Is Connectivism Viable?

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Abstract: Connectivism was proposed decades ago as a learning theory tailored to the digital age, but despite the now ubiquitous use of computers and the Internet in education and the move to online learning during the pandemic, it remains unclear how connectivism might be applied in the classroom. It is time to ask whether connectivism is viable and the presentation was organized around this question. This paper, structured to mirror the presentation, first provides an overview of the theory (section 1). Its grounding claims are that knowledge is distributed across networks, meaning that learning is increasing network connectivity, and that access to networks is more important than knowing. The paper then (section 2) describes the initial reactions to the theory, which were generally either harsh rejection or advocacy with recognition that it needs further work. This is followed by a discussion of its current standing. There remains little to no research supporting the theory, long-time advocates have begun distancing themselves from it, and it is widely misunderstood by teachers and educational theorists. Highlights from the session's general discussion (section 3) are then given. There seemed consensus that although the connectivist epistemology is for various reasons incorrect, the learning theory and pedagogy provide insights into how learning should be approached in the digital age. Basically, the epistemology should go, but the pedagogy should stay. The paper closes (section 4) by suggesting that research based on the insights of connectivism minus its epistemology may be fruitful.

Keywords: Connectivism, Learning Theory, Epistemology, Educational Technology.

Introduction

Connectivism was proposed in the early 2000s as a new learning theory for the digital age, yet despite the move to online learning during the pandemic and the now ubiquitous use of computers, the Internet and artificial intelligence (AI) in education, the theory remains little understood, and it remains unclear how it might be applied to support student learning in classroom settings. It is time to ask if connectivism is a viable learning theory, or if it is incapable of being applied in formal learning environments. The presentation, which assumed no prior knowledge of connectivism or learning theory on the part of participants, was based on this question.

The basic plan for the presentation was to provide a general overview of connectivism, its initial reception in the first decade of the 2000s, and how things with the theory now stand. Following this, three questions about connectivism's grounding assumptions were asked of the session participants. The first was whether a new learning theory for the digital age is needed. The second was whether machine and deep learning and human learning are reducible to one learning theory. The third was how connectivism might be used in classrooms. The sections in this paper follow the presentation. A brief overview of the theory will be provided in section 1. Section 2 will describe the theory's initial reception and current status. Section 3 will provide highlights of general discussion that took place at the end of the session. The final section, section 4, will summarize and speculate about directions for future research.

In response to the question of the viability of connectivism, it was generally agreed by session participants that connectivism provides insight into how people learn in the digital age, but its epistemology is flawed, and the question of how the theory might be applied to improve classroom learning remains unanswered.

General Overview of Connectivism

In the early 2000s, George Siemens and Stephen Downes began arguing that traditional learning theories could not account for how learning takes place in the digital age. The Internet and novel forms of communications technology had altered society in radical ways, changing how people work, live, interact, and even affecting brain physiology and how thinking takes place. The three dominant traditional learning theories, behaviourism, cognitivism, and constructivism emerged from psychology and presuppose learning to be relegated to the human mind and human behaviours. In the digital age, however, computers are not merely ancillary to human learning, but produce new knowledge, and should therefore also be considered learners. Moreover, in the digital age the ability to access networks came to be more important than knowledge. When facts or other pieces of information are needed, they are accessed on demand via the Internet, which is more efficient than memorizing as much information as

possible in the hope that it may become relevant at some indefinite point in the future. Even the way humans interact to learn has changed. The days when journal articles and other peer-reviewed publications were the only way for researchers to exchange ideas were over; in the digital age, email and social media allow new insights to be broadcast immediately to anyone, no matter the level of expertise. The three dominant theories, which relegate knowledge and learning to individual humans, assume print and other legacy media, and do not account for the social changes brought about by the inception of the Internet, had become outdated. A new learning theory was called for, and connectivism was the response.

In 2004 and 2005, Siemens and Downes began releasing the foundational work of the theory, and in 2008 they led an online course with connectivism as the topic, considered the world's first Massive Online Open Course (MOOC) (MAUT, n.d.). Downes was responsible for forming the epistemology, which coincides with the psychological theory or theory of mind in the three dominant traditional theories. Siemens assumed responsibility for explaining how learning takes place based on the epistemology and for proposing connectivist pedagogical principles. The basic epistemology will be given in a subsection, followed by Siemens' learning theory and pedagogical principles.

Connectivist Epistemology

The main epistemological insight of connectivism is that knowledge is distributed across networks (Downes, 2005; Siemens, 2008). Rather than view knowledge as a mental state, like a belief, or as in some way pertaining solely to individual knowers, knowledge in connectivism is a supervening quality on an activated pattern of connections in a network. The central structural feature of such networks is the node, which is not a singular and indivisible thing, like a person or mind; rather, nodes are loci or bundles of connections (Bates, 2019). The more connections a node possesses, the more of a "profile" it has (Siemens, 2005).

There are three levels of networks. The first is physical networks, such as the neural networks of human brains and of artificial neural networks and computer processors. The second is conceptual, and accounts for meaning and relations among ideas. The third is social or personal networks, and accounts for interaction among humans and among intelligent machines, such as computers and various other smart appliances (Siemens, 2008).

An example from the conceptual level was used in the presentation to illustrate how the theory works (see figure 1). Knowing what "Paris" means involves connecting "France," "Eiffel Tower," and "capital," etc., and such knowledge would coincide with a particular state of a neural network. Context plays a significant role. It could be that "Paris" does not refer to the city in France, but to "Paris Hilton," in which case a different set of connections is instantiated (becomes salient or prevalent, in the words of the theory). Furthermore, a learner might consult a phone or Google to

bring up possible meanings of "Paris." Connectivism includes such devices and programs as nodes, and knowledge does not reside in the human knower alone; rather, knowledge is an attribute of the state of the network overall (Downes, 2005).

Figure 1

An Example from the Conceptual Level of Connectivism
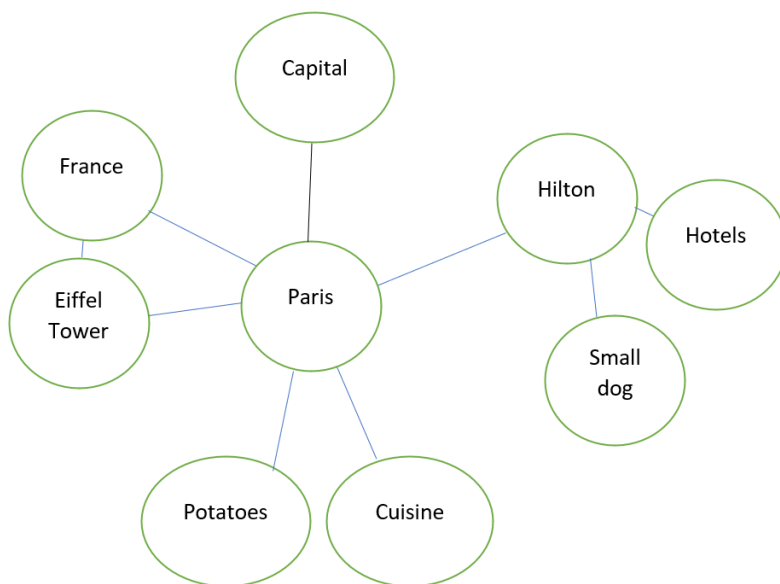
Note. The above image was used during the presentation to illustrate how the concept "Paris" would be known according to connectivism. Each circle represents a node. Beyond what is illustrated in the image would be additional nodes connecting to various other networks. "France," for instance, might connect with "country," "history," "European," and a host of additional nodes, each of which, in turn, could link up with additional nodes, and such connections could continue indefinitely.

Another example used in the presentation to illustrate how a connectivist understanding of knowledge differs from traditional understandings was the research paper. From a traditional standpoint, a research paper is the product of the individual human mind and reflects the degree of knowledge that mind possesses on a subject. From a connectivist standpoint, however, the paper is a node in a network. The reference list and citations are indicative of the process of writing a research paper, which is nothing but bringing together various bits of information typically present in databases on computers and accessed via the Internet. The information from such databases often originates with other humans. Seen in this way, the paper is not the work of an individual human mind; it is, rather, a relay

connecting various nodes, including computers, artificial neural networks, information networks, and other people, and it reflects the overall state of a network that extends well beyond the paper and its author.

The example of a research paper as illustrative of the connectivist theory was also used to highlight another relevant feature of networks: they undergo constant change. Sources used in a paper, such as online peer-reviewed encyclopedias, are updated routinely, and human experts cited and quoted change their opinions. Because knowledge is a state of a network and networks are in flux, only through current access is the actual state of knowledge at any given time about any subject accessible.

Learning Theory and the 8 Pedagogical Principles of Connectivism

The connectivist learning theory follows from its epistemology. Knowledge is a supervening quality of a network, and a network is nothing but a set of connections, so it makes sense for learning to be the maintenance of existing connections and the building of new ones (Downes, 2005; Siemens, 2005). On a biological or physical level, this would amount to keeping the neural network that coincides with an understanding of "Paris," for example, intact and adding connections to additional nodes. On the conceptual level, Googling "Paris" would give us the population of the city of Paris, which would add another node (the total population on a given date) with its own connections to add to the network pertaining to demographics, for example, and residing in digital databases. Another connection might be to "Parisian potatoes," which would add another node with its own connections, and so on. The way the nodes manifest structurally as an instance of knowledge is context sensitive, but in general, the addition of connections equals an increase in knowledge.

How the theory looks in learning is best illustrated from the type that takes place outside of formal education and classroom settings. One might see something interesting on television and want to know more about it, so they Google it, accessing various nodes and networks. While searching on the original topic, one might come across an unfamiliar word and search it. While searching this word, they may come across something else relevant and connect with it, and so on. In learning, nothing is occurring but connecting different nodes and networks.

How does this transfer to a classroom setting? The answer to this question is not clear from the explanations given by Siemens and Downes. Downes (2010), for instance, suggests 23 roles a teacher might fill! Be that as it may, Siemens (2005) offers 8 pedagogical principles to go along with the theory:

1. Learning and knowledge rests in diversity of opinions
2. Learning is a process of connecting specialized nodes or information sources
3. Learning may reside in non-human appliances
4. Capacity to know more is more critical than what is currently known

5. Nurturing and maintaining connections is needed to facilitate continual learning
6. Ability to see connections between fields, ideas, and concepts is a core skill
7. Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities
8. Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision

A few potential problems with the principles were noted in the presentation. The first is that there seems no reason stemming from connectivist epistemology or learning theory why 1 is true. It appears instead to be a truism that no teacher would question. The second is that 7 is potentially an example of the fallacy of novelty, although there is reason to think that because networks are in flux, only current network states would count as knowledge, in which case it may not be an example of the fallacy. The third and most pressing problem, apparent in principles 6 and 8, is the tension between humanism and connectivism's post-humanism. To be clear, humanism here refers to the view that humans are the only things that truly know; post-humanism here is the view that the human mind is not the sole locus of knowledge and that other things besides humans can know. Connectivism is intended to be a post-humanist theory that levels human and artificial intelligence to network functions, but Siemens' pedagogical principles may reveal some unintended humanist assumptions. "Ability to see," from principle 6, implies some sort of space or position outside of networks, like a human mind, that has a type of knowledge. It could be that this "ability to see" is itself a network or a pattern of nodes, which appears to be necessitated by the theory. If that is the case, however, then how can networks take other networks as intentional objects to see potential connections before actual connections exist? An explanation of how that would work is needed but missing. "Decision-making," from principle 8, exhibits the same tension more blatantly. It identifies decision-making as something learned but does not clarify whether decision-making is a network capable of taking other networks as objects to identify connections before they are made, or whether decision-making presupposes a human mind. Without an explanation of what decision-making and ability to see are in connectivist terms, the theory seems incoherent.

Connectivism's Initial Reception and Its Current Status

The initial reception of connectivism in the first decade of the 2000s generally went in two directions. The first was harsh rejection and the second was encouragement for an emerging theory. Each will be discussed in their own subsections, followed by an overview of the theory's current standing.

Harsh Rejections

The harsh criticisms of the theory came in degrees, and in the presentation those of Verhagen (2006) were used for the most part, because they stem from the theory itself rather than being ad hominem attacks (mostly), and because his criticisms are echoed by others.   The most common criticism of the theory, made by Verhagen (2006) and Bates (2022) among others, is that it does not present anything new, but repackages theories of networked learning and distributed knowledge that have been around since the 1960s and 1970s. Indeed, aspects of it seem lifted entirely from connectionism, which was proposed in the early 1940s (Waskan, n.d.).

Verhagen (2006) further claims that the theory confuses what people ought to learn with how people learn. Connectivism is correct in pointing out that we use the Internet to access information instead of memorizing it, but this only means that accessing information on the Internet is what should be taught. It does not mean how people learn has changed. It is like saying that because people need to learn to use the telephone that people therefore learn like telephones. Verhagen (2006) also claims that the assumption human learning and machine/deep learning are the same is simply false (this is a sentiment recently echoed by Geoffrey Hinton (2023). The constructivist theory, basically the view that humans learn by interpreting experience according to previous understanding, best describes human learning, and this is fundamentally different from how learning occurs in smart appliances.

The criticisms get a bit harsher at this point. Verhagen (2006) claims that the theory is a bric-a-brac of trendy but little understood theories; it remains unclear how the theories alluded to in support of it have anything to do with connectivism. Siemens (2005), for instance, claims that connectivism integrates "chaos, network, and complexity and self-organization theories" (para. 22), with inadequate explanation of how this is the case, giving the impression that a series of hip-sounding theories are being name-dropped to create an aura of credibility. Verhagen (2006) ends by saying that the theory is a result of "'unsubstantiated philosophising'… over a glass of wine" (para. 12), and that "we should forget about connectivism" (para. 12).

As harsh as Verhagen's (2006) criticisms may sound, they are not the worst. Others have dismissively (and rather rudely) claimed that connectivism is an outright hoax designed to win undeserved notoriety on the part of two dilettantes (Mackness, 2011). Downes and Siemens tend to view themselves as mavericks and see their theory as challenging the status quo and the privileged standing of academia (Bates, 2022). Both have been accused of shunning legacy media and traditional methods of disseminating academic research (Mackness, 2011), such as peer-reviewed journals, preferring blogs instead. Some have concluded from this that connectivism is a manifestation of Siemens and Downes' resentment of academia and that connectivism is an attempt to prank academics and develop a following

among those who lack an understanding of learning theory and hold similar resentments (Mackness, 2011).

One last criticism worth mentioning is the absence of empirical studies that use experimental methods to validate the theory (Mackness, 2011). Downes and Siemens, according to this criticism, have not done the needed work to test the veracity and usefulness of connectivism, and without such prerequisite testing, the theory is only an interesting idea.

Encouragement and Support for an Emerging Theory

Another trajectory of reception came from those who agreed with connectivism's premise that a new theory for the digital age is needed. Connectivism's shortcomings were recognized by this group, but it was felt that they would be overcome in the ensuing years (Anderson, 2008; Bates, 2019). In the past, major theories from various disciplines initially stood against the status quo and received harsh criticism but eventually came to be accepted. It takes time to work out the kinks in a new theory and conduct needed studies before it can be fully established. Connectivism is just such a theory, and what it needs is encouragement and patience.

A handful of people from this second trajectory were well-respected authorities in educational studies and began placing brief descriptions of connectivism as a new learning theory for the digital age in their textbooks alongside descriptions of the three traditional theories, giving the impression to teachers-in-training that connectivism is fully developed and can be used as a stand-alone pedagogy (Ally, 2008; Anderson, 2008; Bates, 2019). This is the likely reason connectivism came to be considered a bonafide learning theory and entered the general lexicon of educational studies.

Connectivism's Current Standing

In the ensuing years from the initial introduction of the theory and its early reception, now decades in the past, little to nothing has been done to provide empirical confirmation to the theory in the form of studies demonstrating improved student learning by employing the principles of connectivism. A bibliography compiled during the pandemic (Boraz & Ocak, 2021) shows no studies, but only reiterations of the theory's initial exposition. It should be noted that there are a handful of studies that do employ connectivism, but they typically supplement connectivism with constructivism or reduce it to any learning that uses computers and the Internet, which does not really get to what the theory is about (Al Maawali, 2022). One could argue on behalf of connectivism that the absence of empirical support does not matter. The theory is hostile to formal learning (Bates, 2022) and is not intended for such settings. Rather, it describes how people actually learn in their personal lives. However, if that is the case, then the theory simply describes principles learners have already employed, and, therefore, offers nothing to further improve learning. There remains

little to no indication of how connectivism might be used by teachers and students in the classroom.

Those from the second trajectory, who continued to support the theory and were hopeful that it would be more fully developed, seem to have finally given up. In February 2022, Downes (2022b) released an updated explanation of connectivist epistemology, and he now seems to see connectivism as a physical reductionist theory of mind, meaning that knowledge reduces to only physical networks, like organic and artificial neural networks, essentially denying the mind any role in learning. Tony Bates (2022), a long-time advocate of connectivism with a high reputation in the field of online learning, responded in a post of his own, pointing out the issue. Downes (2022a) replied by doubling down on physical reductionism, at which point Bates (2022) seemed to part ways with connectivism.

In the meantime, textbooks and teaching-advice websites have continued to provide short descriptions of connectivism as a new learning theory for the digital age, maintaining the appearance that the theory is viable and can be used as is in the classroom. There is a general awareness of the theory, but for the most part, it is understood as nothing more than learning with computers and the Internet (Dudas, 2016; Underwood, 2016), which, as mentioned above, does not get to what the theory is about.

General Discussion

The presentation ended by asking participants questions about connectivism's basic assumptions. Three questions were planned, although there was only time to fully treat the first two. The questions will be provided in what follows along with a few highlights from the general discussion.

Is a New Learning Theory for the Digital Age Needed?

For the most part, participants agreed that there is need for a new learning theory to better inform classroom learning for the same reasons Siemens and Downes claimed connectivism is needed. Everything has changed in the digital age and learning needs to reflect that. However, there was less agreement about connectivism as the theory to reflect such changes. One participant commented that she is already doing what the theory suggests and that connectivism offers no real help in improving student learning. Another participant simply could not see how the theory could be applied in a classroom setting.

One position that gradually emerged from the discussion is that some parts of connectivism have it right and others do not. There seemed to be consensus that the epistemology gets it wrong, but that greater competence in working with networks along the lines of connectivist learning theory and pedagogy should be given increased priority in learning. One participant commented that critical thinking skills needed to navigate

the Internet and sort good information from bad should be stressed and that such skills are more important for students to have than subject knowledge.

Do Humans and Machines Learn and Know in the Same Way?

Connectivism seems to assume that machine learning, deep learning, and the way humans learn are the same or are at least reducible to the same learning theory. Participants were asked if this is true. One participant responded that constructivism has it right for humans. We interpret information gradually from past experiences and from current contexts, and each of us constructs knowledge in an idiosyncratic manner. Machines and AI, on the other hand, do not learn using interpretation and understanding, but only process information in the way the programming algorithm allows. The presenter then quickly explained John Searle's Chinese Room thought experiment (BBC Studios, 2015), and participants seemed to agree with Searle's conclusions. Human learning and machine/deep learning are essentially different and cannot be reduced to the same theory.

Can the Connectivist Theories of Knowledge and Learning be Used to Improve Classroom Learning?

As mentioned, the session ran out of time before this question could be fully discussed. However, in the brief time remaining, points worth mentioning were made. Participants could not see how to apply connectivism in classroom settings, but they did say that it reflects learning as it takes place in their personal lives far better than other theories. Connectivism's effectiveness in describing personal learning networks has been mentioned in the secondary literature (Boyraz & Ocak, 2021), and session participants thus echoed this sentiment. One other participant stated that perhaps the theory should be considered as a critique of formal education and in-class learning that fits in with a long tradition that includes John Dewey. This comment met with general agreement.

Summary

The presentation, and this paper, began by explaining that connectivism was produced from the conviction that a new learning theory for the digital age was needed. It then described connectivism's basic epistemological claims that knowledge is distributed across networks and that access to networks is more important than knowing. An overview of what this means for learning, basically that learning is the maintenance and increase of connectivity in networks, was then given, and Siemens' 8 pedagogical principles were listed. After it was noted that there may be coherence issues with a few of Siemens' principles, the theory's initial reception was discussed. One trajectory rejected the theory, claiming, among other things, that a new learning theory is not needed, that connectivism offers nothing new, and that the theory as it then stood was incoherent. Another trajectory saw the need for a new learning theory, but

recognized connectivism to be incomplete. Support and encouragement were offered from those who adopted this perspective in the hopes that the theory would develop over the years. The current status of connectivism was then touched on. There remains little further development, little to no empirical support of it, and long-time supporters seem to be finally giving up on the theory. Although connectivism is a commonly known term in education studies, it is simplified to mean any learning on computers and the Internet. The presentation ended with a general discussion. There seemed consensus that the connectivist epistemology should be rejected but that the learning theory and pedagogy are insightful.

A few directions for future research result from the session. As already touched on, participants agreed that connectivist epistemology should be rejected but that the learning theory and pedagogy have much to offer. Work from a connectivist perspective on exactly which critical thinking skills are most effective in helping students navigate networks, make connections, and evaluate information would be useful, in addition to further research into how human learning should interact with machine and deep learning. Moreover, even if connectivism is ultimately not viable, its implicit critique of formal education could spark a debate about how learning environments and lessons should be designed to better reflect how people learn in their personal lives. After all, similar critiques in the past led to the development of experiential learning (Ignacio, 2018). Why couldn't something similar happen stemming from connectivism? If connectivism stands as an obstacle to progress, then ignore it; however, the implicit critique of current educational practices connectivism presents is itself valuable.

Conflict of Interest
The author declares no conflict of interest.

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