

2013

## Connectivism and information literacy: Moving from learning theory to pedagogical practice

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### Recommended Citation

Transue, Beth M., "Connectivism and information literacy: Moving from learning theory to pedagogical practice" (2013). *Library Staff Presentations & Publications*. 6.[https://mosaic.messiah.edu/libstaff\\_pub/6](https://mosaic.messiah.edu/libstaff_pub/6)

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Connectivism and Information Literacy: Moving From Learning Theory to Pedagogical Practice

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2013

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### Abstract

Connectivism is an emerging learning theory which hypothesizes that knowledge is comprised of networked relationships and that learning comprises the ability to successfully navigate through these networks. Successful pedagogical strategies involve the instructor helping students to identify, navigate and evaluate information from their learning networks. Many principles of connectivism align with the information literacy standards of the Association for College and Research Libraries. Librarian educators should consider connectivism learning theory and implement pedagogical strategies the network domains of the students.

## Connectivism and Information Literacy: Moving From Learning Theory to Pedagogical Practice

This article explores the intersections of connectivism, information literacy, and pedagogical practice. As the role of ‘librarian as educator’ expands in an increasingly complex information age, librarians must consider new learning theories and technologies and the impact on pedagogical practice (Dunaway, 2011). Downes (2007) defines connectivism as a learning theory that knowledge is comprised of networked relationships. Networks are connections between various entities such as experts, databases, blogs, colleagues, and websites. Learning therefore is the ability to “construct and traverse those networks” (paragraph 1).

In his seminal work on connectivism, George Siemens (2005) identified eight core principles of connectivism (Table 1). Siemens discusses several recent social and educational trends that impact lifelong learning and personal learning networks: Knowledge is evolving ever more rapidly, informal and continual learning within context becomes more important due to more frequent career changes, and knowledge needs to be made available at the point of need.

It is important to understand the learning theory of connectivism within the context of established learning theories. Anderson & Dron (2011) describe three generations of learning theories. The first generation, cognitive-behaviorist applies well in the pre-Web world, while constructivist learning theory makes good use of Web1.0 technologies. However, they state that connectivism as the third generation learning theory works best in a Web2.0 environment. Connectivism can be thought of as a successor to established learning theories (Bell, 2010). Siemens (2005) emphasizes that knowledge is gained no longer through experience only, as theorized by Constructivism, but also through one’s own networks. Connectivism theorizes that

knowledge is not a ‘thing’ that exists, but is rather a relationship that exists within complex networks (Downes, 2007).

It is important to acknowledge that the nature of information is changing in this technological environment. In addition to thinking of information as a commodity to be managed, Bell (2010) notes that information is now also a social activity, a new domain which has yet to be addressed effectively by most information literacy instruction. Libraries are the original physical representations of knowledge within networked relationships, through interconnected catalogs, subject headings, print and online resources, and experts. Libraries must continue to adapt within this network model to retain this central role. Connectivism theory should be of particular interest to librarians because “concepts like critical thinking, credibility, relevance, validity, information seeking, and access to information, all concepts that are important to the missions of libraries, are all prevalent in the principles of Connectivism” (Guder, 2010, p. 37).

### **Connectivism and ACRL Standards**

Information literacy is the ability to efficiently and effectively search, locate, access, evaluate, and use information from a variety of sources. It involves creating connections between many types of resources in a rapidly evolving environment (ACRL, 2000). The principles of connectivism align remarkably well with the Association for College and Research Libraries’ *Information Literacy Competency Standards for Higher Education*. Table 1 lists each core principle of connectivism, and the standards that relate most directly to it from the ACRL information literacy standards.

Table 1.

*Relationship of connectivism principles to ACRL information literacy standards*

Connectivism Principles (Siemens, 2005)	ACRL Standards (ACRL, 2000)
1. Learning and knowledge rests in diversity of opinions	3.2.a Examines and compares information from various sources in order to evaluate reliability, validity, accuracy, authority, timeliness, and point of view or bias  3.5.a Investigates differing viewpoints encountered in the literature
2. Learning is a process of connecting specialized nodes or information sources	1.2.c Identifies the value and differences of potential resources in a variety of formats  3.2.a Examines and compares information from various sources in order to evaluate reliability, validity, accuracy, authority, timeliness, and point of view or bias  3.3.a Recognizes interrelationships among concepts and combines them into potentially useful primary statements with supporting evidence  3.6.b Participates in class-sponsored electronic communication forums designed to encourage discourse on the topic  3.6.c Seeks expert opinion through a variety of mechanisms
3. Learning may reside in non-human appliances	2.5.a Selects among various technologies the most appropriate one for the task of extracting the needed information
4. Capacity to know more is more critical than what is currently known	Preface: Information Literacy Defined: Information literacy enables learners to master content and extend their investigations, become more self-directed, and assume greater control over their own learning.
5. Nurturing and maintaining connections is needed to facilitate continual learning	Preface: Information Literacy Defined: Information literacy forms the basis for lifelong learning.
6. Ability to see connections between fields, ideas, and concepts is a core skill	3.3.a Recognizes interrelationships among concepts and combines them into potentially useful primary statements

with supporting evidence

7. Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities

8. Decision-making is itself a learning process.

1.3.a Determines the availability of needed information and makes decisions on broadening the information seeking process beyond local resources

4. The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.

While some of the connectivism principles are addressed by several ACRL information literacy standards, it is interesting to see those which are not fully addressed. If librarians choose to incorporate connectivism as a learning theory into information literacy, the ACRL standards should evolve to address these principles. For example, several ACRL information literacy standards apply to the connectivism principle that “learning is a process of connecting specialized nodes or information sources”. Librarians understand this principle intuitively. However, the connectivism principle of current sources is not explicitly mentioned in the ACRL standards. As knowledge continues to evolve at an ever more rapid pace, ACRL standards should be updated to value currency of information.

As might be expected after reviewing the above table, McBride (2011) assures us that “librarians already use Connectivist approaches in information literacy education” (p. 298) through teaching to ACRL Standards. While librarians may unthinkingly incorporate connectivism learning theory into information literacy instruction, they should become more intentional about applying this theory to the classroom.

### **The Networked Student Model**

One way to understand the student within connectivism theory is the model of the networked student. Drexler (2010) hypothesizes that a student utilizes networks within four domains. All of these domains should be addressed in a holistic pedagogical approach. The four domains of the networked student (p. 372) are:

1. Information Management - library resources, open courseware, scholarly works, evaluating sources and locating experts,
2. Contacts - teachers, experts, friends, classmates, family, and coworkers,
3. Synchronous Communication - videoconferencing, microblogging, instant messaging, and mobile texting,
4. RSS - subscription readers, blogs, wikis, podcasts, social bookmarking, and social networks

Through these four domains, students create a personalized network. Teachers and librarians should work together to address all four domains adequately, through instruction on using networked resources, evaluating information from various networks, and teaching students how to use information effectively and ethically within their networks.

It is often a challenge for educators to move from learning theory to practical pedagogical practice. Librarians desiring to incorporate connectivism learning theory into information literacy instruction should consider Drexler's student domains. This model provides a framework upon which to design specific learning objectives, instructional strategies, and assessment. Librarians routinely address the Information Management domain of the networked student



(Drexler, 2010). However, librarians must also consider how they can address the three other domains, Contacts, Synchronous Communication, and RSS. Dunaway (2011) correctly states that the objective of all these strategies is to teach students core transferable skills that can be used beyond the classroom for lifelong learning. Strategies for information literacy instruction should expand to explicitly incorporate connectivism learning theory and address all four domains of the networked student.

### **Addressing the Information Management Domain**

The information management domain is probably the most robust area of current information literacy instruction for most librarians. Librarians often focus on networks of information found in formal systems such as catalogs, databases, and bibliographies. Librarians should expand their instruction in the information management domain to address new methods of connecting with information. New areas of information literacy instruction could include digital literacy instruction, student personal and information networks, and citation management software.

Expanded information literacy instruction should merge with digital literacy to become transliteracy instruction (McBride, 2011). Students often become confused with the multiple platforms they now encounter in a simple search, often jumping from one a periodical index to a full-text database or from a catalog to an ebook collection. Students then face barriers in locating and determining how to download identified articles or ebooks onto computers or mobile devices. Librarians must allocate instruction and reference time to help students navigate the multiple connected networks and interfaces that students encounter.

Librarians can utilize databases to expand students' personal networks. Librarians and faculty should demonstrate how a successful research process exposes foundational resources in the academic discipline. Students can then expand their research to include these quality sources and be assured of their reliability (Dunaway, 2011). A critical piece when using connectivism as a framework for information literacy instruction is helping students connect their extant personal networks to additional reliable resources. For example, Google and Wikipedia are typical resources already in use by most students. The librarian should help students expand their personal information networks by showing students how resources from Wikipedia or Google connect back to the library. For example, the librarian can start at a Wikipedia page and discuss website reliability and sources. The librarian should then scroll to the References and Notes sections, and demonstrate how the information in the article is based on these cited resources, many of which may be academically rigorous and are available through the library. Journal articles cited in Wikipedia often have digital object identifiers (doi) which may lead directly to the full-text article within a library database. Students should also know how to read the citation, determine the format of the resource, and search for the item within the library or interlibrary loan systems if a direct link to the item is not available.

A critical area of information literacy instruction that addresses students' information management domain is citation management. Librarians should be aware of multiple citation management software systems. They need to be able to recommend citation management systems based on the research situation and user need. For example, librarians might recommend Zotero to a student who routinely works from a single computer, who uses a browser that works with the zotero plugin, who plans to use many documents outside formal bibliographic

databases, or who wants to use full-text documents in the ZotPad app. Conversely, the librarian may recommend Refworks to a student who routinely works from several computers including shared public computers in the library, who typically works with documents in library databases, or who needs to use a lesser-known citation format such as CSE. Providing an appropriate citation management system recommendation shows the student how technological tools can help them manage resources effectively within their personal knowledge network.

### **Addressing the Contacts Domain**

In addition to the Information Management Domain, librarians must address the remaining domains when providing information literacy within a connectivist framework. Instruction addressing the Contacts domain explains the publication process, highlighting bibliometric data, and discusses how to appropriately contact experts in the discipline when appropriate.

Students typically rely on contacts from their personal networks such as friends, family or teaching faculty, and may be reluctant to contact librarians for research assistance (Bailey, 2008). Friends and family in particular may not be able to provide adequate resources needed for academic research projects. Teaching faculty should be encouraged to refer students to liaison librarians. This addresses students' reluctance to contact librarians, and places the librarian within the students' learning network. Librarians can then take the opportunity to expand students' learning networks to include appropriate expert contacts and resources.

To adequately address the contacts domain, students must come to understand the academic publishing process in their discipline (Booth, 2011). Students are often unfamiliar with

how to identify experts within their academic field; understanding the peer review process can help them with identification. Students come to learn that researchers who go through the peer review process for publication, especially those with many peer-reviewed publications on a specific topic, comprise a more reliable source than an individual who has never published through a peer review process.

Librarians should address the contacts domain during information literacy instructions by demonstrating advanced features of many discipline-specific databases. Many of these databases, such as Engineering Village, present data which can be a useful tool for students to identify expert contacts. In Engineering Village, for example, the user can quickly review the top authors and institutions doing research on a specific topic. Librarians should highlight these features and explicitly explain how they can be used by students to identify experts and institutions for future research assistance, graduate study, or employment opportunities.

When appropriate, librarians may also wish to discuss how students should contact experts in an academic discipline. This research assistance involves in-depth reference interviews to identify student needs, and what expert assistance is required. The librarian can then work with the student to identify content experts that the student could add to their personal learning network, and strategize appropriate methods of contact.

### **Addressing the Synchronous Communication Doman**

A third domain that librarians must address with students when utilizing a connectivist framework is the synchronous communication domain. When considering pedagogical application in the library, the scope of this domain should be expanded to consider multilateral

asynchronous communication as well. In an academic environment, students become familiar with unilateral asynchronous communication networks for academic research. Librarians and faculty encourage this by stressing that students should only use peer-reviewed published material, thereby downplaying the potential usefulness of material embedded within multilateral communication networks. Because students may not be aware of how to effectively evaluate and use material from synchronous or multilateral communication networks, information literacy instruction which includes evaluation skills is critical to adequately address this domain.

Librarians can begin to address the synchronous communication domain by facilitating discussion about the nature of synchronous and multilateral communication networks versus peer-reviewed and unilateral communication networks. This discussion is often easy to initiate by bringing up Wikipedia. Librarians, teaching faculty and students should discuss the model of Wikipedia, and how the knowledge creation and editing process works in this environment. Comparisons and contrasts can be made between the editing and review process of Wikipedia articles, and peer reviewed publications. Critical evaluation skills of Wikipedia and other online resources from multilateral communication websites should be discussed at this point.

As discussed in the contacts domain section, librarians must work with teaching faculty to encourage students to include librarians in their personal learning networks. Librarians can expand this contact to address the synchronous domain. Specifically, librarians should emphasize their availability for synchronous assistance at the point of need. This can be done through several avenues including reference or personal chat accounts, chat widgets on subject pages or databases, and being an active presence in social networking sites (Guder, 2010).

Synchronous communication using technology bridges geographic distances and brings experts into student and faculty learning networks. Librarians can research and recommend synchronous communication options to teaching faculty or students to supplement classroom instruction. Librarians who are comfortable in both academic and technological arenas are the natural individuals to work with IT to arrange synchronous communication such as Skype with experts over the internet, particularly if teaching faculty are hesitant to do so because of technology requirements.

When explaining connectivism, Siemens (2005) recognizes that as information becomes more abundant, and less controlled by experts, evaluation of that information becomes an even greater core skill. As students begin to access synchronous and multilateral communication networks, evaluation becomes a critical piece of information literacy within this domain. Students step out of the bounds of peer-reviewed published research and start accessing and using synchronous and multilateral sources. Therefore, students must have superior evaluation skills to determine value and trustworthiness of material that has not been authored or reviewed by subject experts.

### **Addressing the RSS Domain**

It should come as no surprise that the RSS domain overlaps significantly with the information management domain. RSS can be thought of broadly as tools that effectively manage the onslaught of information that students encounter through the academic research process and allow the researcher to monitor information resources for newly published research. Skills from the RSS domain can be used to manage the information and to create and maintain networks within the connectivist framework. Librarians should include discussion and

demonstration of RSS tools such as social bookmarking, RSS readers, social networking, and microblogging. In order to effectively provide information about these tools, librarians must be familiar with them. This requires the librarian, and the employer, to be willing to dedicate professional development time and funds towards this continuing education. Students may be aware of some of these sites, particularly social networking and microblogging, but may not be comfortable using them for educational and research purposes, or even aware that they can be used for those purposes. This opens the door for librarians to demonstrate their familiarity with these tools, and highlight their uses in the research process. Librarians should also draw connections for students between concepts in the social networking field such as tagging, and traditional library practices such as subject headings.

In addition to managing information through RSS tools, librarians and teaching faculty should encourage students to use RSS tools to disseminate knowledge created through their own academic research. This can be an excellent way to introduce students to the process of publishing new knowledge and being open to feedback from others. Students move from being passive recipients to active participants within their learning networks, thus completing the connectivism educational cycle.

After searching, accessing, and evaluating information across networks, Dunaway (2011) reminds us that students must finally synthesize and create new knowledge across their multiple networks. Students must learn to responsibly post their new knowledge using various dissemination technologies to become full participants within their knowledge networks.

### **Providing information literacy within a connectivist framework**

Librarians wishing to incorporate connectivism learning theory into their information literacy instruction should consider the above pedagogical strategies. Librarians will of course choose diverse strategies that best meet their instructional needs. This will vary depending on academic discipline, assignment requirements, and student characteristics.

The author recently had an opportunity to incorporate several connectivist principles using the student domain model within a life sciences class. A professor in a life sciences class made up of junior and senior Biology students contacted the liaison librarian for assistance providing research skills instruction for an upcoming assignment. The assignment required students to select a species that had a minimal to moderate amount of research published about it. The students were to conduct a comprehensive literature review about the selected species.

The librarian chose to provide information literacy instruction within the connectivism framework and addressed three of the four student domains. The librarian addressed the information management domain by initially focusing on traditional discipline-specific research databases. The librarian spent time reviewing various interfaces that the students would encounter, and what to do when systems did not work as expected. The librarian introduced the usefulness of mining citations in bibliographies to identify foundational research for a species; this formed the basis for the literature review and species description. An in-depth discussion of Wikipedia ensued which stressed the usefulness of this source to begin research and learn background information. The Wikipedia discussion expanded to review citations on the page, identifying quality sources and connecting back to the library collection to access the resources. The librarian also stressed the importance of selecting and using a citation management system



for a comprehensive literature review project. Based on student needs, research patterns and computer resources, the librarian provided basic information about Zotero, Refworks and Noodlebib for the students to consider. The librarian addressed the Contacts domain by highlighting bibliometric data from the research databases and bibliographic citations to help students identify primary researchers. While not provided in this instance, the librarian could also have discussed methods of contacting contemporary researchers identified in the bibliographic information for students to expand their personal learning networks as appropriate. Synchronous and multilateral domain needs were addressed during the previous discussion about Wikipedia and the editing process used to create entries. The librarian facilitated a small group activity and discussion about evaluating websites for academic content, stressing the need to rigorously evaluate content from synchronous and multilateral sources such as Wikipedia or general websites. The librarian emphasized her availability through synchronous and asynchronous channels for reference assistance. Reference services were provided through various methods to the majority of the students in the class over the next several weeks. The RSS domain was not addressed in this session. The librarian could have addressed this domain by discussing RSS tools and search alerts to continuously monitor sources for new relevant content. The professor discussed the possibility of publishing this research in the future which could have led to in-depth discussion of appropriate avenues to disseminate research findings.

The start of this assignment was difficult for students, professor and librarian alike. For many of the students in this class, this was their first open-ended research assignment, and first comprehensive literature review. Students felt overwhelmed by the task of selecting a species that had the 'right' amount of literature to review, and they felt uncomfortable using information

resources in new ways. The information literacy instruction was critical to provide the students with effective research strategies and resources. The students came to realize how their work fit into the overall research environment. It was personally rewarding to see the students' abilities and confidence grow throughout this assignment. As one student said at the end of the assignment, he discovered that he enjoyed "diving into the databases and learning about the research and publication process". The student also told the librarian that it was "cool" to identify the core researchers and see them in many different groupings for various publications about the selected species.

### **Conclusion**

This article attempts to explore the potential role of connectivism as a learning theory with practical information literacy instruction strategies. The core principles of connectivism align remarkably well with ACRL *Information Literacy Competency Standards for Higher Education*. Specific applications of connectivism to information literacy instruction should be considered and expanded. Drexler's model of student domains can provide the framework for this instructional design. Instructional strategies could include demonstration of networked resources such as library catalog or databases, exploration of Wikipedia as a starting point of collaborative knowledge creation, bridging connections between general search engines and library collections, and instruction on citation management software, RSS, and social networking sites. Librarians should seriously consider connectivism as a learning theory, and determine its implications on pedagogical practice for information literacy instruction.

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