

## 2. Learning – What Does It Mean?

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Until 1990 I struggled with defining what learning meant and how I would know it had been accomplished by my students. Courses were designed to be outcomes driven, it is true, but largely because the technology field has an inherent bias toward inquiry and action rather than any intention on my part. Discovering Senge's (1990) *The Fifth Discipline* made it clear that the teacher is a participant learner, as well as a coach and designer. Senge believes "deep down, we are all learners ... infants are intrinsically inquisitive, masterful learners who learn... all on their own ... it is our nature to learn ... we love to learn" (p. 4). This definition had real meaning for me, and from that point forward, my teaching and student learning were organized around it and established it as the basis for designing teacher professional development.

Senge (1990) describes learning with a term from Classical Greece, *metanoia*, a fundamental shift of mind. Learning is not only the "taking in of information," as is commonly thought today, but involves a re-creation of ourselves. Real learning gets to the heart of what it means to be human. *Through learning we re-create ourselves...we become able to do something we never were able to do...we extend our capacity to create, to be part of the generative process of life.* Our hunger for this type of learning is "as fundamental to human beings as the sex drive" (p. 207).

A learning person continually discovers how they create their own reality and how they can change it. Therefore, the learning, "shift of mind," leads us away from seeing ourselves "as separate from the world" to "connected to the world" to "transforming the world" and, finally, to "creating the world" (Senge, 2000, pp. 206-209). This fits with our use of Bloom's and the revised Bloom's Taxonomy, as the ultimate learning level on the revised Bloom's is "create" (Anderson & Krathwohl, 2001).

Senge extends his thoughts to include a discussion on a transformative pedagogy that leads to deeper learning. His "generative model" coaches learners through a process of inquiry, exploration, and discovery of the subject. The model encompasses various theories and methods, including constructivism and collaborative learning (p. 206). Using this model, teachers (or staff development leaders) provide learning experiences where "learners create knowledge by building on their own experiences and by interacting with the subject matter(s) and other people" (p. 206). Knowledge is created in layers. As students (or teachers) learn more, what they learned previously develops to deeper and extended meanings. Each time learning occurs, the information previously learned changes and gains greater meaning.

The generative model of teaching and learning is about content *and* process, rather than just content. By extending active learning beyond the classroom into the world, providing the opportunity to more critically consider the world, a more significant change can take place. This synchronizes well when the result is learning communities that can provide a broader learning environment to deepen learning by extending the classroom and types of learning experiences.

Transformative pedagogy results in transformative learning that “grants learners the power to relate to the subject matter...builds upon existing knowledge...constructs new knowledge...and empowers one to create their desired future” (p. 211). “Transmission pedagogy takes power away from the learners...and the teacher. Generative pedagogy grants teachers and learners the power to relate to the subject matter and build on their knowledge...providing a functional literacy to fit into the world. Transformative pedagogy, however, provides learners with a functional literacy and provides teachers and learners with a social literacy...and systems literacy...to create their desired future” (p. 211). This is actually the basic meaning of a learning organization, “an organization that is continually expanding its capacity to create its future” (Senge, 1990, pp. 14-15).

One other concept that particularly draws attention is “creative tension.” Senge quotes Martin Luther King, Jr.: “Just as Socrates felt that it was necessary to create a tension in the mind,” said King, “so that individuals could rise from the bondage of myths and half truths...so must we...create the kind of tension in society that will help men rise from the dark depths of prejudice and racism” (pp. 52-53). King was talking about the *creative tension* of personal mastery, generated by holding a vision and telling the truth about the current reality relative to that vision. According to Senge, those who master creative tension gain a profoundly different view of reality: “People literally start to see more and more aspects of reality as something they, collectively, can influence...[and] are subject to being influenced by creative tension...[a] shift of view or metanoia” (p. 357). Creative tension is necessary for closing the gap between the current reality and a vision. The “gap” is the source of creative energy – creative tension.

Senge (2000) says that we can structure tension so that we will seek a solution. This all comes into play as we work with teachers on what they want to change and how they will go about making the change happen. The professional development described below provides real cases of what Senge is describing.

### *Schools as Learning Organizations*

In another of his books, *Schools That Learn* (Senge et al., 2000), Senge writes that one of his most difficult challenges with teachers is to get them to understand that there are others in the classroom, that they are teaching students *and* the subject. Fields of knowledge do not exist separately from each other or from the people who study them. The processes through which people create knowledge “are living systems made up of often-invisible networks and interrelationships...all learners construct knowledge from an inner scaffolding of their individual and social experiences, emotions, will, aptitudes, beliefs, values, self-awareness, purpose, and more. ...Disconnecting them weakens the scaffolding and, consequently, the knowledge” (pp. 21-22).

Our strategy has been to have the teachers understand their own purpose and goals for participating in our initiatives by envisioning something different (or more) for themselves and their students. We help them to build a vision, first individually and then together as an interdisciplinary team, of what they want to accomplish and what they want their students to be able to accomplish. We have set up our initiatives for interdisciplinary teams of mathematics, science, technology, and English teachers to formalize and learn more deeply that they should

not disconnect the disciplines if they want to bring students to the transformation that takes place when real learning occurs.

### *To Extend This Conversation*

According to Senge, “we need to design assessments for learning, not for blaming, ranking, and certifying. This requires deep *shifts of attitude* about testing and learning” (p.188). He describes the qualities of assessment for learning: timeliness, honesty, reflection, constructive guidance, focus. This ties into the 1996 Third International Mathematics and Science Study (TIMSS) report (Johnson, 1998; Stigler, 1997), which addresses the value of reflection by teachers participating in “lesson study.” Tests as assessments serve merely as “indicators of potential performance ability...” (Wolf & Reardon, 1996, p. 19). I have always been suspicious of traditional tests and test results as indicators of learning. My assessment focus has always been on assessment through projects that typically require a range of products, performances, and behaviors. It is important that students provide evidence of learning by demonstrating the application of knowledge: “the ability to transfer knowledge into action, even in situations that are less than routine” (Senge, 2000, p. 187).

The ultimate assessment goal should be to more authentically assess learning using Senge’s three types of learning: (1) formal, (2) applicable, and (3) longitudinal. In other words, (1) can students provide evidence of learning the academic content, for example, principles, facts, information? (2) Can they then provide evidence that they know something by demonstrating the application of that knowledge to solve a problem, design a solution? (3) Finally, can they demonstrate that they have sustained the capability to use knowledge over time and across contexts; that is, can they use the new knowledge and skills in their major senior capstone course? This discussion needs to include assessment as an integral part of learning, especially the more authentic and performance-based version.

Learning and providing evidence of learning should be intertwined rather than separated. For example, while learning about teams, students or any other group (e.g., teachers) could begin to function and perform as teams. Students who are learning to design and build an electronic circuit, using the underlying physics and mathematics inherent to circuitry, could be simultaneously assessed on how well they learn physics principles, mathematics concepts, and electronic concepts. No separation between learning and assessment has to occur.

To move to professional development for teachers, it has always worked for us to structure most learning as product or process development with culminating performances. In learning to develop integrated MSTE curricula, teachers design and develop an integrated module. In learning to use more teaching strategies, they incorporate them into the module to use during their pilots with students, after first trying them out with each other. Learning has always been doing, at least to us, and assessment has usually occurred while learning takes place.

After piloting new curricula, teachers engaged in small groups to network and reflect on what worked, what did not work, and what could be changed to enhance teaching and further learning. Teachers reported that group “lesson study” was very valuable. We tried to use this approach in a small way throughout the pilot experiences; and throughout the development, we tried to get teachers individually and as teams to reflect on what they were really teaching and what students were really learning. Is teaching tied to what is assessed? (Stigler & Hiebert, 1997).

## *Literacies*

We are all familiar with the traditional literacies of reading, writing, and speaking, but, as Senge (2000) remarks, literacy now describes multiple skills: computer, cultural, environmental, financial, and technological, to name only a few. The National Academy of Engineering of the National Research Council (NRC) formed a Committee on Technological Literacy, which published *Technically Speaking* (National Academy of Engineering, 2002). The authors of this report complained that “the issue of technological literacy is virtually invisible on the national agenda” (p. viii). Few educators grasp the basic concepts of today’s technological society. To address this deficiency, the International Technology Association (2000) developed *Standards for Technological Literacy, Content for the Study of Technology*, followed by its companion guide advancing excellence in technological literacy: student assessment, professional development, and program standards (2003), and the International Society for Technology in Education (1998) produced the *National Educational Technology Standards, Standards for All Students*.

We have interwoven “technology” throughout our professional program – as disciplinary knowledge, as process for teaching and learning, and as tools and infrastructural requirements. Far more is needed, but we did help the teachers build confidence in themselves and create a comfort zone with “not knowing,” thus stimulating them to seek the answers and exciting them about the possibility of knowing more.

The National Academy of Engineering of the NRC (National Council of Engineering, 2000) recommends that “NSF, DoEd, and teacher education accrediting bodies should provide incentives for institutions of higher education to transform the preparation of all teachers to better equip them to teach about technology throughout the curriculum” (p. 9). Those institutions or agencies, one might argue, should continue professional development, thus making it easily accessible for continued learning and professional growth. For some reason, it seems difficult for people to grasp that *accessible and continued* opportunities for learning are what ultimately help teachers to develop depth of knowledge and the ability to design and develop broader learning contexts for their students.

One aspect of learning that perhaps fits into technological literacy is “growing up digital.” The teaching and learning dynamics between students who grow up with digital literacy and their teachers, many of whom did not, can be quite a mess, or it can work, depending upon the teacher’s comfort zone with the new environment where student learning takes place. Brown (2000) reports a Xerox, Inc. study in which 15-year-olds were hired to join researchers. They were given two jobs: design the “workscape” of the future – one they would want to work in – and design the school or “learningscape” of the future, also where they would want to be. What occurred really “shook up” the Xerox people. The 15-year-olds operated the same as top executives in a fast changing context and “were always multiprocessing,” for example, listening to music, talking on the cell phone, and using the computer; their attention span ranged between 30 seconds and 5 minutes. Brown (p. 14) describes a set of dimensions and shifts:

- (1) “Literacy today involves not only text, but also image and screen literacy... to read multimedia texts and feel comfortable with multiple-media genres...[T]he new literacy is

beyond text and image.... [I]t is one of information navigation, the ability to be your own reference librarian – to know how to navigate through complex information spaces and feel comfortable.”

(2) Gone is, or should be, the lecture-with authority-based formal learning. It should be replaced with learning that is discovery based, enabling us to discover new things as we browse through digital libraries. Surfing “fuses learning and entertainment,” to create “infotainment.”

(3) Infotainment combines with different “forms of reasoning,” not the classical deductive and abstract. Rather, the method is a form of “bricolage,” a concept that anthropologist Claude Levi-Strauss related to “the concrete...abilities to find something, an object, tool, document, a piece of code – and to use it to build something you deem important. Judgment is inherently critical to becoming an effective digital bricoleur...Web-smart kids learn to become bricoleurs.”

(4) The final dimension is “a bias toward action.” Older generations want to know everything about something before they try it. Today’s young people want to “muck around, and see what works...link, lurk, and watch how other people are doing things, then try it themselves...[This] brings us back into the same loop in which navigation, discovery, and judgment all come into play *in situ*...[L]earning becomes situated in action...as much social as cognitive...concrete rather than abstract...and intertwined with judgment and exploration...[T]he Web becomes not only an informational and social resource but a learning medium where understandings are socially constructed and shared...[L]earning becomes a part of action and knowledge creation.”

We have sought to deepen our teachers’ understanding of their own disciplines, broaden that understanding into interdisciplinary knowledge relationships, and establish in them a comfort zone where they are willing to explore the use of technology for teaching and learning purposes and build their repertoire of teaching strategies, models, processes, and procedures. Too often teachers feel that their product is the student. Ultimately, we hope they realize that “their product” is their choice of academic content, educational products, and teaching and learning processes.

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