There are many arguments in favor of incorporating service-learning into the classroom (Jacoby, 1996; Boss, 1994; Tucker & McCarthy, 2001; Eyler & Giles, 1999; Eyler, Giles, Stenson, & Gray, 2001), and we assert another important, yet not currently recognized, benefit is that service-learning can change the brain. Proponents of service-learning advocate for its use because it helps students learn (Astin, Vogelgesang, Ikeda, & Yee, 2000; Steinke & Buresch, 2002; Eyler, 2000).

Based on research into brain-based learning, we assert that experiencing service-learning in an academic setting creates conditions that can lead to changes in the learner’s brain. We provide support for this assertion from research in neuroscience field and make suggestions of how we might increase learning by explicitly applying concepts from these areas of study to service-learning pedagogy so that we might increase learning.

**Keywords**: brain-based learning, teaching and learning, experiential learning

Enhancing Learning, Changing the World: How Service-Learning Influences the Brain

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**ABSTRACT**

Service-learning helps students learn about course concepts through applying them in a setting outside the classroom. The experiences provided by service-learning create conditions that can lead to changes in the learner’s brain. In this paper, we provide support for this assertion from research in brain-based learning with suggestions of how to explicitly apply concepts from these areas of study to service-learning pedagogy so that we might increase learning.

There appears to be some agreement that “Whatever learning is or is not (and the debate continues despite the wealth of literature in the area) it involves some kind of change in the brain of the person doing the learning…” (Baldwin, 2006, p. 203). We searched the EBSCO database, including all discipline categories, for the terms “service-learning” and “brain” and found only two publications that link service-learning with brain-based learning: an article about the use of service-learning in an undergraduate language development course (Nwokah & Leafblad, 2013), and a magazine story titled “Service Learning Stimulates the Brain.” This article will be the first to examine brain-based learning as an explanation for the impacts often seen in service-learning courses.

Service-learning has been shown to have a positive effect on academic performance, values, self-efficacy, leadership, choice of a service career, and plans to participate in service after college (Astin et al., 2000). However, even though students report an increase in learning when they participate in service-learning (Steinke & Buresch, 2002), objective measures have failed to provide conclusive support for the claim that service-learning promotes improved course material learning over alternative assignments. Eyler (2000) notes “Intellectual outcomes—knowledge, cognitive development, problem-solving skills, and transfer of learning—are at the heart of the school and college mission and yet we know relatively little about how they are affected by service-learning” (p. 11).
Service-learning can also provide students with a transformative learning experience. According to Mezirow (1991), the transformational learning process consists of encountering a dilemma, making meaning, and achieving a transformative insight that results in changes in real-life behavior. Like service-learning, transformative learning requires the process of critical reflection to work through our assumptions and beliefs (Cranton, 1994). When students are put into new environments working with people unlike themselves, this same critical reflection is required to learn from the experience. We expect that students will learn and also change through their service-learning experience. Cranton’s (1992) framework describes three types of change: Transformative learning can result in a change in assumptions, a change in perspective, and a change in behavior (Cranton, 1994), much like we can see in service-learning courses.

Given that attempts to document the connection between service-learning and course material learning have not always yielded the evidence to support this claim, another approach to studying learning may be more appropriate (Herbert & Hauf, 2015). Deeley notes (2010, p. 50), “There is no satisfactory explanation in the service-learning literature of how students’ transformation occurs.” Zull (2002) was one of the first in higher education professional development to define learning in his book as “The Art of Changing the Brain.” If the service-learning community takes their lead from the neuroscience community and redefines learning as actually changing the connections in the brain, we may be able to explain its effectiveness.

Service-learning is a type of experiential learning where students not only learn concepts from their courses, but also learn about applying these concepts to themselves and their communities (Astin et al, 2000). In his work on the experiential learning model, David Kolb describes learning as “…the process by which knowledge is created through transformation of experience” (p. 26) and can be measured through behaviors, cognitions, and emotions (Kolb, 1984). Service-learning provides an experience where students create knowledge and actually change their brains.

Neuroscientists agree that learning changes the physical structure of the brain in a way that organizes and reorganizes the brain (Bransford, Brown, Cocking, Donovan, & Pellegrino, 2000.) These changes are dependent on experience. Bransford et al. (2000) note, “The functional organization of the brain and the mind depends on and benefits positively from experience. Development is not merely a biologically driven unfolding process, but also an active process that derives essential information from experience” (p. 126). We assert that students who participate in service-learning experience an interaction with the community and reflect on that interaction in a way that helps them learn. Nwokah & Leafblad (2013, p. 70) describe brain-based learning as “…the ability to make and change neuronal connections when knowledge is acquired through real-life situations and using multiple senses.” Service-learning can take students into new environments and provide opportunities to meet new people who are not like them. These new experiences often make a lasting impression that stays with a student long after the class is gone. Why does that happen? We assert that it is the result of brain-based learning and the biology of the brain.

**Biology of the Brain**

Brain imaging technology has allowed researchers to identify which part of the brain is active when a person is engaged in different types of tasks. Zull (2002) bases his discussion of the brain’s learning process in the work of Kolb’s (1984) experiential model of learning, and discusses how the different parts of the brain are related to the model. We can see how the brain was created for learning (Zull, 2002) and, as instructors, we can use this information to
redesign our classes and revisit our pedagogies. Table 1 shows how Moffett and Fleisher (2013) provide a clear vision of the relationship between the two in their discussion of matching the neurobiology of learning with teaching strategies.

More specifically, Schreiner, Rothenberger, and Sholtz (2013) describe four primary areas of the brain that serve major functions and interact with each other in learning. First, the brainstem is found in the back of the brain. This is where we become aware of what is going on in the world through our senses. Second, the interior limbic area including the hippocampus is where memory and meaning begin. With an emotional connection to what we have sensed, repeated experience, and sustained attention, this part of the brain supports comprehension and connection to previous knowledge. However, the hippocampus has limits on how much information it can hold; 15-minute chunks of information seem to be the limit (Jensen, 2010). Third, the prefrontal cortex in the front of the brain is where executive functions such as creating, higher-order thinking, creativity, and problem-solving occur. We hope that our students pay attention to what we present, connect the sensory data to what they already know, and move to this part of the brain where the real work gets done. The final area is the cerebellum, which is the motor area of the brain. This part of the brain controls writing and speaking and allows the internal processes of the brain to be transmitted back to the outside world.

Service-learning and the Brain

There are several key neuroscience implications for the classroom that are already incorporated into most forms of service-learning. Nwokah and Leafblad (2013) provide a specific example of how brain-based learning concepts can help to explain the impact of service-learning in their language development course (see Table 2). In this example, undergraduate students interacted with homeless and low-income children as part of a service-learning component of the class. Students completed a survey and questionnaires, completed reflection journals, and participated in small group discussions as part of the experience. The instructors analyzed this data in light of what we know about brain-based learning and concluded that students benefited from multisensory experiences and related problem solving, changes in their attitudes and

Table 1.

Learning Cycles and Brain Activity

<table>
<thead>
<tr>
<th>Learning Cycle (Kolb, 1984)</th>
<th>Processed by this Part of the Brain (Zull, 2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Experience</td>
<td>Sensory Cortex</td>
</tr>
<tr>
<td>Reflective Observation</td>
<td>Integrative Cortex at the Back</td>
</tr>
<tr>
<td>Creating New Abstract Hypotheses</td>
<td>Frontal Integrative Cortex</td>
</tr>
<tr>
<td>Active Testing</td>
<td>Motor Brain</td>
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</tbody>
</table>

be-liefs, application of classroom information and related learning, and emotional learning (Nwokah & Leafblad, 2013). This study shows that this service-learning experience supported several aspects of brain-based learning. Students reported vivid images and memories as a result of their experiences working with the children. This type of multisensory experience is very difficult to create in a classroom. Second, students were challenged by the children in ways that required immediate problem-solving responses that involved both the frontal integrative cortex and the motor cortex. Again, it is difficult to create a classroom experience that can show the immediate impact of a student’s decisions and can create the emotions experienced by these students when they interacted with the children. The authors note that, “This study provided evidence that service learning is one of the best ways of enhancing brain-based learning by arranging for “hands-on” experiences in a real-life setting with novel and often-unexpected events requiring immediate solutions” (p. 92).

Another example of how brain-based learning concepts support experiential learning is found in the Universal Design for Learning (UDL) guidelines for curriculum design (CAST, 2011; Vitelli, 2015). UDL recommends that educators use flexible pedagogical approaches to address the needs of learners, specifically because learning approaches and styles vary widely (CAST, 2011). UDL uses three principles based on neuroscience research to guide pedagogical design: 1) Provide multiple means of representation (the “what” of learning); 2) Provide multiple means of action and expression (the “how” of learning); and 3) Provide multiple means of engagement (the “why” of learning). These principles are based on the assumption that learners differ in how they perceive, comprehend, and experience learning. Each principle is further described by three guidelines for implementation. The first principle, provide multiple means of representation, can be implemented by Guideline 1: Providing options for perception; Guideline 2: Providing options for language, mathematical expressions, and symbols; and Guideline 3: Providing options for comprehension. The second principle, provide multiple means of action and expression, can be implemented by Guideline 4: Providing options for physical action; Guideline 5: Providing options for communication and expression; and Guideline 6: Providing options for executive functions. The third principle, provide multiple means of engagement, can be implemented by Guideline 7: Providing options for recruiting interest; Guideline 8: Providing options for sustaining effort and persistence; and Guideline 9: Providing options for self-regulation. Service-learning specifically addresses these three principles in providing multiple learning opportunities throughout the service-learning experience. Diverse learners engage with the service-learning experience, and then reflect on that experience in their own unique way.

In the following section we identify specific concepts from brain-based education that can be applied to enhance learning in any service-learning course.

**Movement Enhances Learning and Memory**

We know that brains use cognition, control, fear, and pleasure to survive and that there is a relationship between pleasure and movement such that activity in the movement centers of the brain also generates pleasure (Zull, 2002). This action may take the form of physical action, anticipation of movement, or imagined movement, including progress toward a goal. One of the guiding principles of UDL is to provide options for physical action (CAST, 2011; Vitelli, 2015). Sousa (2010) notes that one reason brain research is so relevant for teaching and learning is that it tells us that movement enhances learning and memory (Jensen, 2008; Radin, 2009). Movement can mean physical movement such as moving around the room, or even moving out of the classroom to learn from and work with a
community partner. Movement can be related to being actively engaged in learning (active learning). Movement can also be more cognitive than physical such as when we perceive movement toward accomplishing a goal. Fischer (2009, p. 5) goes so far as to say “knowledge is based in activity.”

Why is movement helpful for learning? There is a connection between movement and happiness. “We get enjoyment and satisfaction through anticipation of movement and imagined movement” (Zull, 2002, p. 62). Csikszentmihalyi (1990) argues that movement contributes to a sense of well-being and makes optimal experience possible. Movement can go beyond physical experience, including progress toward a goal or stories that lead our minds to a goal. When we want to see something happen, we are curious about what will happen. This anticipated movement can also be satisfying.

Service-learning takes students out of the classroom and into the community. Students are actively involved with the community partner in a project that often has a designated goal of serving the organization’s mission. In addition, the community partner may engage in work that is meaningful to the student and consistent with the student’s values. Kenworthy (2010) uses service-learning in a negotiations class

Table 2.

<table>
<thead>
<tr>
<th>Concept from Neuroscience</th>
<th>Application in Service-Learning</th>
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<tr>
<td><strong>Movement enhances learning and memory</strong></td>
<td></td>
</tr>
<tr>
<td><em>Active Learning</em></td>
<td>Collaborate with the community partner in a service project</td>
</tr>
<tr>
<td><em>Physical movement</em></td>
<td>Go out into the community</td>
</tr>
<tr>
<td><em>Movement toward a goal</em></td>
<td>Meet learning goals with service; accomplish service goals</td>
</tr>
<tr>
<td><strong>Emotional engagement</strong></td>
<td></td>
</tr>
<tr>
<td><em>Positive Emotions</em></td>
<td>Positive experience with their classmates and the class material</td>
</tr>
<tr>
<td><em>Emotional engagement in the service</em></td>
<td>Positive experiences with the community – feel good about helping</td>
</tr>
<tr>
<td><em>Reflection on emotions</em></td>
<td>Process emotional reactions to the service and the partner through reflection</td>
</tr>
<tr>
<td><em>Emotional connection to material</em></td>
<td>Developed through active participation in service and reflection on the link to the material</td>
</tr>
<tr>
<td><strong>Multiple contexts</strong></td>
<td>Classroom, partner, community</td>
</tr>
<tr>
<td><strong>Multiple senses</strong></td>
<td>See, hear, smell, touch in the multiple contexts</td>
</tr>
<tr>
<td><strong>Builds on previous learning</strong></td>
<td>Pre-reflection to connect to previous experience</td>
</tr>
<tr>
<td><strong>Create structures for learning</strong></td>
<td>Reflection activities and other assignments that provide students with an opportunity to process their service-learning experience</td>
</tr>
</tbody>
</table>
where the student teams are formed based on common student interest in a community issue. Working toward that goal provides a sense of meaning and purpose, leading to a sense of accomplishment when goals are attained. In a class on change management, (Sigler, 2006) student groups identified a community need that they wanted to address with their service-learning project and then created a specific mission statement that described their goals. They selected a community partner whose mission fit with the team goal described in the mission statement. One of the UDL guidelines is to provide options for executive functions including goal-setting and self-monitoring (CAST, 2011; Vitelli, 2015). Pre-reflection and reflection during and after a service-learning project can help students to set goals and monitor their progress toward those goals (Roebuck, Sigler, & Tyran, 2006). They may develop goals related to the specific course or community partner, or they may start working toward policy or community-level goals that can impact the larger society.

**Emotional Engagement Enhances Learning**

There is growing evidence that emotion has a significant influence on learning. Social and affective neuroscience are revealing more clearly than ever before the interdependence of cognition and emotion in the brain and the importance of emotion in guiding successful learning (Immordino-Yang & Faeth, 2010). LeDoux (1997) explains it this way: “A purely cognitive view of the mind, one that overlooks the role of emotions, simply won’t do” (p. 200). Emotion is a critical piece of the thinking process; it is not a separate process (Felten, Gilchrist, & Darby, 2006). “While neurological networks shape the initial physiological experience of emotions, individuals reflect on, make sense of, and learn from their emotions through the cognitive appraisal process” (Felten et al., p. 41).

When students experience positive emotions, they are more open to learning because to learn something is to have emotional success (Hodges, 2010). Judy Willis (2010) explains the importance of what she labels “joyful learning.” The reticular activating system (RAS) is the first filter for the brain’s sensory input system. All sensory input must pass through this network of cells before it can be received by the reflective cognitive brain. If a student feels stress or fear, the RAS sends the signal of a threat to the lower reactive brain where the involuntary responses are flight, freeze, or fight (Raz & Buhle, 2006). The content of the lesson never makes it to the cognitive, thinking part of the brain. However, if the student perceives novelty or the change associated with pleasure or with content that arouses curiosity, the RAS sends these positive signals directly to the thinking brain where students learn. Minimizing threats is one way that UDL provides multiple means of engagement; student engagement will increase when threat is absent (CAST, 2011; Vitelli, 2015). Thus “joyful learning” is that which evokes feelings of novelty, change, or curiosity and that lead to successful learning (Willis, 2010). If we provide students with an achievable challenge so they can see movement toward a goal, they will want to keep learning and experiencing the positive emotion of the successful movement. They will want to keep learning.

Part of the transformative learning experience discussed by Mezirow (1991) includes the experience of a disorienting dilemma. Because this disorienting experience can generate anxiety, transformational learning is more likely in environments perceived as safe (Mezirow, 1991). Kolb and Kolb (2005) suggest that safety is created by fostering a supportive environment through social inclusion, honoring differing experiences, and combining challenge and support. Students are more likely to be able to learn in a stressful situation if they have the support of others to help them through the experience.

The importance of engaging in meaningful work—feeling a sense of pur-
pose in tasks related to learning—has been established by many researchers (Csikszentmihalyi, 2003; McGregor & Little, 1998; Niemiec, Ryan, & Deci, 2009; Pink, 2009). Emotional engagement is critical in learning as it relates to changing the brain. With emotion comes passion and meaning, which makes the changes in the brain much more impactful (Zull, 2002). We can explain why this happens if we understand the role of dopamine in influencing behavior (Willis, 2010). According to Willis (2010), dopamine is one of many neurotransmitters that carry information across the branches of the brain. More dopamine is released when one’s prediction (choice, decision, answer) is correct and less dopamine when the brain becomes aware of a mistake. If a student action or response is correct, the dopamine reward reinforces the memory of the information, the brain favors and repeats actions that release more dopamine so the involved neural memory circuit becomes stronger and is favored when making similar future choices. If the response is wrong, then a drop in dopamine results in unpleasantness and the brain tries to avoid repeating the mistake (Willis, 2010, p. 54). Engaging students in learning activities that result in greater dopamine release will likely get them to respond with pleasure and increase focus, memory, and motivation (Storm & Tecott, 2005).

Service-learning engages the emotions of students in numerous ways. Students may be emotionally impacted by the realities of the community issues and community members they encounter. They may be inspired by the spirit and dedication of their community partners (Hein & Singer, 2008). Zull (2002) suggests that we need to “…give students the kind of experiences that would produce dreams—experiences that engage their emotions…” (p. 169). They may feel good about the service they provide and they may feel a sense of achievement when they are able to learn and apply the concepts from their courses. The organization’s purpose may be meaningful to them, and this sense of purpose provides energy to commit to their learning and their work (Csikszentmihalyi, 2003). They may have a positive reaction to the class because of the opportunity to participate in a service-learning project that provides them with these opportunities.

Deeley (2010) conducted a qualitative study (interviews and focus groups) with a small group of undergraduate students in Glasgow, Scotland, who participated in service-learning as part of a public policy course. The service took place in a variety of community organizations that provide social services. The strong emotional reactions that students experienced played a key role in their personal transformation.

Service-learning also provides students with opportunities to reflect on the emotions that come out of their experiences. They are able to process the emotional reactions they have in response to the service, the community, and their experience, and to receive feedback from the instructor who is facilitating their learning. Felten et al. (2006) go so far as to suggest that we redefine reflection in service-learning as “…a process involving the interplay of emotion and cognition in which people (students, teachers, and community partners) intentionally connect service experiences with academic learning objectives…” (p. 42). Understanding the connection between brain chemistry and experience provides additional support for Felten’s argument.

Service-learning can also foster an emotional connection to material. When students actively engage in the concepts they are learning and apply them to their experiences (active learning), an emotional connection is created. Often students are allowed to choose or find their own community partner organizations. Letting students participate in the selection process allows them to choose projects that relate to their lives and interests (Immordino-Yang & Faeth, 2010). Optimizing individual choice and autonomy is also one of the
guidelines for UDL (CAST, 2011; Vitelli, 2015). Instructors need to perfect the art of selling the importance of the concepts we teach because we know students learn and internalize things that are important to them (Zull, 2002). Plasticity in the brain probably depends more on signals from the emotional centers about importance than it does on new sensory input (Zull, 2002).

Prior Knowledge is the Beginning of New Knowledge

Students arrive in our classrooms with massive amounts of prior knowledge. Everything they have learned prior to entering the class has physically changed their brain and created physical networks that are strong. This prior knowledge is always the beginning of new knowledge (Zull, 2002, p. 93). Part of the art of changing the brain is recognizing the existing neural networks in a learner and then inventing ways for her to use them. We continually add new experiences to our old ones. Experiential activities like service-learning help students connect course material to themselves and to their concrete experiences (Cherney, 2008). The concrete and often shared experiences that are created through service-learning projects enhance student learning.

One important element about the brain that has arisen from recent research is the concept of plasticity. This means that the brain is constantly changing and reorganizing itself (Doidge, 2007). Zull (2002) recognizes that plasticity depends more on internal signals from the brain indicating importance and emotional satisfaction than from direct sensory signals. The implication of this point is that teachers should enable students to build on what they can already do (Freeman & Wash, 2013). Changes in synapses occur depending on how much they are used and how important the signals are (Zull, 2002, p. 114).

When new information is recognized as related to prior knowledge, learning extends beyond the domain in which it occurred. It is available through transfer to create new predictions and solutions to problems in other areas (Willis, 2010). Thus, knowledge accessed this way is retained to apply in other situations, such as tests and assignments.

Service-learning can help students connect the new experience to previous experience. Pre-reflection can help them to identify what they might already know about the project, community, or mission or how it relates to their lives. If students have been given the opportunity to choose their project or partner, they may be able to explain the connection or the reason they chose the project, the reason this specific partner was important to them, and/or the emotional attachment they feel to the organization as it relates to their values (McGregor & Little, 1998). Reflection assignments throughout the project might ask students to write about how their observations or experiences connect to their past experiences. Students may also be asked to reflect on what personal experiences, skills, or gifts they brought to the class and project before learning the course concepts.

Learning is Enhanced Across Multiple Contexts and Multiple Senses

Traditional classrooms assume that learning takes place during class time, study time, and homework time. Service-learning intentionally extends the learning environment to the community. Students are learning in their community, through interactions with community partners and clients, perhaps visiting new neighborhoods, experiencing cultures different from their own—all of which create a learning environment dramatically different than a classroom. In reality “given that so few hours are spent there [in the classroom] in the higher education context, none could argue that learning takes place only at that time and in that place and in the presence of an educator. Instead, whatever learning does or does not happen in the brains of our learner’s takes place outside the classroom” (Baldwin, 2006, p. 203). Service-learning incorporates some of the concepts of the flipped classroom (Bergmann & Sams, 2012) where
concepts learned from assigned materials are applied and explored in the community. Class time can be spent reflecting on the service-learning experience and connecting the experience to the course content.

One important outcome of student learning is the ability to transfer what has been learned to a new context. While there are many ways to increase the likelihood of transfer of learning, service-learning helps students learn across multiple contexts. Research indicates that knowledge that is taught in only a single context is less likely to support flexible transfer than knowledge that is taught in multiple contexts (Bransford et al., 2000). Students are exposed to and reflecting upon course concepts in the classroom, in their team meetings, and in the community. They may be working in a community organization and interacting with community members who are clients of the partner organizations. Engagement with course concepts in real time or through reflection helps students learn across multiple contexts in a way that will help them transfer the learning to new contexts.

Student learning is enhanced when multiple senses are engaged. Not only do multiple inputs strengthen the concept learning, but they make it easier to access later because more areas of the brain are stimulated, and duplicated storage of information means more successful recall (Willis, 2010). One of the key principles of UDL is to provide multiple means of representation (CAST, 2011; Vitelli, 2015). Each sensory organ has a separate storage area in the brain and there are also areas of the brain that get input from multiple senses. These areas where multiple senses converge are where the information is integrated into a complete picture. Approaching a new concept from multiple angles strengthens the overall understanding because it helps students to see patterns (Hodges, 2010).

For example, Zull (2011) suggests that we give students opportunities to have concrete experiences such as field trips, internships, research projects, hands-on experiences, collaboration, role playing, and other active learning approaches. “One of the most important and powerful aspects of experiential learning is that the images in our brain come from the experience itself. These are the richer images. They contain data from all of the senses at once; they are sense-luscious…” (p. 145) and we are more likely to trust our own experience than experiences we hear about second-hand.

Service-learning is a form of active learning where students are engaging with multiple senses. When they work in the community, they see the work of their partner, they feel the touch of the people or places they work, they hear the experiences of the partners, their clients, and other students who are experiencing the service, they smell the outdoors when they move between locations, and the smells of the service location become part of the experience. They may even experience new tastes as part of their experience.

Learning Is Enhanced When Students Have Time

The brain receives sensory input from multiple senses in multiple contexts. Students go to class, read their textbooks, engage in active learning, and work on applying concepts through homework and projects. They receive large amounts of sensory information quickly, but the integration of all that information into a complete picture is much slower (Hodges, 2010). It takes time to get all of the sensory input from an experience integrated and to see the full meaning of our experience. We have to think about things (reflect) and examine the images in our memory (observation) before we are able to fully process our learning.

Reflection assignments help students process all of the sensory information they experience through their service-learning and are thus most effective for learning. Reflection, as it is used in service-learning, requires students to find that space and time to reflect on their experiences and to integrate it into their current knowledge.
structures in a way that makes sense to them. Reflection takes time because the process involves the brain literally searching for connections between new experience and past learning (Zull, 2002). “The functions of the back cortex all work together to produce comprehension. The integration of what with where, emotion with fact, big picture with precise detail, symbolic language with prosodic language, and language with image, all play their part on the development of deep understanding by the learner. All of this takes time” (Zull, 2002, p. 162).

Reflection in service-learning can occur before the service, during the service, and after the service is completed. The multiple step reflection process requires the students to focus on their experiences and make sense of their learning all throughout the process.

How to Improve the Learning in Service-Learning

Research into brain-based learning provides additional suggestions for instructors who are trying to create changes in their students’ brains. Instructors should consider how they might capitalize on the benefits of social learning, arouse curiosity in their students, emotionally engage students in their projects, and incorporate frequent formative assessment and feedback. Our suggestions are as follows:

Capitalize on the Benefits of Social Learning

Learning does not occur in isolation. People learn a great deal from their social interactions because the brain has built-in mechanisms that help us learn by imitation. First, teachers should model the behaviors they want students to emulate. Another important aspect of social learning is group learning. Neurologically, we are wired with shared attention mechanisms. Using teams in the classroom and in the service-learning is an effective tool for improving learning (Hodges, 2010).

Curiosity Entices the Brain

As noted earlier, all sensory information passes first through a network of cells in the brain, the reticular activating system (RAS) (Willis, 2010). However, not all bits of sensory information are selected to pass through the RAS. The RAS is most receptive to changes in the environment that are seen as threatening. When no threat exists, the RAS becomes receptive to novelty and change associated with pleasure and to input about things that arouse curiosity (Raz & Buhle, 2006). A service-learning project on its own may be enough of a novel approach to learning that students become interested and pay attention to the details of the assignment. Another RAS strategy particularly applicable to service-learning is to engage students’ curiosity by asking them to make predictions. For example, predictions about what they will experience at their service site, predictions about how or when they will meet their goal, or predictions about the projects that each community partner might need completed. A novel experience has a greater chance of becoming a long-term memory because students will be more likely to share their experience with others than a classroom experience that is like all of the others.

Provide an Opportunity for Students to Engage Emotionally

By using projects that are meaningful to students with goals that provide students with a sense of purpose, students will be more emotionally engaged. Along with this increased sense of purpose, students will feel more positive about themselves and their learning. The new connections in the brain are related to integrating cognitive and emotional experiences. By providing these unique opportunities to students, learning is enhanced.

Incorporate Regular Feedback and Self-Assessment

Plasticity is the ability of neural networks to “extend, prune, reorganize, correct, or strengthen themselves based on ac-
quiring new information, obtaining corrective feedback, and recognizing associations between new and prior knowledge” (Willis, 2010, p. 55). A key implication for teaching based on this discovery is the importance of assessment and feedback. Frequent formative assessment provides feedback to students (and the brain) about how they are progressing toward their goals. If they are off track and not progressing, corrective feedback can help them get back on a course to make progress and thus experience pleasure.

As noted earlier, we know that brains crave control and pleasure and use these tools (along with cognition and fear) to survive (Zull, 2002). Instructors should encourage students to set a goal at the beginning of the project, class, or semester and create ways for them to examine their own performance and improve it. Progress toward the goal provides pleasure, and self-assessment provides control over the learning process. Students must be interested in achieving the goal, and the goal must be realistic. Students should be motivated based on their learning and progress toward their goals. The instructor’s job is to help students set realistic, achievable but challenging goals, and then to experience some sense of success or progress toward the goal. Team members or peers can also provide support and feedback, thus reinforcing the importance of social learning.

CONCLUSION

Service-learning can be used across disciplines to change the student brain. Students in service-learning courses engage in active learning, experience physical movement completing their service, and experience movement toward accomplishing their learning and service goals. They may become emotionally engaged with their community partner and the course concepts and reflect on their emotional response to the service-learning. Service-learning provides the opportunity for students to learn in multiple contexts and to engage multiple senses in their learning experiences, allowing them to learn consistent with their own learning style and approach. Structured service-learning reflection activities help them see how their previous experience connects to their learning and help them to create a structure for integrating their new learning with their past experiences. Using service-learning as a pedagogical approach actively stimulates learning through changing brain pathways. This is especially important for learners who learn best by being engaged in multiple neural networks. Applied and experiential learning may lead to better learning progress for more learners when educators understand how service-learning changes the brain.

REFERENCES


AUTHOR NOTE

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