

Reviewing, re-viewing, and re-encountering

Lixin Luo

University of Alberta

Abstract: *The present study is part of a hermeneutic inquiry that re-conceptualizes mathematics curriculum as recursive through the lens of complexity thinking. In recognizing the pervasiveness of the phenomenon of a learner encountering something she has previously encountered before and the lack of attention in orientating such reencountering towards transformation in theory and practice, the process of reviewing is reinterpreted as re-viewing and re-encountering. Four forms of re-encountering (re-languaging, re-imagining, re-inbodying, and re-storying) are proposed. Each form is informed by related lived re-viewing experiences, in which a learner learned something new through encountering what s/he had encountered before. Such texts of experiences are generated through autobiographical reflections, teaching documents analysis, conversations with experienced high school mathematics teachers, and iterative reinterpretations of them. This study can provide theoretical and practical references for mathematics educators and education researchers to draw inspirations from, when designing towards recursive curricula that center on re-encountering.*

RESEARCH NECESSITY

A mathematics curriculum often seems to be designed or delivered as linear: a sequence of predetermined, sometimes unrelated, topics with few chances for learners to revisit them from different perspectives. This suggests learning as accumulation with predictable outcomes. Learning, observed through a complexified world view, is neither linear nor predictable. Learning is a self-organizing process through which a learner and her environment co-evolve, and a recursive elaboration through which a learner transforms her previous understanding (Davis & Sumara, 2002; Davis, Sumara, & Luce-Kapler, 2008). Both learners and school subjects are complex systems with a biological structure (Davis & Sumara, 2002) that emerges. This view demands a recursive curriculum that centers on reviewing previously encountered ideas with an orientation towards newness and changes along its formation. What might such mathematics curriculum be like, particularly at high school level, in theory and practice is my research (see Luo, 2019) focus. There is a gap in how little we (i.e., mathematics educators and mathematics education researchers) know about recursive curricula and how important they are for mathematical learning. The present study reports part of the research, focusing on reinterpreting

the process of reviewing as a form of recursion. Such reconceptualization is deemed necessary in recognizing the pervasiveness of reviewing in lived, planned, and hidden mathematics curricula in contrast to a taken-for-granted attitude towards it in both theory and practice. The leading question is “How can one design reviewing processes that help learners build connections and see something new from what they have encountered before?”

THEORETICAL FRAMEWORK

The study is derived from Doll’s (1993) seminal conceptualization of a post-modern curriculum with the criteria of 4Rs (i.e., richness, relations, recursion and rigor) and continues the effort to complexify and theorize recursion and recursive curriculum. The study is grounded in complexity thinking (Davis & Sumara, 2006), which studies complex systems that are adaptive, such as cognition and knowledge. Key ideas in complexity thinking, such as self-organization, emergence, fractal-like self-similarity, recursion, and that the whole is greater than the sum of the parts, are used to frame reinterpretations of learning, learner, knowledge, school subject, and curriculum. Agreeing with Presmeg, Radford, Roth, and Kadunz’s (2016) emphasis of the significance of semiosis for mathematics, I enlist Peirce’s sign theory, interpreted through Presmeg et al. (2016), to situate my interpretation of reviewing with necessary terms and needed assumptions about signs in mathematics.

METHODOLOGY AND RESEARCH PROCESS

The research methodology follows the tradition of hermeneutics (Gadamer, 1989/2013) that attends to language and emphasizes emerging understanding through iterative loops of interpretations. The interpretations in this research are informed by three kinds of entry texts, my personal reflections about recursive curriculum, teaching documents (i.e., programs of studies and textbooks) analysis, and conversations with teachers, serving to provoke my thinking and generate further reflection subjected to new rounds of interpretations. Several high school mathematics teaching documents from Canada and China were examined to see in what ways a planned curriculum might afford recursion. Conversations with experienced high school mathematics teachers were conducted in professional development workshops and/or individual meetings. Teachers were invited to reflect on their learning and teaching experiences and comment on several teaching and learning practices (e.g., reviewing), and work with me to revise or generate curriculum materials to promote such practices orientated towards helping students to learn something new from what they have encountered before. Given the connection between complexity thinking and Merleau-Ponty’s work on embodiment (see Varela, Thompson, & Rosch, 1991/1993), it is inevitable that this study has some affinity to Merleau-Ponty’s ideas and

phenomenology, yet the connection is beyond the scope of the study and my interpretations of any lived experience are not to reveal its essence but to, following (Gadamer, 1989/2013), understand it differently.

REVIEWING REINTERPRETED AS RE-VIEWING AND RE-ENCOUNTERING

Reviewing is interpreted as re-viewing and three forms of re-viewing (i.e., re-languaging, re-imagining, re-inbodying) are proposed. Later these forms as a whole are reinterpreted as re-storying. Together these interpretations transform re-viewing into re-encountering. Each of the forms of re-encountering is informed by related lived re-viewing experiences. For example, the theorization of re-inbodying drew inspirations from my mathematical and pedagogical growth benefited from (re)enacting a previously learned idea in novel ways: Through paralleling my physical enactments of $-6 - 2 = -8$ in two representation systems (i.e., number line and integer token), I renewed my understanding of zero and negative numbers, and found that two problem solving strategies frequently used in higher grades (i.e., introducing needed symbols through making 1 or 0, simplifying mathematical expressions before calculations) have already appeared in lower grades through the use of negative tokens.

Re-viewing

A re-viewing process is similar to a reviewing process in having a structure of looping back yet differs from it with an affordance in novelty: Through encountering what they have encountered before, learners understand it anew. I propose three forms of re-viewing: 1) re-languaging, a process of changing the language used to express or explain something with an orientation or outcome of understanding it anew; 2) re-imagining, a process of generating a different image to present something with an orientation or outcome of understanding it anew; 3) re-inbodying, a process of one attending to and/or using one's body differently to engage with an idea with an orientation or outcome of understanding it anew. These three forms, when looking together, suggest both the whole and part of re-viewing as a re-storying process: Each of the three forms can be considered as changing different dimensions of the same story. Dietiker's (2013) theory of mathematical story is modified to support this interpretation.

Re-encountering

To deemphasize the eyes, consciousness, and logical analytical mode of knowing, to stress the whole body with kinesthetic, tacit, and analogical modes of knowing, and to acknowledge re-viewing as both planned and lived processes, re-viewing is changed to re-encountering. The word "encountering" is also chosen for its connotation of meeting something unexpectedly and informally, in order to have the theorization of re-encountering to lend support for designing a recursive curriculum that changes along its unfolding hence open for novelty and serendipity. In a

re-encountering process, one works with the medium (i.e., a signifier/representation and process) of thought to afford re-interpreting and re-experiencing. Different forms of re-encountering engage different types of mediums: language, image, body, and story, or worded differently, linguistic, visual-spatial, physical, and narrative representation, and the process of expressing, representing, and working with the medium itself. Each type of mediums enables one to express and/or engage with ideas in a certain way, invoking certain ways of thinking and eliciting different modes of knowing. Since in all four forms of re-encountering, learners work with equivalent ideas/texts, which could be different ideas/texts about the same thing or same idea/text encountered at different times, they are subjected to the influence of the different affordances and limitations of the different mediums. New understanding often emerges when a learner establishes or revises a sense of equivalency by seeing different objects as the same, seeing the same or equivalent objects differently, or generating something equivalent. In the language of sign theory, all four forms uses a sign vehicle (i.e., a wording, an image, a physical engagement, and a story respectively) for meaning, and use the means and process to inform mathematical meaning making. They are a process of making a sign vehicle more mathematically meaningful, either through seeing/sensing it anew or changing between equivalent ones. The focus of a re-encountering process, though, is not at the end of the process as there is no interest to label one form better than the other or settle down with any of the forms. Rather, in line with Sfard's (2010) conceptualization of learning mathematics as "changing forms of communication" (p. 217), re-encountering is a process of learning through change and difference. The harmony or tension that arises from the comparison of forms is the source of insights in re-encountering. The space for growth is in between.

IMPLICATIONS

Albeit a reconceptualization of reviewing has no end and the above proposed categorization of re-encountering is neither exhaustive nor absolute, this study has implications in both theory and practice. It extends Davis et al.'s (2008) work that provides provocative recursive curriculum design advice for particularly collective learning settings: It offers finer details of recursive elaborations and broadens the possible starting points of a recursive curriculum for both individual and collective learning settings. The theorization of elaborative processes as re-encountering and the proposal of four possible forms (i.e., re-languaging, re-imagining, re-inbodying, and re-storying) allows practical questions, such as "What might it be worded like? What might it be imagined like? What might it be embodied/enacted/perceived like? What might a story about it be like?", or general prompts, such as "It is like ___" and "It reminds me of ___", where the word "it" refers to the mathematics idea that one re-views and/or the medium used to express the idea, to be used to occasion recursion in class or guide design towards recursive curricula. Re-encountering enlists the narrative, artistic, metaphorical, and intuitive modes of knowing, beyond the analytic and logical ones. Such mix is what Doll (1993), following Bruner, advocates in post-modern

curriculum design and believes “would encourage us to think of knowledge in a new light” (p. 124).

The theorization of re-encountering as a play with contingent equivalency allows a recursive elaboration process to start from any content at micro or macro scales and unfold by generating new entitie(s) that are tentatively and heuristically equivalent to the previous whole(s) at a particular time and space. This helps to break the boundaries of a planned curriculum as one can always generate equivalent contents for an existing one, hence actualizing the recursive curriculum that Doll (1993) envisions: “In a curriculum that honors, values, uses recursion, there is no fixed beginning or ending” (p. 178). It helps to enact Whitehead’s (1929/1959) teaching aphorisms, i.e., keeping the main ideas one teaches few and important, teaching them thoroughly, and throwing them into all possible combinations, which, as Doll (2005) emphasizes, are important to keep knowledge alive. It is also in line with what Davis et al. (2008) advocate, to have the educational intentions be “embedded and embodied in *every* aspect of the learning experiences, as opposed to being identified as goals to be met by the end of a sequence of instruction” (p. 211), and it actualizes a fractal-view of mathematics, seeing it as a complex system understood not through discovering some underlying truth or “secret in the middle”, but through observing it as “holograph” in which “every piece contains the information of the whole” (Fleener, 2002, p. 138). Further inquiry and practice of re-encountering, particularly in teacher education, is worth trying, as it affords engendering and experiencing abundant possibilities of generating something new through revisiting something old.

References

- Davis, B. & Sumara, D. (2002). Constructivist discourses and the field of education: Problems and possibilities. *Educational Theory*, 52(4), 409-428.
- Davis, B., & Sumara, D. (2006). *Complexity and education: Inquiries into learning, teaching, and research*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Davis, B., Sumara, D. J., & Luce-Kapler, R. (2008). *Engaging minds: Changing teaching in complex times* (2nd ed.). New York, NY: Routledge.
- Dietiker, L. (2013). Mathematics texts as narrative: Rethinking curriculum. *For the Learning of Mathematics*, 33(3), 14-19.
- Doll, W. E., Jr. (1993). *A post-modern perspective on curriculum*. New York, NY: Teachers College Press.
- Doll, W. E., Jr. (2005). Keeping knowledge alive. *Journal of Educational Research and Development*, 6, 27-42.
- Fleener, M. J. (2002). *Curriculum dynamics: Recreating heart*. New York, NY: Peter Lang.
- Gadamer, H. G. (2013). *Truth and method* (Rev. 2nd ed., J. Weinsheimer & D. G. Marshall, Rev. Trans.). London, England: Bloomsbury Academic. (Original work published 1989)

- Luo, L. (2019). *Towards recursive mathematics curricula: A complexified hermeneutic journey*. Unpublished Ph.D dissertation. Edmonton, Canada: University of Alberta.
- Presmeg, N. C., Radford, L., Roth, W-M., & Kadunz, G., (2016). *Semiotics in mathematics education*. New York, NY: Springer. doi: 10.1007/978-3-319-31370-2
- Sfard, A. (2010). Challenges of researching mathematics as discourse. In M. Pinto & T. Kawasaki (Eds.), *Proceedings of the 34th conference of the international group for the psychology of mathematics education* (Vol. 1, pp. 217-218). Belo Horizonte, Brazil: PME.
- Varela F. J., Thompson, E. & Rosch, E. (1993). *The embodied mind: Cognitive science and human experience*. Cambridge, MA: MIT Press. (Original work published 1991)
- Whitehead, A. N. (1959). *The aim of education and other essays*. New York, NY: Macmillan. (Original work published 1929)