**SCIENCE LEARNING AND LANGUAGE: SELECTED REFERENCES**

**(Last updated 12 August 2022)**

Afitska, O., & Heaton, T. J. (2019). Mitigating the effect of language in the assessment of science: A study of English‐language learners in primary classrooms in the United Kingdom. *Science Education*, *103*(6), 1396-1422.

Ainsworth, S., Prain, V., & Tytler, R. (2011). Drawing to learn science. *Science, 333*(6046), 1096-1097.

Alonzo, A., & Gotwals (Eds.). (2012). *Learning progressions in science: Current challenges and future directions*. Sense.

Alvarez, L., Capitelli, S., Valdés, G., & De Loney, M. (2020). English Learners as agents: Collaborative sense-making to support science and language development. In A. Kibler, G. Valdés, & A. Walqui (Eds.) *Reconceptualizing the role of critical dialogue in American classrooms: Promoting equity through dialogic education* (pp. 78–104). Routledge.

An, J., Macaro, E., & Childs, A. (2019). Language focused episodes by monolingual teachers in English Medium Instruction science lessons. *Journal of Immersion and Content-Based Language Education*, *7*(2), 166-191.

August, D., Branum-Martin, L., Cardenas-Hagan, E., & Francis, D. J. (2009). The impact of an instructional intervention on the science and language learning of middle grade English language learners. *Journal of Research on Educational Effectiveness*, *2*(4), 345-376.

Avenia-Tapper, B., & Isacoff, N. M. (2015). Explicitness in science discourse: A Gricean account of income-related differences. *Language and Education, 30*(1), 58-71.

Ben Hammou, S., & Kesbi, A. (2021). The teaching of science subjects through foreign languages in Moroccan secondary schools: Science teachers’ perceptions and experiences. *RELC Journal*, [https://doi.org/10.1177/00336882211035832](https://doi.org/10.1177%2F00336882211035832).

Berland, L., Schwarz, C., Krist, C., Kenyon, L., Lo, A., & Reiser, B. (2016). Epistemologies in practices: Making scientific practices meaningful for students. *Journal of Research in Science Teaching, 53*(7), 1082-1112.

Brown, B. A., Donovan, B., & Wild, A. (2019). Language and cognitive interference: How using complex scientific language limits cognitive performance. *Science Education*, *103*(4), 750-769.

Buxton, C., Cardozo-Gaibisso, L., Xia, Y., & Li, J. (2018). How perspectives from linguistically diverse classrooms can help all students unlock the language of science. *Counterpoints, 442*, 273-291.

Buxton, C., Harman, R., Cardozo-Gaibisso, L., Jiang, L., Bui, K., & Allexsaht-Snider, M. (2019). Understanding science and language connections: New approaches to assessment with bilingual learners. *Research in Science Education*, *49*(4), 977-988.

Canac, S., & Kermen, I. (2016). Exploring the mastery of French students in using basic notions of the language of chemistry. *Chemistry Education Research and Practice*, *17*(3), 452-473.

Carlsen, W. S. (2013). Language and science learning. In S. K. Abell, K. Appleton, & D. Hanuscin (Eds.), *Handbook of research on science education* (pp. 57-74). Routledge.

Charamba, E. (2021). Learning and language: Towards a reconceptualization of their mutual interdependences in a multilingual science class. *Journal of Multilingual and Multicultural Development*, *42*(6), 503-521.

Charamba, E., & Zano, K. (2019). Effects of translanguaging as an intervention strategy in a South African Chemistry classroom. *Bilingual Research Journal*, *42*(3), 291-307.

Childs, P. E., Markic, S., & Ryan, M. C. (2015). The role of language in the teaching and learning of chemistry. In J. García-Martínez & E. Serrano-Torregrosa (Eds.), *Chemistry Education: Best Practices, Opportunities and Trends* (pp. 421-446). Wiley Online Library.

Clotilde, B. M., & Andrea, C. (2016). CLIL & IBSE methodologies in a chemistry learning unit. *European Journal of Research and Reflection in Educational Sciences Vol*, *4*(8), 1-12.

Council of Chief State School Officers. (2012). *Framework for English language proficiency development standards corresponding to the Common Core State Standards and the Next Generation Science Standards.* <https://www.ccsso.org/sites/default/files/2017-11/ELPD%20Framework%20Booklet-Final%20for%20web.pdf>

Council of Chief State School Officers. (2014). *English language proficiency (ELP) standards with correspondences to K-12 English language arts (ELA), mathematics, and science practices, K-12 ELA standards, and 6-12 literacy standards*. <http://elpa21.org/sites/default/files/Final%204_30%20ELPA21%20Standards_1.pdf>

Danielsson, K. (2016). Modes and meaning in the classroom: The role of different semiotic resources to convey meaning in science classrooms. *Linguistics and Education, 35*, 88-99.

DeBarger A. H., Penuel, W. R., Harris, C. J., & Kennedy, C. A. (2016). Building an assessment argument to design and use next generation science assessments in efficacy studies of curriculum interventions. *American Journal of Evaluation, 37*(2), 174-192.

Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (1994). *Making sense of secondary science: Research into children’s ideas.* Routledge.

Duschl, R. A., & Gitomer, D. H. (1997). Strategies and challenges to changing the focus of assessment and instruction in science classrooms. *Educational Assessment, 4*(1), 37-73.

Estrella, G., Au, J., Jaeggi, S. M., & Collins, P. (2018). Is inquiry science instruction effective for English language learners? A meta-analytic review. *AERA open*, *4*(2), [https://doi.org/10.1177/2332858418767402](https://doi.org/10.1177%2F2332858418767402).

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

Firmayanto, R., Heliawati, L., & Rubini, B. (2020). Learning chemistry in English: The relationship between language skills and learning outcomes. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, *5*(2), 253-264.

Forbes, C. T., Zangori, L., & Schwarz, C. (2015). Empirical validation of integrated learning performances for hydrologic phenomena: 3rd-grade students’ model-driven explanation-construction. *Journal of Research in Science Teaching, 52*(7), 895-921.

Garza, E., & Arreguín-Anderson, M. G. (2018). Translanguaging: Developing scientific inquiry in a dual language classroom. *Bilingual Research Journal*, *41*(2), 101-116.

Gomez, K., Gomez, L. M., Cooper, B., Lozano, M., & Mancevice, N. (2019). Redressing science learning through supporting language: The biology credit recovery course. *Urban Education*, *54*(10), 1489-1519.

Gorin, J. S., & Mislevy, R. J. (2013, September). Inherent measurement challenges in the Next Generation Science Standards for both formative and summative assessment. Educational Testing Service. Retrieved from <https://www.ets.org/Media/Research/pdf/gorin-mislevy.pdf>

Gotwals, A. W., & Songer, N. B. (2009). Reasoning up and down the food chain: Using an assessment framework to investigate students’ middle knowledge. *Science Education, 94*(2), 259-281.

Grapin, S. E. (2022). Are we missing part of the picture? Assessing English learners in science from a multimodal perspective. In M. A. Christison, J. Crandall, & D. Christian (Eds.), *Research on integrating language and content in diverse contexts* (pp. 38-52)*.* Routledge.

Grapin, S. E., Haas, A., Goggins, M., Llosa, L., & Lee, O. (2019). Beyond general-purpose talk moves: Using discipline-specific probes with English learners in the science classroom. *Science and Children, 57*(4), 36-43.

Grapin, S. E., & Llosa, L. (2020). Toward an integrative framework for understanding multimodal L2 writing in the content areas. *Journal of Second Language Writing, 47*, 1-8.

Grapin, S. E., & Llosa, L. (2022). Dynamic assessment of English learners in the content areas: An exploratory study in fifth-grade science. *TESOL Quarterly, 56*(1), 201-229.

Grapin, S. E., & Llosa, L. (2022). Multimodal tasks to assess English learners and their peers in science. *Educational Assessment, 27*(1), 46-70.

Grapin, S. E., Llosa, L., Haas, A., Goggins, M., & Lee, O. (2019). Precision: Toward a meaning-centered view of language use with English learners in the content areas. *Linguistics and Education, 50,* 71-83.

Grapin, S. E., Llosa, L., & Lee, O. (2022). Disciplinary practices with multilingual learners in the content areas: Investigating grasp of practice in fifth-grade science. *Journal of Language, Identity and Education*. Retrieved from <https://www.tandfonline.com/doi/full/10.1080/15348458.2021.2008253>

Harris, C. J., Krajcik, J. S., Pellegrino, J. W., & McElhaney, K. W. (2016). *Constructing assessment tasks that blend disciplinary core ideas, crosscutting concepts, and science practices for classroom formative applications.* SRI International.

Helman, A. L., Calhoon, M. B., & Kern, L. (2015). Improving science vocabulary of high school English language learners with reading disabilities. *Learning Disability Quarterly*, *38*(1), 40-52.

Hokayem, H., & Gotwals, A. W. (2016). Early elementary students’ understanding of complex ecosystems: A learning progression approach. *Journal of Research in Science Teaching, 53*(10), 1524-1545.

Hubber, P., & Tytler, R. (2013). Models and learning science. In R. Tytler, V. Prain, P. Hubber, & B. Waldrip (Eds.), *Constructing representations to learn in science* (pp. 109-133). Sense.

Hunston, S. (2013). Systemic functional linguistics, corpus linguistics, and the ideology of science. *Text & Talk*, *33*(4-5), 617-640.

Jackson, J. C., Watts, J., List, J. M., Puryear, C., Drabble, R., & Lindquist, K. A. (2022). From text to thought: How analyzing language can advance psychological science. *Perspectives on Psychological Science*, *17*(3), 805-826.

Jaipal, K. (2009). Meaning making through multiple modalities in a biology classroom: A multimodal semiotics discourse analysis. *Science Education, 94*(1), 48-72.

Jewitt, C., Kress, G., Ogborn, J., & Tsatsarelis, C. (2001). Exploring learning through visual, actional and linguistic communication: The multimodal environment of a science classroom. *Educational Review, 53*(1), 5-18.

Johnson, P. (1998). Progression in children’s understanding of a "basic" particle theory: A longitudinal study. *International Journal of Science Education, 20*(4), 393-412.

Kress, G., Jewitt, C., Ogborn, J., & Tsatsarelis, C. (2014). *Multimodal teaching and learning: The rhetorics of the science classroom* (2nd ed.). Bloomsbury Academic.

Lachance, J. (2018). A case study of dual language teaching in science class: Implications for middle level teachers. *RMLE Online*, *41*(5), 1-14.

Lee, O. (2005). Science education with English language learners: Synthesis and research agenda. *Review of Educational Research*, *75*(4), 491-530.

Lee, O. (2017). Common Core State Standards for ELA/literacy and Next Generation Science Standards: Convergences and discrepancies using argument as an example. *Educational Researcher, 46*(2), 90-102.

Lee, O., Eichinger, C. D., Anderson, W. C., Berkheimer, D. G., & Blakeslee, T. D. (1993). Changing middle school students’ conceptions of matter and molecules. *Journal of Research in Science Teaching, 30*(2), 249-270.

Lee, O., & Fradd, S. H. (1998). Science for all, including students from non-English-language backgrounds. *Educational Researcher, 27*(4), 12-21.

Lee, O., & Llosa, L. (2015-2019). *Development of language-focused three-dimensional science instructional materials to support English language learners in fifth grade* [Research project]. Funded by the National Science Foundation [DRK-12 1502507].

Lee, O., Llosa, L., Grapin, S. E., Haas, A., & Goggins, M. (2019). Science and language integration with English learners: A conceptual framework guiding instructional materials development. *Science Education, 103*(2), 317-337.

Lee, O., Quinn, H., & Valdés, G. (2013). Science and language for English language learners in relation to Next Generation Science Standards and with implications for Common Core State Standards for English language arts and mathematics. *Educational Researcher, 42*(4), 223-233.

Lee, O., & Stephens, A. (2020). English learners in STEM subjects: Contemporary views on STEM subjects and language with English learners. *Educational researcher*, *49*(6), 426-432.

Lehrer, R., & Schauble, L. (2015). The development of scientific thinking. In R. M. Lerner (Ed.), *Handbook of child psychology and developmental science* (7th ed., pp. 371-388). Cambridge University Press.

Lemke, J. (1998). Multimedia literacy demands of the scientific curriculum. *Linguistics and Education, 10*(3), 247-271.

Lyon, E. G. (2013a). Conceptualizing and exemplifying science teachers’ assessment expertise. *International Journal of Science Education, 35*(7), 1208-1229.

Lyon, E. G. (2013b). What about language while equitably assessing science?: Case studies of preservice teachers’ evolving expertise. *Teaching and Teacher Education, 32,* 1-11.

MacDonald, R., Cook, H. G., & Miller, E. (2014). *Doing and talking science: A teacher’s guide to meaning-making with English learners*. Board of Regents of the University of Wisconsin System.

Márquez, C., Izquierdo, M., & Espinet, M. (2006). Multimodal science teachers’ discourse in modeling the water cycle. *Science Education, 90*(2), 202-226.

Marzetta, K., Mason, H., & Wee, B. (2018). ‘Sometimes they are fun and sometimes they are not’: Concept mapping with English Language Acquisition (ELA) and Gifted/Talented (GT) elementary students learning science and sustainability. *Education Sciences*, *8*(1),  <https://doi.org/10.3390/educsci8010013>.

Merritt, J., & Krajcik, J. (2013). Learning progression developed to support students building a particle model of matter. In G. Tsaparlis & H. Sevian (Eds.), *Concepts of matter in science education* (pp. 11-45). Springer.

Meskill, C., & Oliveira, A. W. (2019). Meeting the challenges of English learners by pairing science and language educators. *Research in Science Education*, *49*(4), 1025-1040.

Meyerhöffer, N., & Dreesmann, D. C. (2019). The exclusive language of science? Comparing knowledge gains and motivation in English-bilingual biology lessons between non-selected and preselected classes. *International Journal of Science Education*, *41*(1), 1-20.

Miller, E., Manz, E., Russ, R., Stroupe, D., & Berland, L. (2018). Addressing the epistemic elephant in the room: Epistemic agency and the Next Generation Science Standards. *Journal of Research on Science Teaching, 55*(7), 1053-1075.

National Academies of Sciences, Engineering, and Medicine. (2018). *English learners in STEM subjects. Transforming classrooms, schools, and lives*. National Academies Press.

National Research Council. (1996). *National science education standards.* National Academies Press.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* National Academies Press.

National Research Council. (2014). *Developing assessments for the Next Generation Science Standards.* National Academies Press.

Nersessian, N. J. (1992). How do scientists think? Capturing the dynamics of conceptual change in science. In R. N. Giere (Ed.), *Cognitive models of science: Minnesota studies in the philosophy of science*, Vol XV. University of Minnesota Press.

Nguyen, M. H., & Dang, T. K. A. (2021). Exploring teachers’ relational agency in content–language teacher collaboration in secondary science education in Australia. *The Australian Educational Researcher*, *48*(4), 1-18.

Nunn, R., Brandt, C., Hassan, A., & Bradley, C. (2019). Reading for science: Anatomy as a metaphor for a holistic college-wide innovation. In H. Reinders, C. Coombe, A. Littlejohn, & D. Tafazoli (Eds.), *Innovation in language learning and teaching: The case of the Middle East and North Africa* (pp. 133-152). Palgrave Macmillan, Cham.

O’Hallaron, C. L., Palincsar, A. S., & Schleppegrell, M. J. (2015). Reading science: Using systemic functional linguistics to support critical language awareness. *Linguistics and Education*, *32*, 55-67.

Oliveira, A. W., Weinburgh, M., McBride, E., Bobowski, T., & Shea, R. (2019). Teaching science to English language learners: Current research and practices in the field of science education. In L. C. de Oliveira (Ed.), *The handbook of TESOL in K‐12* (pp. 277-290). Wiley Online Library.

Passmore, C. M., Gouvea, J. S., & Giere, R. (2014). Models in science and in learning science: Focusing scientific practice on sense-making. In M. R. Matthews (Ed.), *International handbook of research in history, philosophy and science teaching* (pp. 1171-1202). Springer.

Passmore, C. M., Schwarz, C., & Mankowski, J. (2017). Developing and using models. In C. V. Schwarz, C. Passmore, & B. Reiser (Eds.), *Helping students make sense of the world using next generation science and engineering practices* (pp. 109-135). National Science Teachers’ Association Press.

Penuel, W. R., & Watkins, D. A. (2019). Assessment to promote equity and epistemic justice: A use-case of a research-practice partnership in science education. *The Annals of the American Academy of Political and Social Science, 683*, 201-216.

Piacentini, V., Raquel Simões, A., & Marques Vieira, R. (2019). Teachers' view of language (s) in (CLIL) science education: A case study in Portugal. *Problems of Education in the 21st Century*, *77*(5), 636-649.

Plummer, J. D., & Krajcik, J. (2010). Building a learning progression for celestial motion: Elementary levels from an earth-based perspective. *Journal of Research on Science Teaching, 47*(7), 768-787.

Poza, L. E. (2018). The language of ciencia: Translanguaging and learning in a bilingual science classroom. *International Journal of Bilingual Education and Bilingualism*, *21*(1), 1–19. <https://doi.org/10.1080/13670050.2015.1125849>

Pun, J., & Macaro, E. (2019). The effect of first and second language use on question types in English medium instruction science classrooms in Hong Kong. *International Journal of Bilingual Education and Bilingualism*, *22*(1), 64-77.

Quellmalz, E. S., Timms, M. J., Silberglitt, M. D., & Buckley, B. C. (2012). Science assessments for all: Integrating science simulations into balanced state science assessment systems. *Journal of Research in Science Teaching, 49*(3), 363-393.

Richardson Bruna, K., Vann, R., & Perales Escudero, M. (2007). What’s language got to do with it?: A case study of academic language instruction in a high school “English Learner Science” class. *Journal of English for Academic Purposes*, *6*(1), 36–54. <https://doi.org/10.1016/j.jeap.2006.11.006>

Rillero, P., Thibault, M., Merritt, J., & Jimenez-Silva, M. (2018). Bears in a boat: Science content and language development through a problem-based learning experience. *Science Activities*, *55*(1-2), 28-33.

Rollnick, M. (2000). Current issues and perspectives on second language learning of science. *Studies in Science Education, 35*(1), 93-121.

Rosebery, A. S., & Warren, B. (Eds.). (2008). *Teaching science to English language learners: Building on students' strengths*. NSTA Press.

Ruiz-Primo, M. A., & Furtak, E. (2007). Exploring teachers’ informal formative assessment practices and students’ understanding in the context of scientific inquiry. *Journal of Research in Science Teaching, 44*(1), 57-84.

Salloum, S., & BouJaoude, S. (2020). Language in teaching and learning science in diverse Lebanese multilingual classrooms: Interactions and perspectives. *International Journal of Science Education*, *42*(14), 2331-2363.

Schmiedebach, M., & Wegner, C. (2019). Hands-on science for recently immigrated students: Possibilities for language acquisition and motivation for science. *Nordic Studies in Science Education*, *15*(1), 22-37.

Schwarz, C., & White, B. (2005). Metamodeling knowledge: Developing students’ understanding of scientific modeling. *Cognition and Instruction, 23,* 165-205.

Schwarz, C., Reiser, B., Acher, A., Kenyon, L., & Fortus, D. (2012). MoDeLS: Challenges in defining a learning progression for scientific modeling. In A. C. Alonzo & A. Gotwals (Eds.), *Learning progressions in science: Current challenges and future directions* (pp. 101-137). Sense.

Schwarz, C., Reiser, B., Davis, E., Kenyon, L., Acher, A., Fortus, D., . . . Krajcik, J. (2009). Developing a learning progression for scientific modeling: Making scientific modeling accessible and meaningful for learners. *Journal of Research in Science Teaching, 46*(6), 632-654.

Seah, L. H., & Silver, R. E. (2020). Attending to science language demands in multilingual classrooms: A case study. *International Journal of Science Education*, *42*(14), 2453-2471.

Setyaningrum, R. W., Setiawan, S., Anam, S., & Retnaningdyah, P. (2020). Content and Language Integrated Learning (CLIL) in science class during covid-19 outbreak: A narrative inquiry. *English Review: Journal of English Education*, *9*(1), 35-46.

Siegel, M. A. (2007). Striving for equitable classroom assessments for linguistic minorities: Strategies for and effects of revising life science items. *Journal of Research in Science Teaching, 44*(6), 864-881.

Siegel, M. A., Menon, D., Sinha, S, Promyod, N., Wissehr, C., & Halverson, K. L. (2014). Equitable written assessments for English language learners: How scaffolding helps. *Journal of Science Teacher Education, 25*(6), 681-708.

Smit, J., Gijsel, M., Hotze, A., & Bakker, A. (2018). Scaffolding primary teachers in designing and enacting language-oriented science lessons: Is handing over to independence a fata morgana?. *Learning, Culture and Social Interaction*, *18*, 72-85.

Snow, C. E. (2010). Academic language and the challenge of reading for learning about science. *Science*, *328*(5977), 450-452.

Solano-Flores, G., Wang, C., & Shade, C. (2016). International semiotics: Item difficulty and the complexity of science item illustrations in the PISA-2009 international test comparison. *International Journal of Testing, 16*(3), 205-219.

Song, Y., & Carheden, S. (2014). Dual meaning vocabulary (DMV) words in learning chemistry. *Chemistry Education Research and Practice*, *15*(2), 128-141.

Tagnin, L., & Ní Ríordáin, M. (2021). Building science through questions in Content and Language Integrated Learning (CLIL) classrooms. *International Journal of STEM Education*, *8*(1), 1-14.

Tang, K. S., Delgado, C., & Moje, E. B. (2014). An integrative framework for the analysis of multiple and multimodal representations for meaning-making in science education. *Science Education, 98*(2), 305-326.

Tang, K. S., Tan, S. C., & Yeo, J. (2011). Students’ multimodal construction of the work-energy concept. *International Journal of Science Education, 33*(13), 1775-1804.

Treagust, D. F., Chittleborough, G., & Mamiala, T. L. (2002). Students’ understanding of the role of scientific models in learning science. *International Journal of Science Education, 24*(4), 357-368.

Tytler, R., Prain, V., Hubber, P., & Waldrip, B. (2013). *Constructing representations to learn in science*. Sense.

Ünsal, Z., Jakobson, B., Wickman, P., & Molander, B. (2018). Gesticulating science: Emergent bilingual students’ use of gestures. *Journal of Research in Science Teaching, 55*(1), 121-144.

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining computational thinking for mathematics and science classrooms. *Journal of Science Education and Technology, 25*(1), 127-147.

Wilensky, U., Brady, C., & Horn, M. (2014). Fostering computational literacy in science classrooms. *Communications of the ACM, 57*(8), 17-21.

Windschitl, M., & Thompson, J. (2006). Transcending simple forms of school science investigation: The impact of preservice instruction on teachers’ understandings of model-based inquiry. *American Educational Research Journal, 43*(4), 783-835.

Wright, T. S., & Domke, L. M. (2019). The role of language and literacy in K-5 science and social studies standards. *Journal of Literacy Research*, *51*(1), 5-29.

Yore, L. D., Hand, B., Goldman, S. R., Hildebrand, G. M., Osborne, J. F., Treagust, D. F., & Wallace, C. S. (2004). New directions in language and science education research. *Reading Research Quarterly*, 347-352.

Zhang, Y. (2016). Multimodal teacher input and science learning in a middle school sheltered classroom. *Journal of Research in Science Teaching, 53*(1), 7-30.