Engaging in Design-Based Research to Support Integrated Curriculum for Literacy and Science

Dr. Tiffany Gallagher
Dr. Xavier Fazio
Associate Professors

Department of Teacher Education
Faculty of Education
Brock University
500 Glenridge Avenue
St. Catharines, Ontario
Canada
L2S 3A1

tiffany.gallagher@brocku.ca
xavier.fazio@brocku.ca

Abstract

This paper offers insights into the affordances and tensions of design-based research as two university educational researchers and two elementary teachers co-construct their knowledge of integrating digital text in science and literacy instruction. In this paper we spotlight our experience in the research process with them and the dialogical processes between the teachers and the researchers. The teachers were interviewed at the beginning and end of a six month planning period, and during the monthly meetings, field notes were taken and participant reflections were garnered. Qualitative analyses elucidated findings that underscore the value in establishing a collaborative foundation for professional dialogue; the teacher participants' nascent understanding of curricular integration in literacy and science; and their apprehensions about using digital technology to support literacy and science learning. Recommendations are offered for educators, facilitators and researchers using design-based researcher as an innovative approach for curriculum and teacher development

Engaging in Design-Based Research to Support Integrated Curriculum for Literacy and Science

Purpose

For elementary students, the acquisition of literacy skills is essential to support reading for meaning in content areas such as science. For teachers, there is a need to consider how to incorporate different forms of literacy into content-based instruction. The overarching purpose of our study is to examine the processes of teachers and researchers constructing meaning about the domain of science within the context of literacy instruction. As researchers, we are engaged in design-based research (DBR) with two elementary teachers who are co-constructing their knowledge of integrating digital and print texts in science and literacy instruction while addressing curricular standards for the fifth grade in language and science. The value of communicating, reading and writing in science is well established (e.g., Fang, 2006; Norris & Phillips, 2003; Shanahan & Shanahan, 2008). DBR offers important considerations for researchers to capture elementary teachers' understanding and practices as they support science learning through literacy.

By closely examining the roles and contributions made by the researchers and the teacher participants, this paper addresses the 2014 LRA conference theme, *"The Dialogic Construction of Literacies."* Similar to others (e.g., Gee, 1997), we view dialogic literacy as the foundation for pedagogical thinking in teaching and learning as educators participate in dynamic discourse to build new understandings. As communication and collaboration are fundamental aspects of dialogic literacy (Bereiter & Scardamalia, 2005), we present both perspectives (researchers' and teacher participants') giving voice to their conceptualizations of science-based integration in literacy. This is of particular interest to literacy researchers who seek to employ research methodologies such as DBR that connect theoretical research and educational practice methods (Anderson & Shattuck, 2012; Design-Based Research Collective, 2003; Morgan, 2013). This paper offers insights into the affordances and tensions of embarking on DBR by focusing on the following research question: What are the experiences of the researchers and teacher participants in design-based research as they develop integrated literacy and science curriculum to enhance students' science learning?

Conceptual Perspectives

Effective literacy *and* science teachers question their teaching, reflect on their practice, and try out new instructional theories, and resources (Author, 2009; Mazzoni & Gambrell, 2003). However, to embrace such significant changes to teachers' practices, job-embedded professional learning needs to include collegial partnerships and mirror the gradual release of responsibility (Snow, Griffin, & Burns, 2005). This study's goal embodies these principles of professional learning as it documents the impact of enhanced instructional practices for integrating literacy and science, and how this is promoted through DBR.

Educational design research can be defined as a genre of research which involves iterative development of solutions to pragmatic and complex educational problems in schooling contexts (McKenney & Reeves, 2012). DBR can be characterized as: intervention-centred, theoretically informed, goal oriented, iterative, mixed modality design, and pragmatic (Reinking & Bradley, 2008).

We have assumed the conceptual perspective that an integrated instructional approach can build a synergistic relationship between science and literacy as scientific inquiry and literacy share some skills, strategies, and goals (Cervetti & Pearson, 2012). There is evidence of such instructional efficacy in empirically researched science and literacy curriculum materials (Barber, 2009; Goldschmidt, 2010). Thus, making meaning in science via multimodal literacy strategies builds on the notion that language is an essential cognitive tool for learning science. By situating literacy within a robust knowledge-building domain like science, there are opportunities to enhance teachers' professional learning in both domains (Yore, Bisanz, & Hand, 2003). Our DBR study aims to uncover how elementary teachers work collaboratively with university researchers to refine their instructional practices in both literacy and science instruction. In this paper we spotlight our experience in the research process with them and the dialogical processes between the teachers and among the teachers and researchers.

Methods and Data Sources

Teachers were recruited as participants in the study through contact from the university researchers based on advice from the partner school district. Our study reported here involves two grade 5 teachers. One of the teachers in the study was an established teacher (15 years' experience); the other was a novice teacher (2 years' experience). The school is publically funded and located in a moderate SES demographic area in south central Canada. The prescribed school curricula include language and science (Ministry of Education, 2006; 2007), among other subject areas. Both teachers were interested in using DBR as a research methodology for classroom based interventions. Further, both teachers were excited about developing a more effective integrated literacy and science curriculum for their students.

This research project began with initial semi-structured interviews to garner background information about the two teachers' professional experience and their conceptions about science, literacy, curriculum integration, and general instructional beliefs. Over the course of six months, the researchers met monthly with the teacher participants to build rapport, document teacher participants' instructional needs (as related to science and literacy instruction), and investigate their perceptions of effective integrated literacy instruction. Discussions also focused on planning customized a science curriculum unit (*Properties and Changes in Matter*) that incorporated both digital and print-based text resources. Curriculum standards documents (both science and language) were referenced during the planning as well as scholarly and practitioner oriented articles related to integrating science and literacy. The researchers and teacher participants kept reflective notes on this process of collaboration and their job-embedded professional growth. During this period of collaboration and planning, field notes were recorded by the researchers and sessions were audio-recorded and transcribed. At the end of the six month period, the teachers were re-interviewed to capture their perceptions of the impact of this collaborative professional planning and learning. All qualitative data were analyzed through coding and categorizing for recurring themes (Creswell, 2002; Merriam, 2009). While our study involved extensive data collection, herein, we report on only findings related to teachers' and researchers' unique experiences with DBR prior to the intervention of newly developed curriculum resources for the teachers' classrooms.

Findings

Our qualitative analyses revealed three themes presented as salient findings about the experiences of the researchers and participants in the DBR study: (1) establishing a collaborative foundation; (2) curricular integration and initial orientation to DBR; (3) engaging participants and apprehensions with digital tools.

(1)   The effectiveness of teacher professional learning is dependent upon facilitators' understandings of how to support teachers' professional learning needs (Elish-Piper & L'Allier, 2010). In this study, a collaborative partnership was established among the university researchers and elementary school teachers as everyone collaborated in this educational design research. The teachers developed their professional knowledge and skills alongside the researchers to plan and facilitate literacy-focused lessons in science. In this way, the teachers were active co-participants in this study, both in creating and subsequently mobilizing knowledge to prepare for the intervention of the integrated curriculum and instructional curriculum unit within their classrooms.

(2)   Infusing literacy across the curriculum is often misunderstood by practicing teachers. (Crowhurst, 1994). The teachers in this study held a nascent appreciation of how to integrate literacy into science curriculum and instruction despite the fact that they were somewhat confident in the abilities to so at the beginning of the project. The collaborative meetings required explicit clarification and deep reflection on teachers' current situation within their grade 5 classroom, and identifying discrepancies in practice with respect to ideal science and literacy curriculum and instructional design.

(3)   As part of the DBR, the teachers identified an inquiry focus on how to effectively weave digital tools into instruction (Leu et al., 2007) for their grade 5 students while integrating science and literacy. This study seeks to support the need for practicing teachers to enhance their pedagogical knowledge about teaching with technology especially in science education as digital technology is inherent in this discipline. While the elementary teachers acknowledged that they must be responsive to the needs of their 21st century learners, and were willing to consider ways to adapt their instructional pedagogies in ways that support their students meaning making in science from digital text and multimodal media, they held apprehensions themselves about employing digital tools to engage in their own professional learning. For instance, the participating teachers were hesitant to collaborate during the curriculum development phase via a learning management system. This tension related to conducting DBR was an unintended yet important finding from our study.

Educational Importance

This paper presentation contributes to the advancement of professional learning in literacy and science instruction as it explores the ways in which DBR can be employed as a conceptual and operational methodology for innovative research and development for literacy instruction. Of educational significance is the focus on the experiences of elementary teachers and researchers as they establish a base for instructional design principles in science-based integration in literacy. As participants in the research process, the teachers and researchers came to appreciate a collaborative way to share their thinking about teaching and learning and question

how to digital texts might contribute to literacy learning and to knowledge acquisition in science. Establishing this collaborative foundation was necessary to create the space for the teacher participants to expose their limited experience with integrating science and literacy and focus their planned interventions in their respective classrooms (Wenger, 1998). Once this was accomplished, giving the teacher participants the latitude to express their nascent conceptualization of integration was a key step in the process of DBR. Even though digital modalities were offered to the teachers to support their dialogue and model how digital tools can be integrated into their own classrooms, these were approached with some trepidation. This finding should prompt facilitators and researchers to consider the important role of beliefs about teaching with digital technologies in professional learning.

Interest to the Audience

As teachers strive to make students critical consumers of content-based information, they seek instructional applications of digital and print learning media to build literacy capacity in their students. This study will resonate with educators who both facilitate and participate in professional learning that aims to build communities of practice and collaboration in the curricular integration of science and literacy. It is contended that collaboration is necessary but other open-ended discourse is also needed to support dialogue in communities of practice. While there still is a continuing need for more detailed cases of teacher pedagogical practices integrating science-specific literacies (Authors, 2013), this paper presentation provides recommendations on how to encourage effective design-based research in terms of its questions, orientations, and methods, so as to explore teachers pedagogical possibilities for integrating science and literacy using multimodal resources.

References

Anderson, T. & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher, 41*(1), 16-25.

Barber, J. (2009). Insights about the role of reading and writing in science. Presentation at STANYS conference. Rochester, NY.

Bereiter, C. & Scardamalia, M. (2005). Technology and literacies: From print literacy to dialogic literacy (pp. 749 – 762). In *International Handbook of Educational Policy*. N. Bascia, A. Cumming, A. Datnow, K. Leithwood, & D. Livingstone (Eds.). New York: Springer pp. 749 – 762.

Cervetti, G. & Pearson, P. (2012). Reading, writing, and thinking like a scientist. *Journal of Adolescent & Adult Literacy, 55* (7), 580-586.

Creswell, J. W. (2002). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage.

Crowhurst, M. (1994). *Language and learning across the curriculum.* Scarborough, ON: Allyn & Bacon.

Design-Based Research Collective (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher, 32*(1), 5-8.

Elish-Piper, L. & L'Allier, S. K. (2010). Exploring the relationship between literacy coaching and student reading achievement in grades K-1. *Literacy Research and Instruction 49*(2), 162-174.

Fang, Z. (2006). The language demands of science reading in middle school, *International Journal of Science Education*, *28*(5), 491-520. doi:10.1080/09500690500339092

Gee, J.P. (1997). Thinking, learning, and reading: The situated sociocultural mind. (pp. 235 – 260). In *Situated cognition. social, semiotic, and psychological perspectives*. D. Kirshner & J.A. Whitson (Eds.), Lawrence Erlbaum Associates, Mahwah.

Goldschmidt, P. (2010). Evaluation of Seeds of Science/Roots of Reading: Effective tools for developing literacy through science in the early grades. National Center for Research on Evaluation, Standards, and Student Testing (CRESST). Available: http://www.scienceandliteracy.org/sites/scienceandliteracy.org/files/biblio/seeds_eval_in _cresst_deliv_fm_060210_pdf_21403.pdf

Leu, D. J., Zawilinski, L., Castek, J., Banerjee, M., Housand, B.C., Liu, Y., & O'Neil, M. (2007). What is new about the new literacies of online reading comprehension? *Secondary school literacy: What research reveals for classroom practice*. NCTE.

Mazzoni, S.A., & Gambrell, L. (2003). Principles of best practice: Finding the common ground. In L. M. Morrow, L. B. Gambrell, & M. Pressley (Eds.), *Best practices in literacy instruction* (2nd ed., pp. 9-21). New York, NY: Guilford Press.

McKenney, S. & Reeves, T. (2012). *Conducting educational design research.* London: Routledge.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco: Jossey-Bass.

Ministry of Education (2006). *The Ontario Curriculum, Grades 1-8: Language.* Available: http://www.edu.gov.on.ca/eng/curriculum/elementary/language.html

Ministry of Education (2007). *The Ontario Curriculum Grades 1-8: Science and Technology*. Available: http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec.html

Morgan, A-M. (2013). 'Proof of concept': Beginning to use Design–Based Research to improve science literacies for middle years learners. *Australian Journal of Language and Literacy*, *36*(1), 3-16.

Norris, S. P., & Phillips, L. M. (2003). How literacy in its fundamental sense is central to scientific literacy. *Science Education*, *87*(2), 224-240. doi:10.1002/sce.10066.

Reinking, D. & Bradley, B.A. (2008). *Formative and design experiments*. New York: Teachers College Press.

Shanahan, T. & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: rethinking content-area literacy. *Harvard Educational Review, 78*(1), 40–59.

Snow, C. E., Griffin. P., & Burns, M. S. (Eds.). (2005). *Knowledge to support the teaching of reading: Preparing teachers for a changing world.* San Francisco: Jossey-Bass.

Wenger, E. (1998). *Communities of practice: learning, meaning, and identity*. Cambridge University Press.

Yore, L. Bisanz, G., & Hand, B. (2003). Examining the literacy component of science literacy: 25 years of language arts and science research. *International Journal of Science Education, 25*(6), 689-725.