USING EXPANSIVE FRAMING TO ENHANCE PERSONAL RELEVANCY AND ENGAGEMENT IN SCIENCE

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Introduction

With the adoption of the 2016 Indiana Academic Standards for Science, the subjects of science, engineering, and computer science are now conceptualized together as a set of common processes, content, and literacy standards, resulting in new teaching and learning objectives for science educators. However, two deeply rooted goals remain: 1) helping students develop into scientifically literate citizens capable of engaging with socio-scientific issues and 2) preparing students with knowledge and skills to pursue science careers.

To meet these goals, science educators need to contextualize standards-based science skills and concepts towards application *outside* the classroom: teaching beyond the test towards the students' future needs and interests. Students not only need to understand and apply science concepts and skills in school settings, but also have the ability to transfer (apply or adopt) knowledge of content, concepts, and skills into novel contexts (Pai et al. 2014).

However, it is often hard for students to understand when or where they will need to transfer new science knowledge (Oh & Yager, 2004). It is common for an educator to hear a disgruntled student asking, "When are we ever going to need this material?" If that educator cannot provide an example or foster an experience of how understanding in science is applied and adopted, students may perceive science as irrelevant and become disinterested and disengaged.

One educational strategy that can be used to increase science relevancy and engagement is expansive framing: contextualizing science in personally relevant ways. In this paper, we will define expansive framing, discuss its utility and usage for the science classroom, and provide implications for science education.

Defining expansive framing

Expansive framing is best defined as the counterpart to the education strategy 'bounded' framing. Bounded framing refers to the practice of 'teaching to the test' or covering material in a way that minimizes the likelihood students will use it later, including outside the classroom (Goldstone & Day, 2012). This type of instruction directly communicates to students that upon completion of the class, semester, or unit, the acquired knowledge and skills lack relevancy in and beyond the walls of the classrooms (Clayden et al. 1994, Engle et al. 2011). As a result, students' expression of science content, concepts, and skills is no more developed than what was memorized or practiced in the classroom.

In contrast, expansive framing helps students understand why they should invest their time and efforts into learning science (Chase et al., 2016). Through contextualizing instructional material in a way that is both encouraging and relevant to them, expansive framing helps students connect with science on a personal level, widening their perspectives by making the application of science personally tangible. Expansive framing has been shown to increase transfer (Engle et al. 2011; 2012), critical thinking (Chase et al., 2016), and motivation (Grover & Pea, 2014) leading to greater personal relevancy and continued interest in science.

Engle and colleagues (2012) have discussed five potential transfer mechanisms to explain the effectiveness and enhancement of student learning through expansive framing. Table 1 summarizes the five potential mechanisms of transfer. All five mechanisms suggest that expansive framing encourages students to take ownership of what they are learning through fostering a connection between students' present worldviews surrounding science with how they *can* or *plan* to use it in the future (Perkins & Salomon, 2012). Through authorship or ownership, students become accountable for what specific science content, concepts, and skills they learn. As an instructional strategy, expansive framing promotes more of a student-centered classroom that helps students make connections with science in ways not normally undertaken by K-12 science educators.

Table 1: Five Potential Mechanisms for Expansive Framing

	Five Potential Mechanisms for Expansive Framing*
1	Fostering expectations that students will continue to use what they learn later
2	Creating links between learning and transfer contexts so that prior learning is viewed as relevant during potential transfer contexts
3	Encouraging learners to draw on prior knowledge during learning, which may involve them transferring in additional examples and making generalizations
4	Making learners accountable for intelligently reporting on specific content that they have authored
5	Promoting authorship as a general practice in which students learn that their role is to generate their own solutions to new problems and adapt their existing knowledge in transfer contexts

*as described by Engle, et al. (2012)

Applying expansive framing

One way to adopt expansive framing that promotes this type of learning is to create opportunities for students to both *engage with* and *reflect on* how science can be applied. Specifically, this means emphasizing *where*, *when*, and *how* science is used outside the classroom – in relation to students' own lives. For an example, imagine a fourth grade teacher in Lafayette, Indiana using expansive framing to carry out an investigation examining potential sources and causes of pollution (e.g. human impact on the Earth; SEPS.3; 4.ESS.2; 4.ESS.4) (Indiana Department of Education, 2016).

Using Table 1 for guidance, expansively framing the investigation can take many forms. First, it might involve emphasizing to students the ever-present need to protect the community from pollution for both current and future generations. This context would provide students with a reason to retain what is to be learned for both current and future use. Likewise, instead of merely *human* impact on the Earth, the teacher could investigate how *Lafayette citizens* can cause, rethink, and clean up pollution issues. This represents another direct link to students living there. The context of the unit could focus on the local Wabash River watershed, running directly through the Lafayette community (Xu, 2014).

When reviewing content knowledge about human impact on pollution, students may be asked about their prior knowledge or experiences with the river and its pollution problem. This would help students bring to bear what they already personally know about the river for application in the classroom. Following review, students could be asked to investigate and report about one type of pollution affecting the river (e.g. point source versus non-point), or about the broader impacts of Wabash River pollution on the community (e.g. citizens do not normally swim or fish there – SEPS.8). These would both help foster ownership, accountability, and authorship surrounding what they have learned.

Through this example, the personal connection to students through expansive framing is evident. It provides multiple opportunities for students to connect with context, simply by setting the unit in a more relevant context. This is where the utility of expansive framing lies – through providing a practical way of helping make everyday science more perceptible.

This strategy of contextualization is not limited to certain grade levels, topics, or even entire science units. The same approach can be applied towards addressing physical science, life science, engineering, and computer science, as well as science and engineering process standards. It can be utilized to help students connect with single science topics, or aid them in connecting science knowledge across *multiple* investigations. It can be used in creating new science curricula or used to reframe current implementation.

Additional applications for expansive framing

Expansive framing can also be applied to a range of assessments. Educators can develop summative and formative assessments utilizing open-ended writing prompts that include real-world contexts. The students design solutions to these real-world problems as they practice both authorship and application skills for what they have learned. Rodriguez and Zozakiewicz (2010) have found that this type of assessment to be more accessible, equitable, and creative than others.

Drawing from our earlier example (writing or reporting on types and impacts of pollution), students could write-up and/or orally present to others about how they could help preserve the Lafayette watershed. Students' findings can then be discussed or negotiated in response to others' feedback or suggested revisions. Similarly, they might be tasked with constructing and comparing multiple solutions to the local pollution (3-5.E.2). Both of these examples require the transfer and application of prior science knowledge to relatable contexts, as well as foster student accountability and ownership of what they have learned and how that knowledge is put to use.

Considerations for using expansive framing in science instruction

Finding real-world examples of the usefulness of science content that are relatable to students' lives can be difficult task. Providing students with authentic scientific situations occasionally requires expert, career-specific knowledge that may not be readily accessible. Therefore, re-framing instruction to be expansive may require the partnership of science teachers with members of industry, academics, or other researchers. These authentic partnerships could foster discussions about actual problems the expert and/or students are working to understand or solve. As the expert works with students they help students to apply specific science concepts and skills toward reaching a shared goal. These partnerships would assist educators in linking their instruction with experts in their community, give students a chance to interact with experts, give experts an opportunity to share their work with a new generation of learners, and give students a glimpse of STEM careers.

Educators need to be aware of *overzealous transfer*: the overgeneralization of skills or techniques associated with a content area in which students fail to demonstrate deeply structured knowledge (Middleton & Baartman, 2013). Students may try to connect, or expect to connect, personally with all science knowledge. Similarly, they may try to generalize connections or skills to new unsuitable contexts. An analogy is a child that has been taught to use a hammer to hammer in nails may try to use the hammer on other objects such as screws or push-pins. The child may also try to use other objects such as sticks, books, or blunt objects in lieu of hammers.

A strategy for minimizing overzealous transfer is through introducing students to contrasting cases. Using the previous scenario, the child could be taught to only use the hammer on nails. To do so, the teacher may give the child different types of nails to tap with the hammer. Similarly, different types of hammers could be substituted with different types of nails to help students understand how to best pair a certain type of hammer with a certain type of nail. Ideally, contrasting cases represent examples that show subtle differences around a concept/skill and instruct students in a way that encourages them to understand these differences (Schwartz et al. 2012). Contrasting cases help students to understand and evaluate subtleties and apply them (Schwartz, Bransford, & Sears, 2005). This applies to both high-achieving and low-achieving students (Chase et al., 2016).

Broader implications for the science classroom

Expansive framing represents a point of interaction for students and teachers to deeply connect with science. While many science phenomena may be abstract, global, or layered, causing students to feel conflicted (Sadler et al., 2004), expansive framing allows for increased personal relevancy. It provides a means of cutting through those layers and gives students a deeper understanding of science, allowing them more tangible connections with how science is used.

Aside from relevancy, this more personal method of contextualization opens the door for engaging with critical questions not usually covered by standards. As with previous science reform, questions surrounding science are mostly limited to providing *what* concepts and practices should be learned, *where* it should be learned; *when* science takes place, and *how* it progresses. Perhaps given the nature of providing standardized instruction, questions of *why* and *for whom* in science are often left out. With expansive framing, students are very close to, if not directly led to asking these questions.

In both of these ways, expansive framing represents a stepping-stone towards scientific literacy. It is crucial that we help students forge deep bonds with science, starting in the classroom. While we all interact with and utilize science every day, our available personal connections to it may be just beyond our reach, waiting to be pointed out.

References

Chase, A. M. (2016). *Authentic science in education: Studies in course-based research at the United States Military Academy*. Retrieved from ProQuest Digital Dissertations. (AAT 10248783)

Clayden, E., Desforges, C., Mills, C., & Rawson, W. (1994). Authentic activity and learning. *British Journal of Educational Studies, 42*(2), 163-173. http://doi.org/10.1080/00071005.1994.9973991

Engle, R. A., Nguyen, P. D., & Mendelson, A. (2011). The influence of framing on transfer: Initial evidence from a tutoring experiment. *Instructional Science, 39*(5), 603-628. http://doi.org/10.1007/s11251-010-9145-2

Engle, R. A., Lam, D. P., Meyer, X. S., & Nix, S. E. (2012). How does expansive framing promote transfer? Several proposed explanations and a research agenda for investigating them. *Educational Psychologist, 47*(3), 215-231. http://doi.org/10.1080/00461520.2012.695678

Goldstone, R. L., & Day, S. B. (2012). Introduction to "new conceptualizations of transfer of learning". *Educational Psychologist, 47*(3), 149-152. http://doi.org/10.1080/00461520.2012.695710

Grover, S., Pea, R., & Cooper, S. (2014). Expansive framing and preparation for future learning in middle-school computer science. In *International Conference of the Learning Sciences (ICLS) Conference*, 992-996.

Indiana Department of Education (2016). Indiana academic science & computer science standards. Retrieved from: https://www.doe.in.gov/standards/science-computer-science

Middleton, H., & Baartman, L. (2013). Transfer, transition, or transformation?. Transfer, Transitions and Transformations of Learning, 1-11. SensePublishers. http://doi.org/10.1007%2F978-94-6209-437-6_1

Oh, P. S., & Yager, R. E. (2004). Development of constructivist science classrooms and changes in student attitudes toward science learning. *Science Education International, 15*(2), 105-113. Retrieved from: http://www.icaseonline.net/sei/15-02-2004/15-02-2004-105_113.pdf

Pai, H. H., Sears, D. A., & Maeda, Y. (2015). Effects of small-group learning on transfer: A meta-analysis. *Educational Psychology Review, 27*(1), 79-102. http://doi.org/10.1007/s10648-014-9260-8

Perkins, D. N., & Salomon, G. (2012). Knowledge to go: A motivational and dispositional view of transfer. *Educational Psychologist, 47*(3), 248-258. http://doi.org/10.1080/00461520.2012.693354

Rodriguez, A. J., & Zozakiewicz, C. (2010). Facilitating the integration of multiple literacies through science education and learning technologies. In A. J. Rodriguez (Ed.), *Science education as a pathway to teaching language literacy* (pp. 23-45). Rotterdam, Netherlands: Sense.

Sadler, T. D., Chambers, F. W., & Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. *International Journal of Science Education, 26*(4), 387-409. http://doi.org/10.1080/0950069032000119456

Schwartz, D. L., Chase, C. C., & Bransford, J. D. (2012). Resisting overzealous transfer: Coordinating previously successful routines with needs for new learning. *Educational Psychologist, 47*(3), 204-214. http://doi.org/10.1080/00461520.2012.696317

Schwartz, D. L., Bransford, J. D., & Sears, D. (2005). Efficiency and innovation in transfer. J. Mestre (ed.), *Transfer of learning: Research and Perspectives* (pp.1-51). Greenwich, CT: Information Age Publishing.

Xu, Z. (2014). Natural water as cultural water — A thirty year plan for Wabash River corridor in Lafayette, Indiana, USA. *Landscape Architecture Frontiers, 2*(1), 114-124. Retrieved from: http://academic.hep.com.cn/laf/EN/Y2014/V2/I1/114

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