Article

Sociomateriality: A Theoretical Framework for Studying Distributed Medical Education

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Abstract

Distributed medical education (DME) is a type of distance learning in which students participate in medical education from diverse geographic locations using Web conferencing, videoconferencing, e-learning, and similar tools. DME is becoming increasingly widespread in North America and around the world.

While relatively new to medical education, distance learning has a long history in the broader field of education and a related body of literature that speaks to the importance of engaging in rigorous and theoretically informed studies of distance learning. The existing DME literature is helpful, but has been largely descriptive and lacks a sociomaterial "lens," that is, a theoretical perspective from which to rigorously conceptualize and interrogate DME's social (relationships, people) and material (technologies, tools) aspects.

The authors describe DME and theories about distance learning and show that such theories focus on social, pedagogical, and cognitive considerations without adequately taking into account material factors. They address this gap by proposing *sociomateriality* as a theoretical framework allowing researchers and educators to study DME and (1) understand and reconsider previously obscured actors, infrastructure, and other factors that, on the surface, seem unrelated and even unimportant; (2) see clearly how the social and material components of learning are intertwined in fluid, messy, and often uncertain ways; and (3) perhaps think differently, even in ways that disrupt traditional approaches, as they explore DME. The authors conclude that DME brings with it substantial investments of social and material resources, and therefore needs careful study, using approaches that embrace its complexity.

The distributed delivery of undergraduate medical education is increasingly widespread[1] and requires the adoption and integration of a variety of technologies designed to facilitate learning across geographic boundaries. These technologies include, but are not limited to, state of-the-art videoconferencing systems, the largely paperless delivery of curriculum, and the use of electronic teaching cases, assessment tools, and curriculum management tools.

The distribution, and related digitization, of medical education represents a shift in traditional education epistemologies. As Lankshear et al [2] wrote,

> the very *status* of knowledge, learning, teaching and researching are currently in a state of profound upheaval under the double impact of rapid and far-reaching technological change and the massive assault on longstanding narratives of foundation and legitimation.

Within the broader discipline of education, an established history of distance learning as a field of inquiry exists.[3-5] Within medical education, distributed medical education (DME) is growing, both as an approach to medical education and also as a field of inquiry. While current DME literature is helpful, it has been largely descriptive, centering on logistics,[6] outcomes,[4] and issues of comparability.[7] Missing from this body of literature is a theoretical perspective from which to rigorously conceptualize and interrogate the practices of DME.

We offer herein a description of DME and connect it to theories of distance learning from the broader field of education. We draw attention to the fact that theories of distance learning have focused on social, pedagogical, and cognitive considerations, without adequately taking into account material factors, such as technologies and tools. We address this gap by adopting the concept of sociomateriality [new ref. 8?] as a theoretical frame from which to approach the study of distance learning. Sociomaterial studies of education in general are helpful; however, in this

article, we [OK?] focus on distance learning, specifically DME, and thereby build on the growing body of literature calling for sociomaterial explorations of medical education, [8-10]

Distance Learning and DME

Distance learning has been well described in the education literature. It can be [OK?] defined in different ways, depending upon its context; however, there are four commonly agreed-upon defining components associated with distance learning in all iterations:

- It is institutionally based.
- There is a separation of teacher and student. Most often, this separation is geographic, but it can also include separation in time.
- Interactive telecommunications are used, either synchronously (i.e., "live") or asynchronously (in recorded form).
- Sharing of resources—data, voice, and video—occurs.[11]

DME is a type of distance learning. While there are many ideas about how to define DME, for the purposes of this article we have adopted the Association of Faculties of Medicine of Canada's definition of "a decentralized model of health education utilizing a teaching and learning network that is integrated in and accountable to communities."[12] This definition allows us to consider the multiple components of DME, including a network of settings where students can "learn in context; where generalism is valued; and where learning experiences are situated and shaped by community engagement and input."[12] Certainly, a primary aim of DME is to break down geographic barriers; hence, DME is often discussed in terms of decentralization, community-based, and rural settings, frequently utilizing communications technology to create a network of diverse rural and urban learning environments.[13]

The nature of DME worldwide ranges from community-based learning experiences and e-learning modules to distributed simulation and immersive synchronous videoconferencing.[14] The rapid maturing of collaborative technologies, including videoconferencing, Web conferencing, and content-sharing systems, has allowed distance learners to remain electronically connected to their host site despite their geographical separation. A number of benefits have been realized using this form of distance education in medical education: overcoming scheduling problems, providing the best educational programs from different locations, and overcoming geographic isolation while avoiding the cost and technical problems that would normally be disadvantages.[14]

DME relies heavily on the adoption and integration of material resources in the form of technologies. Associated with these material resources is an investment of social resources. Perhaps most evident, the people using these technologies require education and support; other social considerations include the development of viable organizational strategies, appropriate teaching modalities that recognize new learning styles, suitable assessment metrics, and new definitions of meaningful social/professional interaction.[15,16] DME therefore constitutes a challenge to traditional educational epistemologies, requiring members of institutions of medical education to rethink taken-for-granted ideas and approaches.

Why Theory? And Why a Sociomaterial One?

Why do we need a theoretical approach to understanding DME? Theoretical frameworks help us move beyond merely describing a phenomenon to understanding, critiquing, and improving it.[17,18] Theories offer a new lens that allows us see and explain taken-for-granted aspects of a phenomenon that we perhaps did not even notice. Holmberg [19] described theories of distance

learning as "touchstones" that allow distance educators to make significant educational decisions with confidence.

While distance learning, in the form of DME, is relatively new to medical education, it is not a new phenomenon in the broader field of higher education. The University of Wisconsin, for example, offered "correspondence programs" in the field of history dating back to the late 1800s.[11] Radio was used as an educational delivery mode in the 1920s, and educational television was delivered in partnership with universities starting in the early 1930s.[11]

Despite a long history of distance education, some have suggested that the field has been somewhat limited in terms of theoretical explanations.[20,21] Keegan [22] noted that a lack of theory has weakened the field of distance education, leading to what he described as a lack of identity and a sense of belonging on the periphery. Some helpful theoretical approaches have emerged for conceptualizing distance learning. See, for example, Wedemeyer's *Learning at the Backdoor*, 1981[23]; Moore's "The Theory of Transactional Distance," 2007[24]; Peter's *The Industrialization of Teaching and Learning*, 1994[25]; articles by Holmberg in 1985[19] and 1995[20]; and the community of inquiry model developed by Garrison et al. [26]

These theoretical approaches have tended to focus on the social, pedagogical, and/or cognitive aspects of distance learning.[26] Missing from these theoretical approaches is a lens through which to consider the material realities, and in particular the technological aspects, of distance learning. We propose such a lens in the following section.

What Do We Mean By *Sociomateriality*?

Given the growing numbers of DME programs and their reliance on both technology and people, it is essential that our considerations of DME evolve to take into account the social *and* material factors influencing medical education. Yet we in medical education have paid only minimal attention to materiality—objects, technologies, economies, and nature, for example.[10] Medical education has been largely "human-centric," failing to acknowledge the relations among social and material forces.[10]

Social scientists, particularly those from the disciplines of science and technology studies, have encouraged us to think critically about theoretical positions that assume human-centric positions. Those theorists purport that while important, social, cultural, and personal considerations need not be the *defining* preoccupations of education studies. Rather, human processes—such as consciousness, intention, meaning, intersubjectivity, and social relations—are understood to be complexly interwoven with material factors.[27] The term *sociomaterial* is used to represent perspectives that are consistent with this shift, and *sociomateriality* indicates the theoretical framework that encompasses these perspectives.

Within the social sciences during the last three decades there has been a significant turn toward the study of how material things—for example, objects, animals, machines, humans, organizations—might be arranged, manipulated, or enacted to allow particular tasks, activities, or practices to be accomplished. Studies such as these have explored a variety of areas ranging from ethnographies of large scientific laboratories[28] to studies of public texts such as road signs and brand logos.[29] These investigations pay attention to the ways by which material things can convey meaning. Examples include the social and cultural conventions surrounding the wearing of particular kinds of clothes (such as the differences between the wearing of a sari as opposed to wearing more Western styles of dress in India), or the ways in which people choose particular

kinds of ornaments (such as religious artifacts) to decorate their homes.[30] Some studies also pay attention to the ways by which meaning can be transmitted or circulated by material things. Examples range from simple texts, such as those on road signs, to more complex bodies of documentation, such as those in university curricula.[31]

Science and technology were among the first fields studied using this focus on the material foundation of reality, knowledge, and social life. A major theme running through this literature is that making and distributing knowledge requires the collaboration and interaction of many different material entities—for example, humans and other natural objects, instruments and technologies, texts and images. This approach to knowledge blurs the usual distinction between the natural world and the social world; it is simultaneously both natural and social.[32]

Similar points can be made about medical education. Material elements are foundational to every aspect of social life, including education, but when we think about social issues we tend to focus exclusively upon relations among human beings. Inherent technological issues (e.g., Internet infrastructure) or natural issues (e.g., weather phenomena) are taken for granted, and we often stop thinking about their agency—the effects they have in the world and on us—unless, of course, they stop working![30] Sociomaterial life can be thought of as a "mangle of practice,"[34] a back-and-forth of resistance and accommodation among non-human and human entities, where both the human and non-human aspects of material agency are "temporally emergent" and the twists and turns that the interactions will take cannot be known in advance.[34] Sociomaterial theories of science and technology encourage us to unravel the mangle, to notice the twists and turns, to open up the black boxes, to think about the effects that taken-for-granted technologies and natural objects have upon social life—how we are inextricably bound up with them, and they with us, to produce our world.

How Will Sociomaterial Considerations Increase Our Understanding Of DME?

Perhaps nowhere in medical education are sociomaterial considerations more pronounced than in the context of the highly digitized learning spaces in which DME occurs. Both social and technological factors are critical contributors to the educational processes of DME. It is our position that sociomaterial explorations of distance learning will advance our understanding of DME.

The majority of existing theoretical frameworks exploring distance learning focus on variations of social, pedagogical, and cognitive factors.[26] While these factors are relevant, they do not, in fact, exist as disconnected entities in an educational vacuum. Rather, social, pedagogical, and cognitive factors are produced through and reinscribed by material factors. Ignoring the material realities that mediate distance learning decontextualizes and simplifies its complexities, leading to, at best, partial understandings.

To illustrate this point, we provide below descriptions of social, pedagogical, and cognitive components that are discussed in current theories of distance learning. We address these considerations within a context of DME, making clear that material considerations, although neglected in current discussions, are in fact deeply entangled with the processes of DME. These examples are based in our experiences working within a DME program at Dalhousie University Faculty of Medicine and on the emerging data from a current research project.

Social presence

Garrison [35] defined *social presence* in distance learning as

> the ability of participants to identify with the community (e.g., course of study),communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities.

This ability to communicate with others and project personalities in a DME setting, whether delivered via videoconferencing, teleconferencing, or Web conferencing, and whether in small-group, individual, or large-group settings, is reliant upon the material realm in the form of technologies.

Using the example of a videoconferenced large-group lecture, custom-built classrooms are carefully conceptualized and planned for optimal distance delivery and to establish a social presence. Individual seats equipped with cameras and microphones are intended to create a visual and audio connection between distant participants. The lecturer can see and interact with the students at the distant site only through the material realm: cameras, microphones, fiberoptic cables, and screens. Practical issues, like the angle of the camera, influence the lecturers' ability to read, and therefore respond to, the expressions and the body language of students at the other site.

Likewise, students at different geographical locations are reliant upon the material realm to develop a social presence amongst each other. In the example of a small-group, Web-conferenced interaction (for example, using Skype), the projection of a personality is reliant upon a functional computer, connected to a reliable power source, with current, compatible software, networked into high-speed Internet. It is difficult to get to know your colleagues when any of these elements go wrong and you experience your colleagues as pixelated, disjointed images whose voices don't match the movement of their mouths.

Pedagogical presence

Anderson and colleagues [36] described teaching, or *pedagogical presence*, in distance learning as the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes. Realizing personally and educationally worthwhile learning outcomes can be challenging in the context of a distance program.

For example, the didactic delivery of medical education courses, unlike that of many other university courses, depends upon a suite of rotating subject matter experts. This means that most lecturers spend only a few hours per year in the actual classroom setting [OK?] devoted to a particular course and never become particularly comfortable with the technologies of the classroom. These include elements of technologies that facilitate the management of questions and conversations, such as a keyboard, a touchscreen control panel, and a button that the lecturer must press to respond to a question from a student. The host of technologies and their elements could be intimidating to a lecturer who is not a regular user. As such, technology, as a material condition, influences the ways in which lecturers are willing and/or able to engage with learners, and one could imagine the lecturer feeling preoccupied with how to use the technology as opposed to being focused on how to engage learners.

Physical space is another material condition that has a significant influence on pedagogical presence in DME. For example, in a traditional face-to-face lecture, a teacher stands in front of a class of students who are largely engaged in taking notes. The teacher may have written on a blackboard, walked back and forth frequently in front of the room, and approached and interacted with students during the lecture. However, when an educator leads a live session that is also distributed via videoconference, the educator's attention and visual field are now subdivided. In addition to the content of the lecture, the educator must pay attention to the

embodied students sharing his or her physical space, the disembodied remote students on a screen, and the technology required to display teaching materials. The educator also has to pay attention to movement and must consider the range of the camera. Certainly, these requirements influence the educator's ability to draw upon embodied teaching practices, like moving closer to a student to regain that person's attention.

In another example, consider a seminar delivered via Web conferencing. The ways in which an educator can actually deliver material are influenced by material considerations. The educator is required, for example, to sit in front of a Web camera and wear a microphone and headset. In some instances, a session might be recorded and offered as an asynchronous Webcast; this again influences the ways in which educators could use real-time strategies, like asking questions to check learner's understanding.

Pedagogical presence in DME requires more than an engaging teacher and motivated learners. DME is delivered through a complex network of technological infrastructure, audiovisual (AV) tools, and people with related expertise. Much of our attention in education has focused on the teacher–student dyad relationship, or the teacher-student-environment relationship. The material considerations of a DME program, however, depend upon the work of AV professionals. These AV professionals are highly skilled, yet perhaps undervalued. They are most often behind the scenes engaged in work, such as monitoring lectures and classroom spaces, that might be described as monotonous yet essential. It is easy to forget that they are so intricately involved in the process; however, when there is a glitch, our reliance upon their expertise, and the centrality of that expertise to the educational process, becomes exceedingly clear.

Cognitive presence

Garrison and colleagues [37] refer to *cognitive presence* as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse."[37] There is agreement in the education literature that being able to ask questions and explore ideas is an important learning strategy.[38] This is true across methods of delivery, both face-to-face and distance education.

In distance education, material conditions mediate the ability of learners to ask questions and engage in the type of sustained reflection and discourse described by Garrison et al.[37] For example, if someone has a question in a videoconferenced lecture setting, there is a sequence of material factors to consider. To be heard across sites, microphones must be activated. To gain the attention of the lecturer, a button must be pushed indicating that there is a question—and the lecturer has to notice that someone has pushed the button. Questions are placed in a queue based upon the order in which the button was pushed; therefore, the lecturer responds to questions based upon the order in which they were asked rather than based upon relevance to the conversation. This technologically-mediated ordering of questions influences the flow of communications and the ability to engage in authentic discussion or debate.

Those who share the educator's physical space and time have the benefit of making informal, extracurricular connections with her or him, whether that be taking the opportunity to ask for further clarification, or even building a relationship. Some lecturers engage the local participants at the expense of participants at the distant site(s), yet other lecturers engage in an immersive technologic environment, engaging all parties. Regardless of the context, the material realities of time and space mean that these opportunities for reflection and discourse are not as available to those who are in a different location.

These are but a few examples and only scratch the surface of the messy social and material considerations that are at play in any given DME lecture. We can clearly see that while human considerations are important, the material realm mediates distance learning. Certainly, if a goal of our inquiry is to develop a rich understanding of DME, then it is insufficient and incomplete to focus only on social, pedagogical, and/or cognitive factors when they are so intricately connected to material considerations.

What Can Sociomateriality Bring to Studies of DME?

From the underlying technical infrastructure, to the planning of a distance-learning space, to the network of workers involved with the process, to the screens, buttons, and cameras that allow us to interact, the material realm fundamentally shapes DME. As Fenwick [10] reminds us, context is more than a backdrop or a "container"; rather, it is a turmoil of relationships among the innumerable human and nonhuman, and the social and material elements, that structure a learning event. In the case of DME, accounting for the turmoil is central to building a rich understanding.

What, then, can the perspective offered by sociometeriality bring to studies of DME?

First, medical education in its broadest sense, and specifically DME, is deeply entangled with materials, technologies, knowledge, physical spaces, nature, and objects of all kinds. Yet, due to a preoccupation with understanding human activity, we have a history of overlooking these material influences. By applying sociomaterial approaches to study DME, previously obscured actors, infrastructure, and [OK?] other material factors, which on the surface seem unrelated and even unimportant, are illuminated and reconsidered. The theoretical framework of

sociomateriality allows a fuller picture of how distance learning, including DME, is developed, sustained, and modified.

Second, acknowledging and paying attention to the sociomaterial realm can help illuminate the dynamics of everyday life, particularly learning. The human processes of learning—those social and affective elements that we have carefully considered in medical education—do not occur in a vacuum. The social and material components that make up these processes are continuously acting upon each other to produce and reproduce objects and knowledge. And while it is tempting to accept these things as natural, a more careful analysis reveals that objects and knowledge are indeed fluid, messy, and uncertain. This has profound implications for understanding processes of learning.

Third, and not to be understated, is the ability of sociomaterial approaches to unsettle ideas that have become ubiquitous in our understanding of DME. Sociomaterial approaches offer the possibility of thinking differently, even of disrupting traditional approaches, to explore DME.

We maintain that to effectively study and comprehend the complexities of DME, we must expand our current theoretical approaches. While social, cognitive, and pedagogical considerations are indeed important, these factors are necessarily positioned within, produced through, and delivered by a network of material factors. Rigorous study of DME requires theoretical frameworks that account for both human and material factors and the multiple relationships and interactions that occur among them. The emergence of DME brings with it substantial investments of social and material resources, and therefore calls for careful study, using approaches that embrace its complexity.

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