International Journal of Linguistics Studies (IJLS)
ISSN: 2754-2599
DOI: 10.32996/ijls
Journal Homepage: www.al-kindipublisher.com/index.php/ijls

Critical Thinking Formation in the Scope of Connectivism

Hangyan Yu
Department of Linguistics, School of International Studies, Zhejiang University, Hangzhou City, Zhejiang-Province, 310058, China
✉ **Corresponding Author:** Hangyan Yu, **E-mail**: yhyan@zju.edu.cn

ARTICLE INFO

Received: 02 November 2021
Accepted: 29 November 2021
Published: 07 December 2021
DOI: 10.32996/ijlss.2021.2.1.9

KEYWORDS

Connectivism, Critical thinking, Pedagogy

ABSTRACT

Critical thinking (CT) formation is a complex and abstract process that hasn't been studied comprehensively by any existing learning model today. Connectivism, a new learning theory of the information era, provides brand new perspectives to learning, thus has gained considerable attention. The purpose of this study is to examine CT formation in the scope of cognitivism by contrasting this theory to the previous learning theories. This study used the key concepts of chaos, network model, ecology, flow inhibitors, and flow accelerators in connectivism to illuminate some areas of the formation of critical thinking that have not been examined fully. In the scope of connectivism, this study also provides constructive suggestions to teachers to facilitate students' critical thinking cultivation, i.e., introducing some learning materials that might trigger students' critical analyzing; evaluating students' learning procedure from a network perspective; paying more attention to students' CT disposition development and establishing healthy CT ecology, etc.

1. Introduction

With excessive information disseminated under the onslaught of the digital era, critical thinking (CT) as an effective ability to process information has gained increasing attention. The past twenty years have witnessed a boom in CT research in the pedagogical field. Some prominent ones are; (1) defining CT ability (e.g., He Yunfeng, 2000); (2) constructing the measuring tools for CT (e.g., Wen, 2010); (3) exploring the ways and effectiveness of cultivating CT ability in higher education (e.g., Sun, 2011); and (4) empirical studies on measuring CT (e.g., Hu & Chen, 2018). Despite the growing attention on CT, the theoretical discussion on CT formation is relatively restricted to the traditional spectrum. In terms of the theoretical explanation of the CT formation process, previous learning theories such as behaviorism, cognitivism, and constructivism fail to explain some unique traits of CT. Considering the distinct features of CT as essential learning skills required in the information era, an upgraded theoretical framework that has more explanatory power is imperative. A putative approach that might underpin the theoretical understanding of the formation of CT is connectivism, a novice learning theory that emerged explicitly in the digital era. Proposed by Siemens (2005a), connectivism has gained numerous momentum in providing insights into the learning patterns in the new era. To better explain the formation of CT with a more upgraded learning theory and thus provide enlightenment for the cultivation of CT, this paper managed to examine the CT formation in the scope of connectivism.

2. Literature Review

2.1 Traditional Learning Theories

Generally speaking, the past decades witnessed two drastic shifts in terms of learning theories, i.e., the move from bahavorism through cognitivism to constructivism (Facione, 1990). The theory of behaviourism centers on the study of external behaviors that can be observed and measured. Behavior theorists define learning as simply a matter of imitation and habit formation. It views the mind as a "black box" in a way that the response to a stimulus can be observed quantitatively in the pattern of stimulus(S)-response(R), ignoring the mechanism of the thinking process occurring in one's mind. Two of the most significant early researchers in the development of the behaviorist theory were Ivan Pavlov, known for his classical conditioning, and Thorndike (1911) who is famous for "the law of effect". Among later researchers, Skinner (1976) stood out for his studies on "operant conditioning" (Cooper,

1993). Dealing with what has been neglected by behaviorism, cognitivism is a study of how learning occurs from a change in mental state, where changes in observable behavior are used as indicators of what is happening inside the learner's mind. Cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information (Good & Brophy, 1990). Despite the disparity between behaviorism and cognitivism, both theories took objectivistic methods on understanding the external world and espoused that meaning is derived from the structure of reality. In contrast, constructivists questioned this objectivistic assumption and proposed that knowledge "is a function of how the individual creates meaning from his or her own experience" (Jonassen, 1991). Bahavorism, cognitivism, and constructivism, as traditional learning theories, have a significant influence on the following learning theories, while the emerging new features of learning in the information era render the traditional theories relatively obsolete, and call on new theories (Siemens, 2005a).

2.2 Connectivism

First forwarded by George Siemens, connectivism is regarded as the milestone of learning theory in the digital era. It revolutionized the traditional learning theories, namely, behaviorism, cognitivism, and constructivism, by identifying seven significant trends in digital learning (Siemens, 2005a). He argued that most learning theories alleged that learning occurred inside a person. Even social constructivism which promoted the principality of the individual in learning did not avoid this pitfall, neglecting the learning occurring outside of people (i.e., learning that is stored and manipulated by technology) and the learning happening within organizations (Siemens, 2005a). Considering current learning conditions have altered so significantly, and the mere modification of traditional theories is no longer sensible, Siemens (2005a) proposed that learning may reside outside of oneself (within an organization or a database), and learners should focus on connecting specialized information sets because it is connections that enable us to learn more than our current state of knowing (Siemens, 2005a). Once being raised, connectivsm has gained remarkable momentum for providing a new perspective to learning. For this study, its content will be examined in detail along with the discussion of the Critical Thinking (CT) formation mechanism.

2.3 Critical Thinking (CT)

Before 1990, even though researchers could identify some typical characteristics of people who were equipped with CT, they couldn't reach a consensus on its definition. Delphi Report was discussed and examined for two years by 46 experts. However, provided a more systematic way of understanding CT in terms of its definition, pedagogical methodology, and assessment. In this report, CT is defined as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (Facione, 1990). A key highlight of this report is that the conceptualization of CT is composed of two dimensions, i.e., cognitive skills and affective dispositions (Facione, 1990). While cognitive skills include "interpretation, analysis, evaluation, inference, explanation and self-regulation" (Facione, 1990), affective disposition features "a probing inquisitiveness, a keenness of mind, a zealous dedication to reason, and a hunger or eagerness for reliable information which good critical thinkers possess" (Facione, 1990). In light of the significance of this report, the following sections adopt the two-dimensional working definition of CT and utilize the findings of this report to explore the CT formation mechanism.

In the past decades, increasing attention has been paid to the research of college students' critical thinking ability worldwide. Relative research can be roughly divided into three categories: "(1) defining critical thinking ability, (2) constructing the measuring tools for critical thinking, and (3) exploring the ways and effectiveness of cultivating critical thinking ability in higher education." (Wen, 2010).

In 1998, "The Absence of Critical Thinking" written by Huang Yuanshen (1998) launched a fierce onslaught on the phenomenon that English majors lack critical thinking. Subsequently, the following twenty years witnessed a boom in critical thinking research. Some prominent domestic CT research are: (1) defining critical thinking ability (He Yunfeng, 2000), (2) constructing the measuring tools for critical thinking (Wen, 2010), (3) exploring the ways and effectiveness of cultivating critical thinking ability in higher education (Sun, 2011), and (4) empirical study on measuring critical thinking (Hu & Chen, 2018).

Categorizing the related research abroad and at home, it is not difficult to find that compared to other well-established research which mostly follows the sequence of identifying problem-establishing theories-initiating empirical studies to raising suggestions, CT study leaps identifying a problem directly to initiating empirical studies and raising suggestions leaving the inevitable second step underdeveloped. Possible reasons for this negligence might be: (1) the difficulty in cognitively analyzing CT formation mechanism; (2) the urgency of providing suggestions pedagogically, and (3) the lack of befitting theories. Without a solid theoretical underpinning, even if the suggestions which currently meet the demand might face insurmountable challenges in the long run. Thus, attempts to explore the theoretical underpinning of CT are in their high time and it is also where the focus of this study lies.

3. Connectivism and CT formation mechanism

The networked learning proposed by connectivism answers questions about how we process information in a two-dimensional way that skills and disposition are identified, much similar to that of the Delphi report. Connectivism contends that "when we exist in a knowledge climate (or network), we constantly scan, evaluate, and select for use, elements that answer questions with which we are struggling. Some elements of learning will relate to our values, attitudes, and beliefs, others will relate more concretely to how we perform our work" (Siemens, 2006). This similarity gives the following discussion on how connectivism can explain CT formation with more reasonableness since both CT skills and CT disposition can be explicitly addressed in accordance. In addition, the significance of healthy CT formation ecology is another unique perspective of understanding CT formation provided exclusively by connectivism.

3.1 Chaos and CT formation

In disclosing the mystery of connectivism, Goerge Siemens began with the introduction of chaos defined by Nigel Calder as "a cryptic form of order" (Siemens, 2005a), where "the learner's challenge is to recognize the patterns which appear to be hidden" (Siemens, 2005a). Acknowledging "chaos is a new reality for knowledge workers" (Siemens, 2005a), he underpinned connectivism with the principle that "learning and knowledge rest in diversity of opinions" (Siemens, 2005a).

Apart from proving the reasonableness of connectivism, chaos status could also be the premise of CT. The central CT skills Delphi Reported has identified could be understood as a critical thinker's active engagement to the external chaos, during the process of which he forms such listed CT skills. Entering into the digital era where the amount of information has expanded exponentially, the manifestation of chaos has been remarkably overt, and thus the significance of connectivism and CT has never been emphasized.

3.2 Connectivism and CT skills formation

3.2.1 Features of network and CT skills formation

Compared to other general descriptions of CT formation based on empirical hypothesis, the network model of learning can give better enlightenment to the CT formation by graphically manifesting how a network is formed and thus providing a better explanation to CT formation. The detailed network features are as follows:

A network is composed of at minimum two elements: nodes and connections-" a node is an element that can be connected to any other element, a connection is any type of link between nodes" (Siemens, 2005b). In terms of its function, "once a network has been established, the flow of information can move from one domain to another with relative ease. The stronger the connection between nodes, the more rapidly information will flow" (Siemens, 2005b). Even though the model of networks is simple, numerous elements influence the flow and dynamics of the connection. Elements and characteristics of a network are presented as follows: (1) content (data or information); (2) interaction (tentative connection forming); (3) static nodes (stable knowledge structure); (4) dynamic nodes (continually changing based on new information and data); (5) self-updating nodes (nodes which are tightly linked to their original information source, resulting in a high level of currency (i.e. up to date); (6) emotive elements (emotions that influence the prospect of connection and hub formations) (Siemens, 2005b). The classification of different types of nodes gives the premise for the formation of CT, for if all the nodes are static, then there is limited possibility for knowledge acquisition or information updating; if all the nodes are equally dynamic or self-updating, CT can not stand either, because CT often functions to evaluate new information with the existing ones, so if all nodes are equally dynamic, then the existing nodes might be too unstable to provide an evaluating model, thus will lose its credibility. Therefore, when and only when nodes have stratification in terms of stability can CT be formed and functional.

3.2.2 Nodes, connections and CT skills formation

After discussing the features of the network in a macroscopic way, this section will look further at the dynamics of nodes as well as connections and how CT formation can be better explained.

Connectivism explicitly addresses the formation of nodes as the following procedure: "a rogue node exists but has limited traction within the entire network. As the node begins to form its connections with other nodes, it gains traction and begins to link and connect to a greater degree with other nodes. The tipping point occurs when the node itself has created a strong enough network to begin to influence the entire thought process. Once it is no longer a rogue node, it continues to embed itself as a node that is used by the rest of the network. At this point, it can influence the larger network that originally resisted it." (Siemens, 2005b) In this description of how a node begins as a rogue one to an influential one, the conclusion can be made that it takes time for a node to develop, the process of which is quite explicable to the procedure of how the listed six CT skills have been implemented to deal with new information, namely, (1)interpretation, (2)analysis, (3)evaluation, (4) inference, (5) explanation and (6) self-regulation, and thus new information could be integrated to a person's learning network.

3.3 Connectivism and CT disposition

As stated before, connectivism also looks into the disposition aspect of the learning network, which can directly respond to the CT disposition identified in the Delphi Report. In this section, CT disposition and its unique function in the learning network formation process will be discussed in detail which haven't been satisfactorily explained by other theories.

Siemens (2005b) pointed out that "In a learning context, our emotions and logic play the gatekeeper role. They determine which nodes take root, and which nodes are exposed to which connections". And the impact of this disposition is based on the role it plays. Two roles have been identified by Siemens, namely, flow inhibitors and flow accelerators, flow inhibitors, the definition are as follows: "flow inhibitors are internal elements to a network that reduce the possibility of information and knowledge flow. Most often this will include elements like biases, preconceived notions, or lack of flexibility. Legitimate flow inhibitors can be our cognition and emotions. Some types of information should be inhibited due to poor fit with the existing network, or information that is simply false. External inhibitors also impact the flow of information between learners. The physical design of a space, the bureaucracy, or knowledge sharing the culture of an environment will influence and determine how well information flows between networks" (Siemens, 2005b). In contrast, flow accelerators are "elements and conditions inherent in a network that permit the rapid formation and distribution of information. Receptivity and motivation are two key accelerators. External attributes of ecology or network also influence how well information flows. A culture of openness, recognized value of cooperation, and tools and time allotted for collaboration all contribute to accelerating network formation" (Siemens, 2005b).
Even though Siemens did not give much further analysis on how physical design can stagnate the flow of information, the internal elements reveal that an ideal disposition should be inclusive and flexible which perfectly correlated to the key CT dispositions presented in Delphi Report as "open-mindedness regarding divergent world views, flexibility in considering alternatives and opinions, fair-mindedness in appraising reasoning, honesty in facing one's own biases, prejudices, stereotypes, egocentric or sociocentric tendencies, and willingness to reconsider and revise views where honest reflection suggests that change is warranted" (Facione, 1990). This conformance further proves that CT disposition plays a significant role in determining the flow of information. With the underpinning of connectivism, intangible as CT disposition is proved of its tangible function rather than being discussed merely in the hypothetical level. Regarding the external attributes for flow accelerators, the significance of the establishment of a healthy CT ecology will be discussed in due course.

3.4 Ecology and CT formation

After discussing the CT formation in the scope of connetivism internally, either from a macroscopic or a microscopic level, external factors shouldn't be excluded. Like any learning needs a healthy external ecology, CT also needs a healthy ecology that can facilitate its formation. As Siemens stated explicitly, the significance of ecology lies on its breading bed for CT formation: "a network is largely a structured process. Nodes and connectors comprise the structure. In contrast, ecology is a living organism. It influences the formation of the network itself. For example, each learner in a college possesses a personal learning network. The health of this network is influenced by the suitability of the ecology in which the learner exists(in this case, the college). If the ecology is healthy, it will permit networks to flourish and grow. If the ecology is not healthy, networks will not develop optimally. The task of educators and trainers is to create and foster a learning ecology that allows learners to quickly and effectively enhance their existing learning" (Siemens, 2005b).

4. Connectivism and CT cultivation

Subsequent to the discussion on how connectivism can provide many new perspectives on explaining CT formation, some suggestions on CT cultivation under the pedagogical spectrum will be presented in this section directly corresponding to the last section.

4.1 Chaos and CT cultivation

"By recognizing learning as a messy, nebulous, informal, chaotic process, we need to rethink how we design our instruction (Siemens, 2005b)". The core message from this line is that the chaos of information should not be feared but to be recognized and utilized for better CT cultivating. Therefore, the first principle for teachers to deal with chaos is to "shift the emphasis on tasks of presenting information" to "building the learner's ability to navigate the information" (Siemens, 2005b). Since the revelation of chaos indicates that one's previous static and closed linear sequential design of curriculum do not correspond to the authenticity of external information dissemination, and students in the information era have no longer been blocked from online information until adulthood. Therefore a putative corresponding design of curriculum could focus more on (1) integrating chaos to the design of tasks in the classroom to prompt students' intention of sorting chaos out by the guided discovery method; (3) recognizing the extent and purpose of chaos should take the students' current cognition level and the features of tasks into consideration; and (3) eliminating students' fear of chaos by educating them that a better CT ability comes from a critical understanding of the external chaos and the active engagement when encountered with them.

4.2 Connectivism and CT skills cultivation

4.2.1 Features of network and CT formation

The network features its nodes with different steadiness, which might require teachers to adopt different treatments and methodologies. In terms of dynamic and self-adaptive nodes which features less steadiness, teachers should explicitly point out what types of information will be transformed into these nodes, how to critically utilize these nodes to serve the purpose of better absorption, and when updating happens, how should students simultaneously update their nodes; concerning the static nodes, teachers' focus could be what types of information is more stable and can be considered as static nodes, how static nodes differentiate itself from other nodes when CT skills are implemented, and in what condition static nodes can be changed and what is the following impact.

4.2.2 Nodes, connections and CT cultivation

Nodes and connections as crucial elements in the network have some unique features which should be taken into consideration during the process of designing pedagogical activities on CT cultivation. When students are exposed to different subjects, they respond to them differently, and from the perspective of connectivism, this phenomenon can be explained by identifying how networks integrate new materials: "If the subject is in an area that connects well to our existing viewpoints, the material is quickly absorbed and integrated. If the content conflicts with the overall health of our learning network, the material are acquired (i.e. transformed into nodes within our learning network) more slowly"(Siemens, 2005b). Detailed explanation on why conflicting materials are integrated slowly is as follows: "when knowledge is introduced to a learning network which is contradictory to the established structured, the existing network, to preserve itself, attempts to route around or push the new node to the fringe (ensuring that limited connections are formed, and as a result, the new node does not gain significant status with the larger network). If the node does acquire a certain level of status, new knowledge may route through the node, permitting the node to begin replicating itself (i.e., encoding meaning to knowledge)" (Siemens, 2005b).

In light of this, teachers should bear these rules in their mind when they design CT teaching activities since the implementation of CT skills can be greatly influenced by the relatedness of material and network, for when new material is closely related to students' existing network, students are more likely to take things for granted rather than critically challenge the new material. Considering this, an advisable solution for teachers is that after analyzing students' current network characteristics, teachers could present materials slightly conflicting students' networks to avoid their arbitrary judgment. What should be cautious is that the extent of this confrontation should correspond to students' capability of processing new material. If materials with close relatedness have to be presented, teachers need to interfere with the voluntary attempts of students by pointing out some elements that have been underestimated. Under this guidance, students would get exposed to numerous materials which can be used to cultivate their CT skills, and also equip them with a critical mind when they are encountered with either unfamiliar or familiar subjects.

4.3 Connectivism and CT disposition cultivation

The two distinct roles of flow inhibitors and flow accelerators draw our attention to the historically neglected subject disposition. Driven by utilitarian purpose, education has been imposed for quicker equipment of skills rather than considering students' attitude and willingness. This phenomenon does have its reasons behind, such as the urgency for skills reinforcement or little awareness of the significant role disposition can play. Even if some researchers acclaimed firmly that disposition is vital for sustainable study, limited theoretical reasoning has been put forward. Connectivism, however, explicitly explains why disposition can serve as a gatekeeper of information flow, which answers many lingering questions on why students tested with the same scores on CT skills show the drastic difference in overall CT ability. This revelation challenges teachers' previous stereotype towards disposition as useless and motivates them to prompt students' willingness in using their CT skills To achieve this goal, corresponding classroom, as well as curriculum designing, also need further attention.

4.4 Ecology and CT cultivation

From Siemens' perspective, a healthy CT ecology needs educators' incessant effort and management. Not only in terms of the teacher-student relationship where the teacher should hold an inclusive view towards student's attempt of using CT skills, but also in terms of the interaction that students will have towards their classmates, their parents, or even acquaintances online, and also the interaction with unanimated subject as information provided by the textbook, library or Internet. Anything a student can have access to can be regarded as an inevitable element in ecology. Teachers as well as parents and others could make joint efforts in building an open and tolerant healthy CT ecology for students to get involved in CT activities.

5. Conclusion

Underpinned by the features of learning in the information era, connectivism with its unique characters as a new learning theory provides brand new perspectives for understanding CT formation. This study aimed to use connectivism to provide a rationale for the CT formation from the perspective of CT skills, CT disposition, and healthy CT ecology. This study provided a detailed analysis on how connectivism better explains CT formation with a premise of chaos situation, network model, flow inhibitors and flow

accelerators, and healthy ecology. Subsequently, this study also gives corresponding pedagogical suggestions on how teachers can utilize the CT formation rules to better facilitate CT cultivation, such as teachers could introduce some learning materials that might trigger students' critical thinking; evaluate students' learning procedure from a network perspective; pay more attention to students' CT disposition development and cultivate healthy CT ecology, etc. Even if this paper lacks empirical study to prove the findings, it features its synthetic analysis which gives enlightenment both in CT formation and the exploration on the potential of connectivism in the field of CT. Future studies might look further on the theoretical contribution that connectivism could make to the understanding of CT, and pay more effort on empirically implementing the pedagogical suggestions that connectivism provides for CT.

Funding: This research received no external funding.

Acknowledgments: The authors would like to send their sincerest gratitude to the anonymous reviewers for their suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

References

[1] Cooper, P. A. (1993). Paradigm Shifts in Designed Instruction: from Behaviorism to Cognitivism to Constructivism. *Educational Technology, 33* (5), 12-19.
[2] Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction: Research findings and recommendations*. Millbrae, CA: California Academic Press.
[3] Good, T. L., & Brophy, J. E. (1990). *Educational Psychology: A Realistic Approach*. New York, NY: Longmans Green.
[4] He, Y. (2000). On critical thinking. *Social Science Journal, 6*, 15-18.
[5] Huang Y.(1998). The absence of critical thinking. *Foreign Languages and Their Teaching 7*(2),18.
[6] Hu, J., & Chen, J. (2018). Enhancing L2 learners' critical thinking skills through a connectivism-based intelligent learning system. *International Journal of English Linguistics, 8* (3), 12-21.
[7] Jonassen, D. H. (1991). Objectivism vs constructivism: Do we need a new philosophical paradigm. *Educational Technology Research and Development, 39* (3), 5-14.
[8] Siemens, G. (2005a). Connectivism: A learning theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning, 2* (1), 3-10.
[9] Siemens, G. (2005b). Connectivism: learning as network-creation. http://www. elearnspace.org/Articles/networks. HTML.
[10] Siemens, G. (2006). Connectivism: Learning and knowledge today. http://www.educationau.edu.au/sites/default/files/gs2006_ siemens.pdf.
[11] Skinner, B. F. (1976). *About behaviorism*. New York, NY: Vintage Books.
[12] Sun, Y. (2011). Promoting the reform of English majors teaching by emphasizing critical thinking cultivation. *Foreign Languages in China, 3*, 49-58.
[13] Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. New York, NY: The Macmillan Company.
[14] Wen, Q. (2010). A Comparative Study of Critical Thinking Skills between English and other Liberal Arts Majors. *Foreign Language Teaching and Research, 5*, 350-355+400.