## STANDARD 3: STUDENTS ENGAGE IN MEANING MAKING THROUGH DISCOURSE AND OTHER STRATEGIES

The core idea of this standard is that students are active learners who construct understanding for themselves [1, 2]. While teachers and peers can support learning, no one else can learn for students. Students should be active in making meaning during their own learning. Teachers can support students' meaning making by: 1) engaging them in productive discourse; 2) involving them in creating and interpreting multiple modes of representation; and 3) connecting what they are learning to what they already know.

## PRODUCTIVE DISCOURSE

Productive discourse is defined here as students engaging in dialogue that is interactive, externalizes thinking, and focuses on meaning making. Specifically, discourse involves developing arguments, explaining, critiquing, using logic, and giving evidence to support or refute a claim [3-5]. To engage students in active meaning making, these discourse patterns occur in classrooms in all domains, both orally and in written form [6-14]. Productive discourse is also a central component of the Common Core State Standards [15] and the Next Generation Science Standards [16-19].

If you had to write a newspaper headline about productive discourse, what would it be?

Language norms and uses are not generic, but instead change relative to the specific content and context. For example, speaking and writing have different levels of appropriate complexity, density, formality, and vocabulary depending on the situation. These are dynamic variables that are not always readily apparent to students [3, 20-22]. Due to this inherent challenge in both understanding and using language in expected ways in classroom settings, discourse opportunities need to promote both language knowledge and deep content understanding [23-25]. Students' use of meaningful academic language has been shown to be much more prevalent in classrooms when teachers establish clear learning structures aligned with clear language expectations and provide appropriate scaffolding for students [19].

## REPRESENTATIONS IN MEANING MAKING

Research literature points to the importance of representation as a means for students to organize, externalize, extend, and manipulate their thinking [18, 19]. There is also considerable evidence that representational knowledge is related to and may affect complex problem solving, transfer of knowledge to novel situations, and understanding of high-level concepts (e.g., [26-33]).

How would you describe the purpose of representations to a pre-service teacher?

According to Peirce's semiotic theory [34,35], which is relevant to a wide range of classroom activity, a representation is anything that stands for something else. In the

classroom context representations include written and oral language, symbols, diagrams, maps, and pictures. In the case of mathematics, for example, teachers must use representations to first engage students in mathematical thinking. In turn, students use these representations to scaffold their understanding of emerging concepts [18, 36, 37]. In the case of science, students must engage in reading, writing, and visual representations of their ideas in order to develop models and explanations. Across disciplines, when participating in argumentation with peers around representations, students need to speak and listen to reach shared conclusions [19].

In the same vein, the National Research Council [38] has advanced a series of practices foundational for effective learning that involve engaging students with representations and discourse. As the NRC makes clear, these practices are closely intertwined. Many researchers have shown that when engaged in learning processes which are driven by discourse about objects and ideas, students' can more effectively progress through increasingly complex stages of conceptual understanding (e.g., moving from observations to modeling observations to then explaining and defending models) [19]. To achieve high levels of understanding across content areas, students must learn not only how to manipulate representations (including text), but also what the meanings of the represented concepts and processes are [39, 40].

## MAKING CONNECTIONS TO STUDENTS' EXISTING KNOWLEDGE AND EXPERIENCE

In the development of schema (see section in Standard 1), one way that students create new knowledge is by establishing connections [41, 42]. Pauline Gibbons (2009) suggests looking both forward and backwards with learners during academic activities to scaffold their learning [43]. By this, she means that teachers should engage students' everyday language and prior experiences, from classrooms and beyond, in the process of sense making in school activities [43-45]. Student understanding then develops through the creation of connections and recognition of relationships with past and current representations, through which they gradually develop more sophisticated conceptions of already familiar ideas, and gain more academic language and literacies in the process [46-49].

Underline two key phrases about making connections that you want to keep in mind for your classroom instruction.

While teachers may at times explicitly make connections between past and present learning for students, it is also important for teachers to support students to make their own comparisons and analogies between existing knowledge/past experiences and current learning, especially during problem solving efforts and independent work to more deeply understand concepts students are in the midst of learning [50-54]. In general, students' making use of analogies in their reasoning processes is beneficial for learning

across domains [55-61].[1] In the case of science, for example, researchers have found that when students can spontaneously generate analogies for the scientific phenomenon they are learning, particularly in the process of overcoming misconceptions, their understanding greatly improves [54, 63-66].

In reading, relating text content to analogous situations, environments, characters, or systems improves reading comprehension and memory (cf. [52, 67-69]). For students who find it challenging to understand a target instructional concept, hearing peers' analogies can help them to create their own analogies and increase their conceptual understanding [70, 71]. This demonstrates the positive impact on learning that occurs when peers share their understandings with one another in a community of practice [72, 73].

Drawing on prior knowledge is also a critical aspect of summary writing. To transform text, students must rely on system knowledge outside or beyond that which exists in the source material they have encountered [74]. In this effort of transforming text, students often need scaffolding from teachers, such as explicitly articulating, modeling, and practicing with students the ways in which content meanings can be generalized and abstracted before summarizing [75, 76].

In learning history, by comparison, students need to become aware of their preconceptions before they can make sense of historical ideas [77]. For example, young students often believe that an occurrence can only be known about if it is directly observed. Therefore, if an event happened in the distant past, they believe it is impossible to know if it really happened [78]. Also, young students often get confused and apply the relationships they hold about the concepts old and new, and old and young to long ago and now. By teachers guiding students to uncover and examine these preconceptions, students have an easier time developing schema in relation to learning history [79, 80]. Much recent research indicates that some key concepts in history are counterintuitive (also true in science) and contradict working assumptions which may have become deeply embedded after many years of studying history, especially if students are not instructed in how to recognize, examine, and check assumptions for validity [77, 81-84].

## COMMUNITY-CENTERED CLASSROOM CULTURES

Community-centered environments foster norms for people learning from one another, and continually attempting to improve. In such a community, students are encouraged to be active, constructive participants. They are encouraged to make—and then learn from—mistakes. Intellectual camaraderie fosters support, challenge and collaboration [40]. Collaboration with peers encourages motivation and cognitive engagement.

What do you think is the most important thing to keep in mind about community-centered classrooms and why?

[1] Analogies are considered a type of representation (Podolefsky, Perkins, & Adams, 2010).

Collaboration involves working with others to obtain information, to share and discuss ideas and interpretations, and to receive feedback [85]. Collaboration can also encourage motivation [86], encourage shared effort, diminish feelings of inadequacy [87], and can be beneficial to cognitive engagement as students explain, clarify, and critique ideas [88]. To fully benefit from collaborative learning opportunities, students need accountability structures that hold them responsible for their contributions to the group [89]. Additionally, for productive collaboration, students need to be supported in learning how to explain their ideas and critique the ideas of others [90]. Interactions among students can be structured by assigning specific group roles and providing prompts to improve the quality of questions and discussion [91, 92].

In community-centered classrooms, students' meaning making can be supported by engaging in discourse and in the development of representations with peers, as well as with their teachers. Teachers need to accept a variety of styles in which students present their ideas, using whatever experiential and language resources are available to them at the time [18, 44, 93, 94]. Teachers can be attuned to students' understandings of concepts, facilitating shared sense making, while scaffolding language use and deepening students' content knowledge in a safe environment [43].

The need for psychological safety among students is central to creating a learning environment (cf. [95]). Psychological safety can be defined as a "sense of comfort, willingness to take risks, and be oneself and a feeling of acceptance"[96] (p. 491). To enhance feelings of psychological safety, a community-centered classroom is characterized by the norms of mutual trust between teacher and students and among students, demonstrations of respect and caring and an interest in each student's well-being, and supportive, collaborative relationships [86, 97, 98]. For example, identifying students' ideas publically as being wrong or right can inhibit students' intrinsic motivation to learn and cultivate a non-productive, competitive environment [99-101]. Yet many common teaching practices, for example, the I-R-E questioning approach (Investigation, Response, Evaluation) identify student responses as correct or incorrect. In order for students to be open to engaging in discourse and other forms of communication, teachers need to have students participate in discussions that respectfully engage their cognitive abilities [5, 102].

Researchers who work in this field admit that there is a challenge in moving away from an I-R-E type framework of communication and towards one that facilitates productive discourse [103, 104], especially in classrooms with high percentages of students who may be reluctant to talk, such as those without fluent English language resources, or those whose ideas have been shut down in the past [102].

# RESOURCE FOR YOU

In summary, engaging in productive discourse and other strategies, such as creating and interpreting representations and generating analogies from prior experience, is critical in students' process of making meaning of their learning. To facilitate this, teachers can create community-centered classroom cultures where students feel comfortable sharing their learning status and participating in a community of practice.

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