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ABSTRACT

It has become apparent through the work of many researchers and practitioners that adults learn differently than their younger counterparts in the educational system. This is especially important to those educators teaching in colleges and universities in the sciences. Biology education in the post-secondary setting is inundated with teachers who know biology backward and forward but lack the skills to effectively teach that knowledge to others. By applying the theories of andragogy, transformational learning, and experiential learning, and by integrating practices of self-directed learning and critical reflection, we can improve the effectiveness of biology education in American colleges and universities.

Key Words: *Post-secondary and adult learning; andragogy; transformational learning; experiential learning; self-directed learning; critical reflection.*

Adult learning has long been an area of study. Almost as long as there has been research on how children and adolescents learn, the realm of adult learning has been under scrutiny as well. Previously, adults were assumed to learn in a static format that developed in the late teen years and did not change after that. Piaget gave descriptions of learning only up to the late teens, with his “formal operational” stage being the last (Merriam et al., 2007). It was assumed that adults then spent the rest of their lives in that stage. Only fairly recently has the education community realized that this is not so. Adults have specific ways of learning that may be different from those of younger learners.

As the demographics of American education change, it is wise for educators to change along with them. Yoshimoto et al. (2007) described the landscape of higher education in the United Kingdom, Germany, and Japan and how these countries are addressing the changing need for “societal investment” through education. The methods of teaching and learning that have always been good enough for the majority of learners is no longer good enough when the majority changes. Merriam et al. (2007) summed up the situation here with their statement:

In the United States, there are more adults than youth, the number of older adults is growing, the population as a whole is better

educated than ever before, and the population is more diverse – racially, ethnically, and culturally – than ever before. (p. 11)

Formal higher education has traditionally been designed to serve youth, but today the American college student is more likely than ever to be over the age of 24. With the new demand for valid and effective adult education, research on how adults develop, change, and learn has hit an all-time high. King and Watson (2010) gave a reason for this endeavor when they stated, “The enduring achievement gap, proficiency gap, and inequity in educational options and outcomes in this country mean that we need to continually redefine...what we mean by ‘all’ when we refer to improving the educational experience for *all* students” (p. 176). Educators can no longer simply apply what is known about children to the realm of educating adults.

In order to create a positive learning environment for students, we need to first understand the ways in which learning occurs. There are many ideas about learning described in the literature, focusing on how information is acquired and processed in the learner’s brain. The ideas of andragogy, self-directed learning, transformational learning, and experiential learning are some of the theories that have been written and rewritten in order to explain how adults assimilate new knowledge in the context of their prior knowledge.

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○ Andragogy

The initial step in research on adult learning has been to define adult education as being significantly different from elementary or secondary education. The trend in the mid-1960s was to

completely separate the two arenas, and, with the groundbreaking work of Malcolm Knowles, a new name was given to this aspect of education. According to Merriam et al. (2007), “Andragogy became the rallying point for those trying to define the field of adult education as separate from other areas of education” (p. 85). According to Knowles (1980), adults are self directed, problem centered, internally motivated, come with prior knowledge that directs their learning, learn in a social context, and need to know why they need to learn things.

Andragogy has since been criticized as a theory, and now stands as more of a “model of assumptions about learning or a conceptual framework that serves as a basis for an emergent theory” (Knowles, 1989, p. 112). Stephen Brookfield (2000) went so far as to say that adulthood should not be considered a “discrete, self-contained and separate stage of life,” but instead a continuation of previous stages (p. 105). In fact, the more common terminology when discussing education today is to consider the entire life of the learner, and use the term “lifelong learning.” Lifelong learning as a goal can be applied to those who are within formal educational environments as well as those who are not.

○ Self-directed Learning

Self-directed learning is most commonly attributed to Knowles, because it is one of the assumptions inherent in andragogy. However, it has also been examined from other points of view separate from Knowles’s theory. Self-directed learning suggests that learners need to be in control of their learning. Merriam et al. (2007) insisted that in order to achieve this, “educators of adults in formal and nonformal settings need to shift to learners as much control as possible in the learning process” (p. 109). Various researchers have developed different models of self-directed learning, from linear to interactive, and described different viewpoints on the process. Linear models give a set of steps that happen in the process of learning. These models describe how learning happens by describing the action taken by learners. Interactive models give a set of conditions that need to be met for learning to occur, describing learning as the interaction of those conditions. According to Spear (1988), “a successful learning project is one in which a person can engage in a sufficient number of relevant clusters of learning activities and then assemble these clusters into a coherent whole” (p. 217).

Some models are designed to give instructors tools to use to promote self-directed learning in the formal setting, and some describe self-directedness as an attribute of the learner. These two types of models seem to be conflicting, but the research on self-directedness as a personality trait suggests that it can be learned. Guglielmino (1977) defined self-directed learning as a composite of characteristics that create the probability that an individual can accomplish self-directed learning, thus implying that instructors can create a learning environment that promotes self-directed learning. This leads to the idea that if schools create learning environments that encourage self-directed learning, learners will also be transformed into lifelong learners.

○ Transformational Learning

Transformational learning is the theory that because adults enter into learning with a prior knowledge base, they must transform that base in order to assimilate new information. According to Mezirow (2000), transformative learning will occur when there is a change in one of our beliefs or attitudes, or an adjustment of our perspective. In order to achieve this transformation, learners must analyze their own point of view through critical reflection, dialogue with others about it, and, in some models, act on their newly adopted point of view.

The prior experience of a learner can manifest in many different dimensions, including direct experience of the learner, vicarious experiences, simulated experiences, and even introspective experiences (Merriam et al., 2007). Each experience, in order to cause a transformational learning incidence, must be critically reflected upon. In essence, if the student does not think about the experience critically, they cannot

learn from it. Transformational theory says that learning is “constructing and appropriating new and revised interpretations of the meaning of an experience in the world” (Taylor, 2008). It says that we see the world through a frame of reference that consists of assumptions and expectations, and when we encounter conflicts within our frame of reference, we must alter our perspective – that is, transform what we know into a new frame of reference. Experiences that we do not examine and analyze do not initiate transformational learning.

Transformational learning theories fail to address some aspects of learning. Most do not consider the context of the learning, the effect of rationality on learning, the role of relationships in learning, and the requirements of social action in learning.

○ Experiential Learning

Experiential learning refers to how people learn from their experiences. Although this sounds very similar to transformational learning, a transformation may not be necessary in this case. Learning from experiences involves the learner’s ability to “connect what they have learned from current experiences to those in the past as well as to see possible future implications” (Merriam et al., 2007). There are models for the constructive and situative views of this phenomenon, along with descriptive research (but no real models) for the psychoanalytic, critical, and complexity views of experiential learning. They all agree, however, that critical reflection on the experience is essential for learning to occur. According to Itin (1999), “experiential learning involves (1) action, (2) reflection, (3) abstraction, and (4) application.” Although the reflection and abstraction may cause a transformation, it is not required for a person to learn from the experience under this theory.

Another way to view experience is by how the body senses its environment. Embodied knowing happens through using the body and special senses to learn about the world and about oneself. Embodied knowing is often overlooked as important to learning because of its connection of the body to the mind. Unfortunately, this can be a problem. Most people don’t want to admit that they are animals, sensing and “knowing” things through their physical experiences as well as their cognitive ones. Often they engage in “cognitive distancing” to avoid these ideas. In a study on art-making activities in an informal setting, Uptis et al. (2008) described the importance of the materials in embodied learning by describing the “visceral and sensual responses that the materials invoked.” However, it has been found that embodied knowing can enhance learning in all areas. Uptis et al. (2008) noted that the embodied activities they participated in “brought them closer in touch with their physical beings, which in turn strengthened their intellectual and emotional engagement in the academy” (p. 17).

○ Critical Reflection

All these theories address the experience or prior knowledge of the learner, and all have a requirement of self-reflection in order for learning to occur. Itin (1999) described experiential learning as “the change in an individual that results from reflection on direct experience and results in new abstractions and applications.” This definition closely mirrors the definition of transformational learning. Bandura (2001) also expanded on learners’ control of their learning, through social cognitive theory, which describes adult learners as agents of their behavior. An agent is someone who is consciously aware of and in charge of their own behavior. Adult learners create their own environment, not just react to it. They

can come up with novel solutions, reflect on their behavior, and predict outcomes. They also can seek out knowledge and learning opportunities, which is defined as self-directed learning.

Critical reflection is “the process by which adults identify the assumptions governing their actions, locate the historical and cultural origins of the assumptions, question the meaning of assumptions, and develop alternative ways of acting” (Shandomo, 2010, p. 101). Brookfield (1995, 2000) has expounded on critical reflection, for both the learner and the teacher. His descriptions of critical reflection consider internal incongruence and how to deal with it. Argyris and Schön (1974), also referring to internal incongruence, stated that “all human beings – not only professional practitioners – need to become competent in taking action and simultaneously reflecting on this action to learn from it.” They describe this critical reflection as an examination of espoused theories-in-action (what you say you do) in comparison to theories-in-use (what you actually do).

Critical reflection can also be examined from a non-Western perspective. Narrative has long been used to teach and to learn. Telling stories to oneself is a form of reflection and may help learners assimilate and transform their knowledge. McCormack (2009) noted that “in their stories participants actively analyzed, evaluated and re-evaluated. Through self-reflective dialog they recognized that emotions played a role in shaping their experience and its outcomes” (p. 146).

○ Theory into Practice

It is apparent through research that adults develop cognitively in several ways. Learning theories are based on cognitive development. Knowles’s theory of andragogy is the best place to start because it can be used to impart information about adults as learners. These assumptions can then be used as a basis for designing educational practices in the science classroom. The transformative theory, the experiential learning theory, and the practices of critical reflection and narrative can be used to adjust the learning environment to one appropriate for adults.

The relevance of these theories becomes apparent in the first days of a science class. To begin with the experiential learning theory, experiential learning has taken place already in these students. Students may have learned from other attempts at learning scientific principles that the material is difficult to understand, and thus they may have created the belief that they cannot understand it. The goal of the science instructor is to create an environment where transformation of this belief can happen. Introduction of material in such a way that makes it fun and interesting to students can counter the common assumptions that science is boring and indecipherable. These new experiences can trigger a transformation event that allows the student to reflect on science as a whole and transform their views about it. Those who do not hold these assumptions will also benefit, as their positive viewpoints are substantiated in the classroom.

Once students feel comfortable with the idea of science, this same approach can be used to create transformative learning opportunities pertaining to the context of scientific knowledge. Transformation of perspective requires that the classroom is conducive to constructive building of knowledge and critiquing of that knowledge. There are several methods described in the research that can create an environment of this kind. Collaborative learning activities, opportunities for self-directed research projects, and self-reflection and peer-reflection opportunities abound in science.

Science was meant to be based on discovery. It is the search for knowledge, which naturally blends with the definition of self-directed learning. Self-directed learning is often stimulated by experiences that

we cannot integrate with our current set of assumptions and beliefs. According to Jarvis (2004), “no longer can previous learning cope with the present situation, people are consciously aware that they do not know how to act. We have to think, to plan or to learn something new. Learning always begins with experiencing” (p. 93). In order to integrate new knowledge, understand experiences, and transform our assumptions and beliefs, we must seek out that knowledge in a self-directed manner. By allowing learners to seek out the relevant information and research and collaborate on developing their own interpretation, instructors can create a self-directed climate in their own classroom. This also integrates all the learning theories as science students seek knowledge through self-directed pursuit, experience the information in various ways, reflect upon it and themselves, and possibly transform beliefs as a result. Implementing the theories may be as simple as asking the student to find more information on a subject they have shown interest in, or as complicated as having them complete a multifaceted project with various critical-thinking requirements embedded. As learners seek new knowledge through new experiences, transformation will occur.

○ Educational Philosophy

The theories of experiential and transformational learning best describe what should happen in a post-secondary classroom, but these theories also incorporate several ways of knowing that are not necessarily explicit. Often the learning that happens cannot be described by one theory alone.

Critical thinking is another important aspect of learning. Learning is not just about facts and figures, it is about becoming a valuable member of society. If we teach students to think critically, character will come along with it. According to Linda Elder (2004), students thus

become intellectually responsible in their approach to thinking through problems and issues, by learning, for example, to take into account all relevant viewpoints whether or not those viewpoints agree with their own or the viewpoints of the groups to which they belong. (p. 5)

Spiritual ways of knowing may have a part in this understanding and acceptance of multiple viewpoints. As we learn to recognize our humanness, and our spiritual connectedness to other human beings and to the biological world, our desire to understand that world may come naturally (Shahjahan, 2005).

○ Implications Analysis

Practical application of these theories could lead to a revolution in science education in post-secondary schools. Ideally, students would be exposed to science in more positive and encouraging ways in elementary and secondary settings. These students would gain positive experiences that would give them a basis to build on when they reach post-secondary schools. They would already have a set of assumptions based on valid information instead of emotional triggers. The initial resistance to learning the subject would not exist, because the learners would have experiences that give them a strong sense of self esteem regarding their ability to learn the material.

Given this new outlook on the subject matter, the post-secondary instructor could then begin instruction by creating opportunities for self-directed, experiential, and transformative learning. Students could

be set free, in a sense, to learn on their own terms with fewer restrictions. Activities might include more discussion and collaboration and less lecture, allowing learners to incorporate their own prior knowledge and reflect on their assumptions regarding the content.

○ Conclusion

Science requires that information be gathered from many sources and integrated in a meaningful way. The science educator can use the current research to increase learning in the post-secondary environment. Science is typically taught with a lab component that incorporates the social aspects of learning and the embodied learning, along with allowing learners to be self directed, problem centered, and internally motivated. The lecture component of science classes should consider the idea of transformational learning so that adult learners know why they are learning and can incorporate their own prior knowledge. Understanding can also be gained by experiencing the world through our senses, by hearing, writing, and speaking narratives to ourselves and to others, and by feeling and believing spiritually in the connection of all. As we continue to learn about learning, we discover new ways of viewing this complicated phenomenon and can incorporate them into the classroom.

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