a virtual team member to improve collaboration and the delivery of care. Their virtual IPE is an effective and efficient learning tool, and may be of particular benefit to medical and nursing schools that do not have a partner school [28].

5 AFFECTIVE DOMAIN LEARNING OUTCOMES AND ANATOMY TEACHING

Responses to affective activities (involving emotions, feelings, values, interest, appreciation) such as self-confidence, belief that an activity is an academically valuable learning method and enjoyment, lead to higher motivation, deeper approaches to learning and effectiveness in achieving learning outcomes [20, 36]. Learning research reveals that long-term learning involves cognitive, emotional, affective, and social perspectives, each of which interrelate to varying extents. Medical training all too often remains grounded in the biomedical model, with the cognitive domain overshadowing the psychosocial development and needs of learners [37]. Hilton and Slotnick introduced the term “proto-professionalism” to represent the period of medical education and training during which professionalism is acquired [25]. Domains of professionalism in relation to the health professions and medical practice in particular, include: ethical practice; reflection/self-awareness; responsibility for actions; respect for patients; teamwork; and social responsibility. The inclusion of the exposure to cadavers contributes to affective learning in the context of professional identity, where reflection on experience facilitates “being” and “becoming” a physician (in terms of values, beliefs, attitudes etc.).

Western trends render death “invisible”, hidden within specialised institutions such as hospitals, nursing homes and palliative care centres [38] and it is likely that many of our students have had little first-hand experience with death upon entering Medical School. The literature shows that whilst medical students cognitively acknowledge that death is a normal part of living, most do not like the idea of death [39], and students feel that classroom activities are not enough to prepare for real world experience [40]. Medical schools should develop emotionally supportive settings in which to explore death [41]. Given that medical students often consider their cadaver their first patient [38] exposure to
cadavers may contribute to death acceptance, particularly when coupled with the space to attend to affective responses through writing [42] as well as increased self-awareness and professionalism.

In 1997, Hoffman and Vu acknowledged that simulation involving virtual reality, in combination with opportunities to work with real patients, “could increase the depth and breadth of learners’ exposure to medical problems, ensure uniformity of training experiences, and enhance the acquisition of clinical skills” [43]. Students study anatomy through lectures, Problem-Based-Learning [44, 45], models, imaging, dissected cadavers, dissection, multimedia, blended learning, flipped classrooms, virtual reality, avatars, etc. In one way or another all the affective descriptors listed previously feature in anatomy sessions involving human cadavers. Emotion, feelings, respect, reflection are high on the list of experiences expressed by students when they study cadaveric anatomy, however, there is pressure on medical schools to replace cadaveric material with virtual reality software. This push is so strong that there are even apps to replace cadaveric material; for example Mark Zuckerberg is supporting the development of a Virtual Reality App That Could Do Away With Medical Cadavers [46] http://www.huffingtonpost.com.au/2016/10/20/the-virtual-reality-app-that-could-do-away-with-medical-cadavers/.

So, what do we risk losing if students lose the opportunity to study anatomy using cadaveric material? In answering this question, most anatomists and students will talk about the value in learning anatomy and of understanding function. However, increasingly clinical educators are embracing humanism within medical curricula, exemplified by this quote from an article by Anthony Suchman: “Finding a community of kindred spirits, these students were grateful to learn that they were not alone in this struggle and that the personal self is a crucial resource in caring for others, not something to be excluded from their professional lives. They appreciated the opportunity to reflect on personal experiences and to explore the importance of relationships and the meaning of professionalism” [47]. Further, a review by Cohen and Sharif in 2014 concluded that Humanistic values can be incorporated in formal preclinical environments, the transition into clinical settings, medical curricula and clinical clerkships. Additionally, steps can be taken so that medical educators and institutions promote and sustain humanistic values”[48].

I believe humanistic values can be incorporated into anatomy teaching. As an example, I would like to share the following personal experience, which remains unchanged despite more than 40 years of experience in the use of cadaveric material in teaching medical and allied health students. This quote came from an address I made to the 2010 Thanksgiving Service at Griffith University in memory of people who had donated their bodies to the School of Anatomy for teaching Health Science students.

What does it mean to me to hold a person’s heart in my hand? This is a very emotional experience for me on one hand and a source of wonder at the beauty and perfection of the human body on the other. I think about the person who made the decision to donate their body. I share the grief of the family following the death of the person they loved and I contemplate how the decision to donate the body would have affected them. I also think about what went through the mind of the deceased when they made the decision to donate their body. When I consider the function of the heart I think about the way the heart kept that person alive and how much we take life for granted as we go about our day to day activities. In other words, it puts life into perspective. Dissection of a human body permanently changes one’s outlook on life. There is a renewed respect for one’s own life and that of others. There is a renewed wonder at the perfection and vulnerability of the human body [49].

An article written by Michelle Moscova on “Why virtual reality won’t replace cadavers in medical school”, reflects my own views: “It’s also an extraordinary and often profound experience when students hold a human brain in their hands for the first time. These experiences in cadaver labs help students develop respect for patients. Cadavers are often their first experience with death. Cadavers are, in a way, their first patient. ……..They learn respect for the human body and the patient, they learn compassion and they learn humanity. This is something that computers can’t teach” [50].

6 RESEARCH AT GRIFFITH UNIVERSITY

Research on anatomy teaching in the School of Medicine confirms the high level of enjoyment and positive attitudes that students hold towards anatomy practicals. Students view the anatomy resources as useful for their learning. Cadaveric material is considered the most useful of the resources with all students rating cadavers as 4 or 5 on a Likert scale of 1-5 [51]. Students welcome the use of cadaveric material supported by multiple resources, enthusiastic, knowledgeable staff, regular tests and a good learning environment.
Some of the unique aspects of cadaveric dissection include the realistic nature of this teaching medium that allows students to grasp a clear visuo-spatial picture of the organisation of human body, experience the texture of human tissues, witness and comprehend pathological conditions while learning the normal and compare the normal vs pathological. The former can also include anatomical variations that are not always effectively delivered through other means [52].

Previous studies have shown that significant emotional stress in the form of anxiety may be associated with cadaveric dissection. Penny’s work indicated that students’ experience of dissection “had a profound effect upon their thinking about life and death … and that they needed to discuss their feelings” [53]. Interestingly, only a minority of students in our study perceived anatomical dissection as stressful. Student comments reinforce several affective domain measures: Enhances my respect for the human body; Deepens my understanding of anatomy; Makes learning of anatomy more interesting.

Exposure to death begins early in medical studies, when they are exposed to human cadavers. Treadway recalls how she and her colleagues as young medical students “…learned to bury our fears in an avalanche of knowledge…..learnt the trick of silencing the parts of [their] brain that didn’t really want to be close to death” [54]. This contrasts with the Thai approach, in which cadavers are viewed with enormous respect and as “great teachers and treated accordingly” [55].

Anecdotal evidence from medical student comments in the MD program at Griffith University suggest that some students recognise the affective domain learning outcomes associated with studying anatomy, however, School staff have not specifically investigated these learning outcomes. Many authors have discussed the affective domain impacts on students studying anatomy and in particular during dissection [56, 57] and as Coulehan et al noted there is a need to examine more closely these impacts following their work on analysing student views. These authors proposed that, “if medical students were given a greater opportunity to explore and discuss the emotions raised by dissection, their ability to maintain empathy for their patients may be enhanced. They found that “The act of writing about their own reactions to the experience of dissecting a cadaver allows students the opportunity to analyze their experience of personal change and to explore the wider professional issues that dissection of a human body entails” [58].

Many medical schools incorporate writing into their anatomy program to tap into the humanistic elements and attend to affective responses; this maybe a journal reflection, a letter to the cadaver or family, or creative writing/work such as poetry or artwork ([59-61]. A member of the academic staff at Griffith recently commented that the “combination of using real cadavers and writing to the experience epitomises bringing humanities into the medical curriculum. Perhaps this may counter the erosion of empathy that many students experience as they progress through their medical training [62]. I also believe that in attending to the affective domain, and paying attention to their values, attitudes, beliefs in the context of the medical profession, students may be in greater stead for job satisfaction and decreased burnout” [42].

Innovative measures are being introduced within the body donation programs by medical schools across the world to sensitize medical students such that they maintain a respectful, compassionate and empathetic attitude towards the human cadaver while dissecting the same [63]. There is also an important mentoring role for anatomy instructors to “integrate humanistic values into traditional course objectives in a way that adds little time to the curriculum” [64].

In order to better understand the affective domain outcomes associated with anatomy teaching, and in particular, cadaver dissection, the School intends to investigate student views and attitudes in relation to death and dying; patient care and empathy in the current curriculum. Specific questions will cover:

a) Changes in affective domain qualities in relation to anatomy practical classes across the first two years of the graduate entry medical program

b) Impact of dissection on these qualities and

c) Value of current approaches for preparing students for exposure to human cadavers.

7 CONCLUSION

Effective adult learning pedagogy (andragogy) is characterized by (a) self-directedness, (b) need to know, (c) use of experience in learning, (d) readiness to learn, (e) orientation to learning, (f) internal motivation and (g) socialization. Learning involves (a) cognitive learning (knowledge); (b) skill learning; and (c) affective learning (feelings and attitudes). Domains of professionalism in relation to medical
practice include ethical practice, reflection/self-awareness, responsibility for actions, respect for patients, teamwork and social responsibility, however, to what extent can virtual reality effectively address affective domain learning outcomes? Reflective learning in medicine and the process of professional identify formation is more than reflection for improving practice (and skills), it facilitates a way of being and hence becoming a physician. Reflection is a metacognitive process including connecting with feelings that occurs before, during, and after situations with the purpose of developing greater awareness and understanding of self, other, and situation, so that future encounters with the situation including ways of being, relating, and doing are informed from previous encounters.

The exponential development of digital technologies, during the third millennium, including social media, have had enormous impacts on learning and teaching in a wide range of disciplines, including the health profession. Virtual Reality can help develop learning outcomes including presence, motivation, cognitive skills, and reflective thinking. Reality augmented by a virtual element in a learning space has the potential to provide opportunities for innovative learning environments that potentially can make learning more interactive, effective, relevant and powerful. Simulation involving virtual reality, in combination with opportunities to work with real patients, has the capacity to increase the depth and breadth of learners’ exposure to medical problems, ensure uniformity of training experiences, and enhance the acquisition of clinical skills. Responses to affective activities (involving emotions, feelings, values, interest, appreciation) such as self-confidence, belief that an activity is an academically valuable learning method and enjoyment, lead to higher motivation, deeper approaches to learning and effectiveness in achieving learning outcomes. Medical training all too often remains grounded in the biomedical model, with the cognitive domain overshadowing the psychosocial development and needs of learner.

Students study anatomy through lectures, Problem-Based-Learning, models, imaging, prosected cadavers, dissection, multimedia, blended learning, flipped classrooms, virtual reality, avatars, etc. In one way or another a wide range of affective domain outcomes feature in anatomy sessions involving human cadavers. Emotion, feelings, respect, reflection are high on the list of experiences expressed by students when they study cadaveric anatomy, however, there is pressure on medical schools to replace cadaveric material with virtual reality software.

Increasingly, clinical educators are embracing humanism within medical curricula; students appreciate the opportunity to reflect on personal experiences and to explore the importance of relationships and the meaning of professionalism. Humanistic values can be incorporated into formal preclinical environments, the transition into clinical settings, medical curricula and clinical clerkships. Additionally, steps can be taken so that medical educators and institutions promote and sustain humanistic values.

Anecdotal evidence from medical student comments in the MD program at Griffith University suggest that some students recognise the affective domain learning outcomes associated with studying anatomy, however School staff have not specifically investigated these learning outcomes. Many authors have discussed the affective domain impacts on students studying anatomy and in particular during dissection. Further, if medical students were given a greater opportunity to explore and discuss the emotions raised by dissection, their ability to maintain empathy for their patients may be enhanced. A member of the academic staff at Griffith recently commented that the “The combination of using real cadavers and writing to the experience epitomises bringing humanities into the medical curriculum. Perhaps this may counter the erosion of empathy that many students experience as they progress through their medical training. I also believe that in attending to the affective domain, and paying attention to their values, attitudes, beliefs in the context of the medical profession, students may be in greater stead for job satisfaction and decreased burnout”.

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c) Value of current approaches for preparing students for exposure to human cadavers.
REFERENCES


[42] L. Humphreys, "Reflective writing and affective domain outcomes," Griffith University, School of Medicine, 2017.


