Exploring Behaviorism: A Networked (Re)integration

Fabian Gunnars

Department of Education, Mid Sweden University, fabian.gunnars@miun.se

Abstract

Skinner claimed when outlining his behaviorist philosophy, that concepts exist in the world before anyone identifies them, yet that they are inherently linked to social and cultural descriptions and predictions. The perspective has been dismissed by many researchers in the learning sciences as an important but obsolete relic in origin narratives introducing perspectives. In such a narrative, behaviorism is portrayed ontologically as incompatible with complex domains related to agency, emotion and engagement. However, researchers have started to consider its relevancy to clearly specify sequential learning tasks on a materialistic level integral to a networked sociocultural perspective.

Following the recent trend of defending behaviorism, the presented paper creatively explores the valuable and useful functions of behaviorist philosophy that are integral to research associated with design, teacher professional development, and digital ubiquitous technology. The paper aims to provide a philosophical foundation for further discussion of a scientific methodology by relating basic conceptual underpinnings of behaviorism to different domains and levels of analysis integral to the networked sociocultural perspective.

The networked sociocultural perspective concerns the organization of knowledge. This organization functions to link different practices, perspectives and theories without reducing one to another. This organization of knowledge is very similar to the way individuals are conceptualized in a behavioral analysis, constituted and reinforced by different processes of successful behavior, allowing individuals to integrate the successes of a particular organized domain into other knowledge domains and instances of emotion. Following this logic, organizations and professions linked to them depend on an integration of multiple domains, forming complex networked learning amplified at a rapid rate by technological developments since the beginning of the 21st century.

Linking practices, settings, perspectives and theories by an established alignment constitutes scientific rigor and a valid methodology. The behavioristic methodology assumes value to prediction and systematic, creative explorations of complex domains at the level of observable material events. From a networked sociocultural perspective, behaviorism may guide researchers to take the necessary and required steps to provide a clear analysis of sequential learning task outcomes at the level of observable material events. Further, these predictions should be formulated in such a way that as a great amount of networked practices, perspectives and theories can integrate as possible, without reducing one to another.

Keywords

Behaviorism, Design, Network Learning, Philosophy of Science, Philosophy of Education, Community of Practice, Pragmatism, Linguistics, Communication, Creativity

Amplifying Professional Networked Design

Learning, according to Laurillard (2012) and Gee (2008), is intrinsically bound to the notion of design. In the knowledge domain of architecture, design emphasizes the application of aesthetics and functional creativity in practice (Dohn & Hansen, 2016). Similar to this emphasis, design can represent a process of forming and may refer to one or several parts which it consists of. The process of forming consists of giving form in a knowledge domain to what previously has manifested as the result of a concept, or even a preliminary sketch related to a concept (Konnerup, Ryberg, & Sørensen, 2019). Viewing knowledge and concepts as linked to the capacity to engage in and affect the environment, the conceptual underpinnings of design can be related to antique ideas from Greece about learning, inherently cultural and social and still relevant today (Carr, 2010; Goldstein, 2014; Luckin, Holmes, Griffiths, & Forcier, 2016; Selander, 2008).

Some of these knowledge domains aim to link different practices, concepts, perspectives and theories without reducing one to another, such as the networked sociocultural perspective (Bakhtin, 1981; Daniels, 2017;

Wertsch, 1998). These notions can be related to foundational concepts residing in the philosophical knowledge domain of pragmatism, where theories serve to be used as instruments in different instances of emotions that greatly vary (James, 1884, 1907). In this way, the networked sociocultural perspective shares similarities with design, which transacts practices "such that the design, the problem, and even the theory are fused […] in ways that are not easy to disentangle" (Barab, 2014, p. 156). The environment emphasizes informal learning and its impact on professional work life, which cannot be understood without consideration for designs across multiple domains (Jaldemark, 2018).

From a networked sociocultural perspective, different theories "acts as a guide about what to pay attention to, what difficulties to expect, and how to approach problems" (Wenger, 1999, p. 9). This sets design limits to the development of professions, as it ultimately belongs to the practical domain with instances of emotion and engagement. The practical domain affects the likelihood that the concepts of the design will be manifested and integrated (James, 1884, 1907; Papert, 1980; Skinner, 1953; Wenger, 1999). Digital ubiquitous technology provides further complexity to the formal designing of professions (Wang, 2018).

Technological devices, networks, and software today are often referred to as digital. The digital can be understood as mainly characterized by a ubiquitous quality, providing access to different services anytime and anywhere (Wang, 2018). Technological developments since the beginning of the 21st century have amplified this ubiquitous quality drastically (Moebert, Zender, & Lucke, 2016). In short, the ubiquitous quality of digital technology affects communication processes anytime anywhere. Smartphones and similar digital ubiquitous devices are not only resources but in this way intrinsically linked to practices across multiple domains (Luckin et al., 2016). This affects professions and their increasing ability to integrate professional experiences across knowledge domains, forming networked learning effects (Littlejohn, Jaldemark, Vrieling-Teunter, & Nijland, 2019; Wang, 2018).

One example of how the ubiquitous quality of the digital technology affects networked practices across multiple domains is the boundary line between what is considered to be public practice and what is considered to be private practice (Lindell & Hrastinski, 2018). This boundary may shift "with every discovery of a technique for making private events public. Behavior which is of such small magnitude that it is not ordinarily observed may be amplified" (Skinner, 1953, p. 282).

Historically, three main perspectives have been used in the design of digital ubiquitous technology in relation to the professional work of teachers and its development. Behaviorism and cognitivism are two of them (Selander, 2008), where behaviorism often is notoriously associated with the "teaching machine" (Sawyer, 2014). Previously these perspectives were considered incompatible, but recently, this has shifted in networked sociocultural research to the notion of approaching different levels of analysis. This might enable the use of traditional philosophy of science and relate it to current teacher professional development and digital ubiquitous technology (Crook & Sutherland, 2017).

Inseparable Sequences of Environmental Knowledge

Technology tends to develop quickly over time. This is especially true for digital ubiquitous technology, constantly evolving at a rapid pace (Zbick, Vogel, Spikol, Jansen, & Milrad, 2016). Teachers face challenges adapting to these changes when constructing sequences of learning tasks (Luckin et al., 2016). These sequential learning tasks are assumed to have learning outcomes of knowledge relevant to the needs of local communities and are a core part of what defines the profession of teachers (Mølstad, Petterson, & Prøitz, 2018).

The scientific relevancy of sequential learning tasks bound to the practice in which teachers work is by researchers approached from different perspectives and methodologies (Lai & Bower, 2019). Recent literature reviews have outlined evidence for motivational influences relating to sequential learning tasks that involve digital ubiquitous technology (Granić & Marangunić, 2019; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). These reviews outline the motivation for sequential learning tasks but does not analyze task outcomes. However, they explicitly emphasize the need for further research on task outcomes. Some perspectives and methodologies may be considered as more suitable when researching task outcomes.

Broad theoretical approaches may be relevant to educational practice but, according to Andersson & Shattuck (2012) and Michos & Hernández-Leo (2018), insufficient to clearly specify and analyze sequential learning tasks. Instead, a perspective that has a foundational emphasis on observed materialistic complexity and the prediction of sequential learning tasks may be more suitable (Crook & Sutherland, 2017). The learning sciences

were dominated by such a perspective for most of the 20th century. Nowadays considered traditional and foundational, this perspective is referred to as behaviorism (Sawyer, 2014).

Behaviorism is often misconstrued as functionally outdated and dismissed to only serve as part of origin narratives presenting and introducing learning theories (Saari, 2019). The ontological basis for behaviorism is notorious with associations to conceptualizations that replace complex emotional experiences with reductionist learning such as the skinner-box (Barrett, 2017). This may be considered as odd or surprising, as the historical-cultural effects and potential benefits of behaviorism in the field can by no means be regarded as trivial (Bosseldal, 2019). Even researchers with antagonistic approaches to behaviorism admit its relevance to the field (Laurillard, 2012). Despite all of this, elements of behaviorism are clearly visible in the learning sciences to this day, particularly in the design development of sequential learning tasks (Crook & Sutherland, 2017).

According to Skinner (1953), the basic assumption of behaviorism is one of science. While the everyday practice may consist of a way of thinking that assumes value to description, science confines itself to the aim of prediction based upon observable events. This prediction requires identification of independent variables that serve as necessary constituents to the events, forming a relation (Skinner, 1953). As in research associated with design (Mor & Winters, 2007), this relation is referred to as a function.

Learning can be understood as the endowment of knowledge. This knowledge can function as a special repertoire to the process of forming. Knowledge is linked to cultural ideas and concepts of appropriately navigating the environment. This involves a certain organization of relevant materials by means of control (Skinner, 1953). In this way, both the professional work of teachers and the networked sociocultural research on teacher professional development share the goal of shaping a new way of thinking about the environment through a sequential process of forming (Konnerup et al., 2019; Littlejohn et al., 2019). They both share the assumption that theories affect practices, and that learning affects human behavior. Behaviorism assumes that knowledge is maximized by education and that its value can be derived by its efficacy towards encouraging the appearance of solutions or tentative solutions to problems (Skinner, 1953).

As the environment develops, so will notions of appropriate behavior. While the neurons in muscles work in a fashion of passive reactive reflex behavior controlled by an external agent (stimulus-response), in most cases the neurons and synapses in human brains do not (Skinner, 1953). Historically this distinction has not always been made, which has led to exaggerated claims that ignore the fact that "the greater part of the behavior of the intact organism is not under this primitive sort of stimulus control" (Skinner, 1953, pp. 49–50). At the same time, however, brains operate under certain physical limitations, which cannot be avoided by just denying them. As such, ignoring the principle of the reflex entirely would be equally unwarranted (Skinner, 1953).

Many important discoveries have been made since Skinner's contributions. His ideas were permeated by pragmatic notions of exploratory research. He saw great resources being wasted on theories that would inevitably be overthrown along with the associated research. His solution was to emphasize the environment (Skinner, 1974). This has also been done by pragmatists or curriculum theorists such as Dewey, Englund, and Schwab to predict how education can supply meanings to social practice from past collective or political developments (Uljens & Ylimaki, 2017). Not unlike these theorists, Skinner wanted to affect what he referred to as the "cultural design" (Skinner, 1953, p. 419). Interpreting this term networked and socioculturally might entail the organization of knowledge domains (Wenger, 1987; Wenger-Trayner & Wenger-Trayner, 2015), and its practical use in professional communities to explore "how to design the world as a learning system" (Wenger, McDermott, & Snyder, 2002, p. 232).

Giving Form to Contingencies of Association

Teaching may involve taking a central role in the process of designing sequential learning tasks (Laurillard, 2012). Sequential learning tasks may aim towards guiding the students and assisting their performance in a variety of ways, dedicated to different processes, such as modeling, feedback, questioning and cognitive structuring (Forman, Minick, & Stone, 1996). Analyzing some of the processes from a networked sociocultural perspective requires the integration of additional levels of analysis other than the behavioristic (Bergner, 2017; Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006; Van Merriënboer & Kirschner, 2018).

One example of such a level is the cognitive one, emphasizing experiential aspects of behavior. Crook and Sutherland (2017) claim that cognitivism allows narrow focus on the limiting of clutter in terms of input, emphasizing the impact of memory to experience and ways of boosting memory storage through coherent mental representations.

Behaviorism may also be reduced to a similar level of concept depth to ease the integration into a networked sociocultural perspective. At this level, behaviorism can establish a focus on knowledge through behavior, as a matter of attaining complex response capability through contingencies of association. These contingencies of association consist of a bottom-up of sequential construction involving simple task constituents, where success in each step is reinforced with suitable contingent feedback (Crook & Sutherland, 2017).

Crook & Sutherland (2017) claim that if done correctly, these sets of features from the perspectives of behaviorism and cognitivism can without problematic implications be integrated into a networked sociocultural perspective that may concern a variety of ways teacher assist performance and guide the students. Such a perspective must, according to Crook & Sutherland (2017), maintain the emphasis on learners' engagement.

Integrating Ontological Speech

To use multiple theories or concepts on different levels of analysis, they must be aligned in some way to ensure compatibility. Some might argue that emphasizing learners' agency, instances of emotion and engagement or other related issues are incompatible with behaviorism (Barrett, 2017), as a control upon individuals may demotivate or demoralize them (Vansteenkiste, Niemiec, & Soenens, 2010). If one were to exclude the possibility to analyze different levels later to be integrated into a networked sociocultural perspective, this is certainly the case. Below, I will argue that Skinner intended to allow such integration in his version of behaviorism. The allowance in the theory can be illustrated through the function of language and ontology.

According to Skinner, words communicate nothing: they simply have an effect. Grammar is shaped by reinforced practice. Language is verbal behavior: speech acts that require no environmental support yet are acts within it. All verbal behavior in a society is at least indirectly related to systematic power issues (Skinner, 1974). The individual who is performing the behavior is in a behavioral analysis viewed as a concept related to an adaptive process pervaded by judging of what will occur in a variety of practices (Skinner, 1974). The sentiment that grammar is shaped by a reinforced practice of verbal behavior is, according to Givón (1979) agreed upon by many branches of linguistics.

While referring to engagement in a behavioral analysis might not be appropriate as it detracts environmental emphasis and highlights so-called inner influences, it is nonetheless possible to address related issues. One can refer to behavior that has momentary positive consequences that is unrelated to the task at hand (Skinner, 1974; Skinner & Vaughan, 1997). The task behavior are culturally impacted by language and concepts across different networked domains. The individual cannot be separated from the environment as they are viewed as concepts that "exist in the world before anyone identifies them" (Skinner, 1974, p. 105).

What is key, then, is integrating different practices and domains of successfully learned behavior to new domains through positive reinforcements. As verbal behavior is at least indirectly related to systematic power issues and characterized as acts that require no environmental support yet are acts within it, the same reinforcements can be used as tools for control (Skinner, 1974). Butler (1999, p. 187) refers to this phenomenon from an identical ontological standpoint as "politically enforced performativity", where "the possibility for the speech act [...] to function in contexts where it has not belonged, is precisely the political promise of the performative" (Butler, 1997, p. 161).

Verbal behavior can in this way be integrated into a process of forming to "re-represent—that is, to present again—the social to all its participants, to perform it, to give it a form" (Latour, 2005, p. 139). In the same way, non-verbal behavior consists of communicative aspects. Concepts and emotions can socially be communicated through different means of behavior that has integrative regulatory effects related to emotions and systematic power issues (Barrett, 2017; Roth, Vansteenkiste, & Ryan, 2019).

This does not by default exclude theories that make claims on a level of universality, rather, it places them as something useful and valuable in certain practices, highlighted by what kind of knowledge is adapted and manifested. Scientific history has provided us with a certain way of approaching the environment which has been useful (Skinner, 1953). Proof of this is the production of technology that mimics a certain logic from social aspects of these practices: digital ubiquitous devices, software, and networks but also developments in modern astronomy, mechanic chemistry, electrodynamics, atomic nuclear physics, genetics, and physiological psychology are examples of its usefulness (Bunge, 1996).

Methodological Functions of Networked Behaviorism

Bunge claims that the presupposition of science is rigorous theory testing and theory steered explanations through empirical data, in which we can in some cases completely identify fiction, social power struggles, fantasy, and magical thinking to separate them from fact (Bunge, 1996). With these facts, Bunge claims that we can reach an objective level of knowledge about the environment that is, at least in part "suprabiological (in particular, suprapsychological)" (Bunge, 1996, p. 44). This entails a level of universality of knowledge that from a networked sociocultural perspective would be considered as outside the practice of science, containing a dualism of experiential instances of emotion with so-called inner processes that are characterized differently and separate from the adaptive processes of behavior and the environment.

Behaviorism is today often misattributed to similar claims as outlined above (Bosseldal, 2019; Saari, 2019). Rather than reducing the valuable scientific functions of behaviorism, it might better be understood through the notion that "science is not concerned just with 'getting the facts' […] Science not only describes, it predicts. It deals not only with the past but with the future. Nor is the prediction the last word" (Skinner, 1953, p. 6). By establishing that the prediction is not the last word, behaviorism can scientifically function similarly as pragmatism and design in research related to networked professional learning. The definition of knowledge that Skinner presents as "not only a repertoire as such, but all the effects which the repertoire may have upon other behavior" (Skinner, 1953, p. 410) can in this way be elevated beyond facts with its reliance on environmental concerns. This reliance on environmental concerns may highlight informal aspects of networked professional learning (Littlejohn et al., 2019).

Assuming adaptive experiences have developed practically against a set of background constituents that enable them to function by the utilization of certain behavior, the environment and individuals within become fundamentally inseparable. This ontological position entails an allowance of the comparison and integration of multiple perspectives and their history to form a sociocultural network. The building blocks used in the production of knowledge is the environment itself. In the same way, experiential instances of emotion and engagement have not emerged into the environment from a void, implying a dualism, but are instead assembled as concepts from already existing parts, giving form to behavior (including verbal behavior).

The alignment of different theories according to an established standard constitutes scientific rigor and a valid methodology. Part of such an alignment may be according to the standards of the networked sociocultural perspective that require findings to be formulated in such a way that as great amount of practices, perspectives and theories can integrate it as possible, without reducing one to another (Bergner, 2017; Van den Akker et al., 2006; Van Merriënboer & Kirschner, 2018). The behavioristic methodology assumes value to prediction and systematic, creative explorations of complex domains at the level of observable material events. From a networked sociocultural perspective, the integration of behaviorism may be useful as a guiding instrument for researchers to take the necessary and required steps to clearly specify sequential learning task outcomes at the level of observable material events (Crook & Sutherland, 2017; Skinner, 1953). However, even if a scientific community of practice has agreed upon a set of methodological principles that generate research, this "does not prove its value unless the research is valueable" (Skinner, 1950, p. 194).

References

Anderson, T., & Shattuck, J. (2012). Design-Based Research: A Decade of Progress in Education Research? *Educational Researcher*, *41*(1), 16–25.

Bakhtin, M. M. (1981). *The Dialogic Imagination: Four Essays*. (C. Emerson & M. Holquist, Trans.). Austin: University of Texas Press.

Barab, S. (2014). Design-Based Research: A Methodological Toolkit for Engineering Change. In R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 151–170). New York: Cambridge University Press.

Barrett, L. F. (2017). *How Emotions Are Made: The Secret Life of the Brain*. New York: Houghton Mifflin Harcourt.

Bergner, Y. (2017). Measurement and its Uses in Learning Analytics. In C. Lang, G. Siemens, A. F. Wise, & D. Gašević (Eds.), *The Handbook of Learning Analytics* (pp. 34–48). Alberta: Society for Learning Analytics Research (SoLAR). Retrieved from http://solaresearch.org/hla-17/hla17-chapter1

Bosseldal, I. (2019). *Vart Tog Behaviorismen Vägen?: Social Responsivitet Mellan Barn och Vuxen, Hund och Människa*. Lund: Lund University, Faculty of Social Sciences.

Bunge, M. (1996). *Finding Philosophy in Social Science*. New Haven: Yale University Press.

Butler, J. (1997). *Excitable Speech: A Politics of the Performative*. New York: Routledge.

Butler, J. (1999). *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.

Carr, D. (2010). The Philosophy of Education and Educational Theory. In R. Bailey, R. Barrow, D. Carr, & C. McCarthy (Eds.), *The Sage Handbook of Philosophy of Education* (pp. 37–53). London: Sage Publications.

Crook, C., & Sutherland, R. (2017). Technology and Theories of Learning. In E. Duval, M. Sharples, & R. Sutherland (Eds.), *Technology Enhanced Learning: Research Themes* (pp. 11–27). Cham: Springer. Retrieved from https://doi.org/10.1007/978-3-319-02600-8_2

Daniels, H. (Ed.). (2017). *An Introduction to Vygotsky* (3rd ed.). Abingdon: Routledge.

Dohn, N. B., & Hansen, J. J. (2016). Didaktik, Design Og Digitalisering: En Begrebsoversigt. In N. B. Dohn & J. J. Hansen (Eds.), *Didaktik, Design Og Digitalisering* (pp. 19–42). København: Samfundslitteratur.

Forman, E. A., Minick, N., & Stone, C. A. (1996). *Contexts for Learning: Sociocultural Dynamics in Children's Development*. New York: Oxford University Press.

Gee, J. P. (2008). Being a Lion and Being a Soldier. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of Research on New Literacies* (pp. 1023–1036). Mahwah: Lawrence Erlbaum Associates.

Givón, T. (1979). *On Understanding Grammar*. Orlando: Academic Press.

Goldstein, R. (2014). *Plato at the Googleplex: Why Philosophy Won't Go Away*. New York: Pantheon.

Granić, A., & Marangunić, N. (2019). Technology Acceptance Model in Educational Context: A Systematic Literature Review. *British Journal of Educational Technology*, *50*(5), 2572–2593.

Jaldemark, J. (2018). Contexts of Learning and Challenges of Mobility: Designing for a Blur Between Formal and Informal Learning. In Y. Shengquan, A. Mohamed, & T. Avgoustos (Eds.), *Mobile and Ubiquitous Learning: An International Handbook* (pp. 141–155). Springer. Retrieved from https://doi.org/10.1007/978-981-10-6144-8

James, W. (1884). What Is an Emotion? *Mind 34*, 188–205.

James, W. (1907). *Pragmatism: A New Name for Some Old Ways of Thinking*. Popular lectures on philosophy by William James. New York: Longmans, Green and Co.

Konnerup, U., Ryberg, T., & Sørensen, M. T. (2019). Designs for Learning as Springboards for Professional Development in Higher Education. In A. Littlejohn, J. Jaldermark, E. Vrieling-Teunter, & F. Nijland (Eds.), *Networked Professional Learning* (pp. 111–127). Springer.

Lai, J. W., & Bower, M. (2019). How Is the Use of Technology in Education Evaluated? A Systematic Review. *Computers & Education*, *133*, 27–42.

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*. New York: Oxford University Press.

Laurillard, D. (2012). *Teaching as a Design Science: Building Pedagogical Patterns for Learning and Technology*. New York: Routledge.

Lindell, T. L., & Hrastinski, S. (2018). Exploring Functions and Tenable Structures for Mobile Use as Support for School Tasks. In Y. Shengquan, A. Mohamed, & T. Avgoustos (Eds.), *Mobile and Ubiquitous Learning: An International Handbook* (pp. 323–339). Springer. Retrieved from https://doi.org/10.1007/978-981-10-6144-8

Littlejohn, A., Jaldemark, J., Vrieling-Teunter, E., & Nijland, F. (2019). Networked Professional Learning: An Introduction. In A. Littlejohn, J. Jaldemark, E. Vrieling-Teunter, & F. Nijland (Eds.), *Networked Professional Learning* (pp. 1–14). Springer.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in education. *Pearson*. Retrieved from http://oro.open.ac.uk/id/eprint/50104

Michos, K., & Hernández-Leo, D. (2018). Supporting Awareness in Communities of Learning Design Practice. *Computers in Human Behavior*, *85*, 255–270.

Moebert, T., Zender, R., & Lucke, U. (2016). A Generalized Approach for Context-Aware Adaptation in Mobile E-Learning Settings. In A. P. Ayala (Ed.), *Mobile, Ubiquitous, and Pervasive Learning: Fundaments, Applications, and Trends* (Vol. 406, pp. 23–54). Cham: Springer. Retrieved from https://doi.org/10.1007/978-3-319-26518-6

Mølstad, C. E., Petterson, D., & Prøitz, T. S. (2018). Soft Infusion: Constructing 'Teachers' in the PISA Sphere. In R. Normand, M. Liu, L. M. Carvalho, D. A. Oliveira, & L. LeVasseur (Eds.), *Education Policies and the Restructuring of the Educational Profession* (pp. 13–26). Springer. Retrieved from https://doi.org/10.1007/978-981-10-8279-5

Mor, Y., & Winters, N. (2007). Design Approaches in Technology-Enhanced Learning. *Interactive Learning Environments*, *15*(1), 61–75.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.

Roth, G., Vansteenkiste, M., & Ryan, R. M. (2019). Integrative Emotion Regulation: Process and Development from a Self-Determination Theory Perspective. *Development and psychopathology*, *31*(3), 945–956. Cambridge University Press.

Saari, A. (2019). Out of the Box: Behaviourism and the Mangle of Practice. *Discourse: Studies in the Cultural Politics of Education*, *40*(1), 109–121.

Sawyer, R. K. (2014). The New Science of Learning. In R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 1–20). New York: Cambridge University Press.

Selander, S. (2008). Designs for Learning and Ludic Engagement. *Digital Creativity*, *19*(3), 145–152.

Skinner, B. F. (1950). Are theories of learning necessary? *Psychological review*, *57*(4), 193.

Skinner, B. F. (1953). *Science and Human Behavior*. New York: The Macmillan Company.

Skinner, B. F. (1974). *About Behaviorism*. New York: Knopf.

Skinner, B. F., & Vaughan, M. E. (1997). *Enjoy old age: A practical guide*. New York: WW Norton & Company.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the Relationship Between Teachers' Pedagogical Beliefs and Technology Use in Education: A Systematic Review of Qualitative Evidence. *Educational Technology Research and Development*, *65*(3), 555–575.

Uljens, M., & Ylimaki, R. M. (2017). Non-Affirmative Theory of Education as a Foundation for Curriculum Studies, Didaktik and Educational Leadership. In M. Uljens & R. M. Ylimaki (Eds.), *Bridging Educational Leadership, Curriculum Theory and Didaktik* (pp. 3–145). Cham: Springer.

Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (2006). *Educational Design Research*. Abingdon: Routledge.

Van Merriënboer, J. J., & Kirschner, P. A. (2018). *Ten Steps to Complex Learning: A Systematic Approach to Four-Component Instructional Design* (3rd ed.). New York: Routledge.

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The Development of the Five Mini-Theories of Self-Determination Theory: An Historical Overview, Emerging Trends, and Future Directions. *The Decade Ahead: Theoretical Perspectives on Motivation and Achievement* (pp. 105–165). London: Emerald Group Publishing Limited.

Wang, Q. (2018). Core Technologies in Mobile Learning. In Y. Shengquan, A. Mohamed, & T. Avgoustos (Eds.), *Mobile and Ubiquitous Learning: An International Handbook* (pp. 127–139). Springer. Retrieved from https://doi.org/10.1007/978-981-10-6144-8

Wenger, E. (1987). *Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge*. Los Altos: Morgan Kaufmann Publishers, Inc.

Wenger, E. (1999). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Harvard Business Press.

Wenger-Trayner, E., & Wenger-Trayner, B. (2015). Learning in a Landscape of Practice: A Framework. In E. Wenger-Trayner, M. F. O'Creevy, S. Hutchinson, C. Kubiak, & B. Wenger-Trayner (Eds.), *Learning in Landscapes of Practice: Boundaries, Identity and Knowledgeability in Practice-Based Learning* (pp. 13–30). London: Routledge.

Wertsch, J. V. (1998). *Mind as Action*. Oxford: Oxford University Press.

Zbick, J., Vogel, B., Spikol, D., Jansen, M., & Milrad, M. (2016). Toward an Adaptive and Adaptable Architecture to Support Ubiquitous Learning Activities. In A. P. Ayala (Ed.), *Mobile, Ubiquitous, and Pervasive Learning: Fundaments, Applications, and Trends* (Vol. 406, pp. 193–222). Cham: Springer. Retrieved from https://doi.org/10.1007/978-3-319-26518-6