Applying the Principles of Brain-Based Learning in Social Work Education

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Abstract: *This paper contributes to social work education by presenting brain-based learning as a theoretical framework to understand the impact of brain development and brain processes on learning and teaching. Historically, brain-based learning was adopted in elementary and secondary educational settings to assist educators in determining the pedagogical strategies most salient to supporting cognitive processes. However, in recent years, emphasis on brain-based learning has also emerged in higher education. It is more imperative than ever that faculty rely on evidence-based methods and models of teaching in the learning environment given the life stressors and trauma experienced by college students, including the coronavirus pandemic. Brain-based learning is a well-developed approach informed by theoretical constructs in neurology, psychology, biology, education, and medical science. Implementation of the key principles of brain-based learning are associated with improved academic performance, positively influenced motivation, and supported retention of knowledge. Brain-based learning is a model well-suited for implementation in social work education and supports the experiential practices embedded in social work pedagogy.*

Keywords: Brain-based learning, higher education, social work education, academic performance, adverse childhood experiences, pedagogy, scholarship of teaching and learning, experiential learning

Brain-based learning has gained traction in recent years for providing a conduit to understanding the impact of brain development and brain processes within the framework of the learning environment (Caine & Caine, 1990; Jensen, 2008a; Kahveci & Ay, 2008). Greater understanding of how humans make meaning of experiences and how the acquisition of knowledge translates to learning has become the work of researchers and practitioners from multiple disciplines including neuroscience, cognitive neuroscience, psychology, biology, and education. Using the brain-based learning approach, Caine and Caine (1990) framed several neuro-biological concepts of brain science into classroom strategies, bridging research-based constructs with practical application. Brain-based learning moves from traditional learning styles such as rote memorization into a process in which the application of knowledge through problem-solving and experience-based opportunities are used to optimize the student's capacity to learn (Caine & Caine, 1990; Gozuyesil & Dikici, 2014). Brain-based learning takes into account the various environmental influences on brain development and cognitive processing, including adverse childhood experiences and other experiences that manifest chronic stress.

Utilization of a brain-based learning model in higher education settings can have a positive impact on learning. This review explores how brain-based learning is sensitized to the impact of trauma on academic performance and can enhance the use of experiential

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activities, particularly in social work programs. College students come to the academic setting with a myriad of strengths, including life experiences that inform their own scholarly work. In recent years, scholarship has increased our understanding of how negative experiences, such as trauma, poverty, racism, and toxic stress, can shape development and learning outcomes for students (Merians et al., 2019; Mersky et al., 2013; Metzler et al., 2017; Montez & Hayward, 2014; Pascoe et al., 2020). The current coronavirus pandemic has further deepened our understanding of the influences of stress on psycho-emotional states and academic performance across disciplines (Romash, 2020). Therefore, it is imperative that educators understand how these potential developmental injuries can create academic barriers for adult learners, including traditional college students and older adults engaged in higher education. Educators can augment their teaching processes by incorporating brain-based learning as a foundational framework for learning in order to better equip adult learners, including those entering the college setting, to achieve their academic goals.

Brain-based learning supports several important concepts of adult learning specifically related to experiential learning through community service and internships. This model identifies meaningful learning opportunities using real-life experiences to enhance academic performance (Winter, 2019). Experiential learning, such as service learning and internships, are noted as reparative in addressing trauma-related learning difficulties as well as enhancing scholarly activities. The emerging dialogue around the impact of brain-based learning to improve academic achievement (Duman, 2010; Gozuyesil & Dikici, 2014) and the implications for adult learning make this theoretical framework useful in social work education.

Understanding Brain-based Learning

Caine and Caine (1990) identified twelve core principles related to brain-based learning and classroom application of the theory (see Table 1). These principles incorporate complex brain processes that implicate the capacity for learning among students. For example, according to principle one, the brain is a parallel processor with thoughts, emotions, and imagination functioning interactively and simultaneously. Therefore, learning actively engages the body's physiological response to environmental factors, emotions, stressors, nutrition, and multiple other factors. Every brain simultaneously perceives and creates parts and wholes where information is organized separately but understood within or as a whole. For this reason, learning involves both focused attention and peripheral perception where information is assimilated in the brain via direct attention and through peripheral sources. Learning always involves conscious and unconscious processes with the brain absorbing much more than is realized with peripheral information entering at the unconscious level. The brain understands and remembers best when facts and skills are embedded in natural spatial memory, such as with high impact practices where students learn by doing followed by reflection on actions (DuFour et al., 2006; Miller at al., 2011). Furthermore, learning is enhanced by challenging experiences and inhibited by threats or perceived threats, such as stress, which inhibits our ability to learn. Learning changes the structure of the brain; however, because the brain is unique, experiences and emotions are integrated differently for each person. These principles from

Caine and Caine (1990) provide a framework for operationalizing brain-based learning into a classroom setting.

Table 1. *Principles of Brain-based Learning* (Caine & Caine, 1990)

Principle	Brief Description
1. The brain is a parallel processor.	Processes are interactional & concurrent. Thoughts, emotions, memory, imagination interact with other brain processes, social & cultural knowledge.
2. Learning engages the entire physiology.	Learning can be facilitated or inhibited by physiological processes, including neural development, nutrition, synaptic interactions, & life experiences such as stress, trauma, as well as safety, peace, happiness, contentment.
3. The search for meaning is innate.	The ability to make sense out of our experiences includes processes that latch onto the familiar & search for the unfamiliar as part of human survival. Meaning-making is part of the human experience.
4. The search for meaning occurs through patterning.	Patterning is part of the brain's meaning-making process. The brain integrates & generates patterns in its resistance to meaninglessness.
5. Emotions are critical to patterning.	Emotions & mind-set affect learning. Bias, prejudice, self-esteem, social interaction & expectancy influence the organization of information, recall, & memory.
6. Every brain simultaneously perceives & creates parts & wholes.	The hemispheres of the brain are interactive with separate but simultaneous information processing.
7. Learning involves both focused attention & peripheral perceptions.	Information that is paid attention to & that the brain is directly aware of is absorbed as well as information that is "out of the side of the eyes."
8. Learning always involves conscious & unconscious processes.	Learning goes behind what we consciously understand. We learn from & remember experiences as well as what we are told.
9. We have two types of memory: Spatial memory systems & rote memory systems.	Spatial memory allows for "instant" memory without the need for rehearsal. This is always engaged & enriches over time. Facts & specific skills are part of the rote memory, requiring rehearsal to retain.
10. The brain understands & remembers best when facts & skills are embedded in natural spatial memory	Interactive experiences shape internal processes & the social context of learning. Meaning-making occurs via ordinary experiences. Embedding novel with the ordinary enhances learning.
11. Learning is enhanced by challenge & inhibited by threat.	Optimal learning occurs via appropriate challenge, but when overstressed, learning is impeded.
12. Each brain is unique.	The integration of emotions, senses, & our understanding of experiences is unique to the person. The process of learning changes the structure of the brain.

Fogarty (2009) recommended four cornerstones of brain-compatible classrooms: teaching for thinking, teaching of thinking, teaching with thinking, and teaching about thinking. This framework addresses climate, instructional skills, interactions, and reflection. All of these elements are critical to teaching and learning. Ozden and Gultekin (2008) further explicate that in brain-based classrooms students learn about the thinking process and how to use thinking through three phases: orchestrated immersion, related alertness, and active processing. In immersion, students learn how to make the gist of a topic meaningful while active processing speaks to meaningful learning experiences. Active processing also includes students' evaluation of context, emotions, physical environment, process, and organization. Relaxed alertness involves challenging students to take risks within a safe learning environment in order to establish connections between old and new knowledge. All three of these processes encourage exploration and inquiry among students (Ozden & Gultekin, 2008). The incorporation of brain-based learning can be accomplished in a variety of ways. This includes written reflection papers, small group collaborations, service activities that connect to course topics, and self-care modules to encourage the reduction of anxiety and production of a safe learning environment (Winter, 2019).

Stress and the Learning Environment

Students bring the residual effects of adverse childhood experiences and chronic stress into the classroom, and these stressors contribute to difficulty engaging students in learning activities and may contribute to poor academic achievement. The recent pandemic has exacerbated the already demanding lives of college students, and possibly impacted cognitive functioning (Boals & Banks, 2020). Students reported numerous stress-related issues such as social isolation, job loss, abuse from family members upon returning home from college, added caregiving responsibilities, and worries about their own health (Chierichetti, 2021; Mahdy, 2020; Thukral et al., 2020). Specific to social work students, many chose the profession due to their own trauma-related life experiences (Copeland et al., 2021). Social work students have a higher rate of adverse childhood experiences than students in other majors (Branson et al., 2019; Thomas, 2016). Social work students may be exposed to trauma vicariously via classroom role-plays, case scenarios, and through the practicum experience. While these in-vivo experiences are cornerstones to social work education, they can also serve as vicarious trauma experiences for some students (Knight, 2010; Zosky, 2013). This, in turn, adds to emotional, physical, and psychological risk factors experienced by students with adverse childhood experiences, including early burnout (Copeland et al., 2021).

Given the prevalence of stressors and academic demands faced by 21st century college students, the concept of relaxed alertness, which is a key process of brain-based learning that identifies moving the brain's activity from survival mode to a calm, adaptive state imperative to the learning process, is of particular relevance to the higher education setting (Caine, 2000; Pascoe et al., 2020). Students struggle with attaining relaxed alertness for several reasons. Sleep deprivation, depression, anxiety, and stress are common, co-occurring psychosocial issues that can negatively influence alertness, academic performance, well-being, and field performance (Hershner & Chervin, 2014; Song &

Lindquist, 2015). Mitigating these psychosocial issues, particularly anxiety and stress, that sometimes accompany the academic environment, especially for students with negative classroom experiences or significant life stressors, increases opportunities for learning. Gozuyesil and Dikici (2014) further explained that relaxed alertness encourages a safe emotional and social space that reduces brain activity related to potential threats and opens the brain up for intellectually challenging learning opportunities. Promoting academic rigor in the classroom in a manner that does not induce unwarranted stress and fear can shape successful academic performance and provide an enriched classroom experience where prior acquired knowledge is reinforced and novel concepts are introduced (Samur & Duman, 2011).

Creating Meaningful Learning Experiences

The development of meaningful learning experiences underpins brain-based learning as a model relevant to higher education settings, particularly when an experiential approach is warranted as with social work education (Caine & Caine, 2006a; Jensen, 2008b). From the brain-based learning perspective, meaningful experiences are embedded into curriculum. The result for students is an enriched understanding of course content from an operational, or skill-based perspective (Caine & Caine, 2006b). Purposeful construction of meaningful learning involves delivering new information or knowledge in a way that connects to previous experiences and supports a shift in perception about how a student sees and experiences the world (Caine & Caine, 2006b; Kahveci & Ay, 2008). A clear example of meaningful learning is service learning in which students complete community service projects connected to course content. For example, a study of geriatric caregiving might be accompanied by a community-based project in which students shadow home health workers. As described by Nwokah and Leafblad (2013), service learning enables students to benefit from "new and multisensory experiences" and participate in activities to acquire new skills (e.g., "social skills, higher order conceptualization, and information processing") in a novel environment that is more likely to increase memory and consolidate learning experiences (p. 71). Other options to increase engagement and motivation are integrative learning or the inclusion of course learning objectives that advance reflective thinking about lived experiences.

The interdisciplinary nature of integrative learning makes it both relevant and appealing to social work educators and students, particularly non-traditional students who have life experiences to bring into the classroom (Dinmore, 1997). Adult learners do not come to the classroom as a blank slate. Rather, they build upon constructed knowledge informed by experiences. These experiences are a vital starting point for the educator and engage the learner in the process more readily than a lecture style of imparting knowledge onto the learner (Taylor, 2006). In this process, the integrative learning process takes place. A crucial part of meaningful learning is the immersion process that occurs when the real-world is integrated into the learning environment (Caine & Caine, 1990; Samur & Duman, 2011). Duman (2010) explained that through experiences and physical activity synaptic links between neurons are strengthened, causing physical changes to the brain. These changes involve basic stimulus response systems, and are, at their very essence, the process of learning.

Learning and the Neurobiology of the Brain

Fundamentally, learning is biological and connected to physical changes in the brain, including the strengthening of neural networks within the brain (Zull, 2002). Learning is a process in which connections are made within the brain's networks and information is synthesized and stored (Moffett & Fleisher, 2013). The learning process occurs with initial arousal via the brainstem, which governs the flow of information within the body. Further involved in the learning process is the limbic system including the hippocampus, which controls emotions, generates meaning-making, and influences memory origination. Another area implicated in this process is the prefrontal cortex that controls executive functions including higher-order thinking, problem-solving, planning, and purposeful action (Caine & Caine, 2006a; Schreiner et al., 2013). The cerebellum functions as the motor area of the brain where actions are controlled, including writing and speaking. Connections between learning processes and the outside world occur through this region of the brain. Neural networks help the brain to make transitions and assign meaning to experiences. Two unique aspects of brain functioning related to learning include pruning and plasticity. While pruning involves the deletion of unused synapses to make room for new connections, plasticity allows for adaptations and change (Schreiner et al., 2013). All of these functions impact the learning process. Injury to any of these brain areas can negatively impact learning, including the ability to acquire new knowledge, build upon current knowledge, and relate knowledge to experience.

The brain continues to change into adulthood, and the process of learning continues to shape neurological changes to the brain. These changes include strengthening and forming neurological connections between cells that shape the brain's structure. This, in turn, serves to shape and modify behavior (Dam, 2013). Understanding brain processes is pivotal to human learning. Today's world is fast-moving and rapidly changing, requiring that knowledge adapt to this rapid pace (Fischer, 2009). The brain-based learning approach can aid educators in understanding how the brain is naturally constructed to optimally learn, such as helping educators discern which teaching strategy is best suited for a particular learning objective based on our knowledge of how the brain works (Jensen, 2008b). Additionally, understanding the influence of trauma and toxic stress on brain development and students' reception to instructional scaffolding can assist educators in shifting the classroom environment to mitigate undue stress or triggering events. Providing feedback on low-impact assignments early in the semester from which students can build into more complex work is one example of using scaffolding that can serve to reduce stress related to academic performance.

Adverse Childhood Experiences, Toxic Stress, and Learning

According to Jensen (2008a), social conditions impact brain development and brain activity. For example, childhood trauma can lead to maladaptive behavioral manifestations that impact health and learning (Bethell et al., 2014). Adverse childhood experiences can negatively impact adult health (Bryan, 2019; Montez & Hayward, 2014) as well as decrease academic achievement due to worsening mental health (Karatekin, 2018) and substance misuse (Loudermilk et al., 2018). The Adverse Childhood Experiences (ACEs) study

(Felitti et al., 1998) set the stage for a deeper understanding of the effects of childhood trauma and toxic stress on multiple domains, including physical health, mental health, and cognitive development (Dunn et al., 2016; Merrick et al., 2017; Mersky et al., 2013). Toxic stress is of particular concern to the learning process and negatively affects healthy development in children due to the long-term activation of the stress-response system. The toxic stress response is directly connected to adverse childhood experiences and prolonged exposure to adverse conditions, such as physical and emotional abuse, chronic neglect, caregiver substance misuse and mental illness, and family violence without the balance of supportive adults (Center on the Developing Child, n.d.). Chronic stress may or may not be connected to adverse childhood experiences but has an even deeper effect on the learning environment and students' cognitive abilities, concentration, and engagement in positive social and academic experiences (Jensen, 2008a). Chronic stress is triggered by exposure to long-term environmental factors such as combat, caring for a chronically ill family member, or threats experienced over a long period of time (Miller et al., 2007). Emotional responses such as fear and helplessness influence executive functioning, namely reducing the learner's decision-making capacity and ability to problem-solve and attain goals (Caine & Caine, 2006a). These responses are particularly concerning as universities and students maneuver within the sociocultural shifts precipitated by life stress such as the coronavirus pandemic.

The social environment in which the academic experience is couched influences students' capacity to engage in the learning process. These interactions and experiences are expressly influenced by and influence brain development and activity. In other words, prior experiences help shape the brain, current circumstances reinforce the neuro-biological processes within the brain, and the brain is altered daily by every experience encountered (Jensen, 2008a). However, through responsive educational practices, such as brain-based learning, the life trajectory of students can be positively changed. For example, Montez and Hayward (2014) found that higher levels of education extended life expectancy for adults from disadvantaged backgrounds comparably or better than adults from advantaged childhoods with low education levels.

Effectiveness of the Brain-based Learning Model

Brain-based learning is a model with scholarly support, further concretizing its potential role in contemporary academic environments. Researchers have found that brain-based learning contributed to significant differences or higher mean scores on retention tests between a brain-based learning group and a control group (Ozden & Gultekin, 2008); improved student learning outcomes in a sample of high school seniors (Lidiastuti et al., 2020); increased listening and vocabulary skills and retention among business students (Salem, 2017); and was more effective in increasing high school students' achievement, attitude, and motivation in comparison to the control group (Uzezi & Jonah, 2017). A meta-analytic review of 31 research studies on brain-based learning found a medium effect size and noted that the model produced better results related to academic achievement than traditional teaching methods (Gozuyesil & Dikici, 2014). A study of 102 students randomly assigned to a brain-based learning group or traditional teaching methods noted that brain-based learning, which included relaxed alertness, immersion and active processing,

improved academic achievement and promoted a positive attitude about learning among participants (Samur & Duman, 2011).

A study by Akyurek and Afacan (2013) further indicated that brain-based learning activities positively influenced motivation among a cohort of eighth-grade students where brain-based learning methods were employed. Results indicated that students' motivation and attitude toward science and technology were positively impacted. However, in a personal reflection on classroom experiences, Caine (2000) noted that "taking neuroscience into the classroom is challenging…People are too complex, individuals too unique, and contexts too unpredictable" (p. 61). The author further postulated that an integrated approach that included brain research coupled with instructional models provided a positive teaching approach.

Specific to higher education settings, an interest in the concepts related to brain-based learning has reemerged. The transition to online instruction has been accelerated by the pandemic. Winter (2019) found that brain-based learning provided a framework for online teaching. However, faculty in higher education may not be as informed about the brain-based learning approach as elementary and secondary educators. Using concepts related to brain-based learning in an asynchronous setting provides additional engagement opportunities. This includes using collaborative groups to complete tasks, using discussion boards as safe zones in which students can share ideas, and providing consistent feedback to alleviate stress or anxiety related to performance in online courses (Winter, 2019). In online and traditional higher education settings, brain-based learning moved faculty from the role of lecturer to a partner in the learning process (Sesmiarni, 2015). Coupled with the experiential aspects and emphasis on motivation, brain-based learning is well-suited for higher education. Three specific areas of brain-based learning that complement teaching in the college classroom includes the incorporation of life experiences, motivation, and service learning.

Life Experiences, Motivation, and Experiential Learning

Brain-based learning offers implications for student life experiences and motivations toward learning and experiential learning. Meaningful learning experiences, motivation, and the incorporation of experiential learning play a role in successful academic performance among adult learners and are core to social work education. Each of these aspects of the learning environment are influenced by prior life experiences of the learner. Additionally, attuning to motivation and including meaningful learning can help students improve opportunities for academic performance, in spite of the manner in which traumatic events may have affected their ability to successfully maneuver the academic environment. In delivering course material, educators should consider the uniqueness of each student's learning capacity, how the brain processes information, and how individual life experiencessuch as trauma impact students' capacity to process information and engage in the process of learning (Caine & Caine, 2006a; Cozolino & Sprokay, 2006; Taylor, 2006). Environmental stress, including stress related to the academic setting, affects students' ability to learn new information and assimilate knowledge. While brain development is a life-long process and learning increases synaptic activity, the prefrontal cortex of young

adults has not fully formed and executive functioning has not reached an optimal state (Kolb et al., 2012). Furthermore, negative life experiences can delay the development and maturity of young brains. Exposure to environmental events including alcohol and drug use, stress, and relationship discord impact the development of the prefrontal cortex (Kolb et al., 2012). Additionally, adverse childhood experiences impact motivation, self-esteem, and education attainment into adulthood (Arnekrans et al., 2018; Merians et al., 2019; Metzler et al., 2017; Tetzner et al., 2016). These negative early childhood exposures negatively impact healthy brain development and the capacity to learn. Two key findings that influence motivation specific to learning among college students are a sense of control and personally important content (Moffett & Fleisher, 2013). From the context of brain processes, information that is perceived as important receives attention, and information perceived as unimportant is culled out (Moffett & Fleisher, 2013).

Adult learners appreciate teaching and learning when they feel a sense of ownership. Providing students with some control over their choices and having a personal connection to those chosen experiences enhances motivation to learn in and outside of the classroom. Motivation is further enhanced by the use of experiential activities endorsed within a brain-based learning environment, which can mitigate the negative effects of chronic stress and build resilience. For example, motivation among adult learners is heightened through curiosity and through making connections across past, present, and future experiences and individualized feedback (Bărbieru, 2019). The development of meaningful learning experiences (i.e., immersion) has been noted as a key concept in brain-based learning (Nwokah & Leafblad, 2013). Service learning combined with classroom instruction provides a practical application of immersion. Experiential learning, such as practicums and internships prevalent in social work education, are often chosen by students due to a personal connection to the mission of the organization or a particular client population. As Askeland (2003) described, experiential learning bridges the knowing what (i.e., theories) and applying how (behaviors) that is essential to adult learners. Service learning is optimal for creating new learning experiences and destabilizing existing knowledge, which further challenges the student (Nwokah & Leafblad, 2013). Service learning for college students brings about novel situations in which brain development can thrive and supports the core concepts of brain-based learning (Nwokah & Leafblad, 2013). Experiential learning provides an opportune medium by which to integrate brain-based learning concepts.

Brain-based learning considers the integration of strategies that deepen learning. For example, Findlay (2012) proposed a brain-based learning approach that entailed 14 factors to consider when attempting to design a technology-based environment for millennial students. Technology-based learning has become a mainstay as a result of modifications to the learning environment due to COVID-19. Some of these cognitive neuroscience learning factors include using cognitive neuroscience learning theories to inform teaching, designing instruction based on brain research, recognizing the multitasking abilities of students, and using mnemonic devices in instruction (Winter, 2019). Findlay (2012) also recommended nano-teaching with student-teacher role reversal, as well as using students' mobile technology in order to facilitate motivation and learning.

Experiential and brain-based learning may also serve as a restorative or reparative process for students who have experienced toxic stress. Educators cannot ignore the

potential impact of chronic stress, anxiety, or toxic stress brought on by adverse childhood events on students' academic performance. In light of the negative impact of stress on learning, Freeman and Wash (2013) offer strategies for college teaching using brain-based learning approaches that emphasize safety, relevance, and an enjoyable experience as primary to the learning experience. Additionally, experiential learning was identified as key to successful teaching using brain-based learning approaches (Freeman & Wash, 2013).

Implications for Social Work Education

This article reviews the core components of brain-based learning theory and contributes to research and methods by which to implement the concepts of this theory within a framework for higher education, and more specifically, social work education. Social work education relies on immersive service learning and internship experiences. The brain-based learning approach provides faculty with tools to remediate specific stressors and burnout inherent in the helping professions and experienced by social work students. Based on the core principles of the approach, the classroom setting itself, stability of the learning environment, and the way information is presented become part of the instructor's tools to encourage balance between academic challenge and the "down-shifts" described by Caine and Caine (1990). The brain-based learning approach within an academic environment, when attuned to the effects of adverse childhood experiences and toxic stress, provides educators with an opportunity to better prepare to teach students with various learning capacities, strengths, and limitations. This level of preparation by faculty is necessary to address students' stressors that increased dramatically during COVID-19. Students are experiencing higher levels of psychosocial stress related to normative life events and the uncertainty introduced by the pandemic (Chierichetti, 2021).

Attuning to students who are impacted by chronic stress via adverse childhood experiences or modern-day life circumstances via brain-based learning techniques fits within the social work education pedagogy. Brain-based learning can be incorporated into social work education in numerous ways. The foundation of experiential learning via internships, practicums and volunteerism embedded into social work education complements the core concepts of brain-based learning. Additional ways brain-based learning can be incorporated into social work education includes the use of individual and small group reflective exercises, role plays that immerse students through simulations of real-life case studies, and projects that connect course content to community-based experiences. The brain-based perspective provides a framework for instructors to incorporate an understanding of the ways in which students experience triggers and toxic stress as part of experiential work inherent in social work education.

From a social justice perspective, these experiences can serve as macro-level change activities benefiting the student as well as the community. The real-life scenarios often incorporated into social work classroom settings are fundamental to the brain-based learning approach and help students with retention of new material, practice of specific skills, and build on current knowledge (Winter, 2019). Recommendations for online and traditional classroom interactions include mixing short, 15-minute lectures with role plays

or tactile activities (Freeman & Wash, 2013; Nwokah & Leafblad, 2013). While these types of activities are common in the social work classroom, instructors may not recognize the ways in which chronic and toxic stress impede student achievement and performance in field and experiential activities. Brain-based principles and potential learning activities from a social work education perspective are described in Table 2.

Table 2. *Application of Brain-Based Learning in Social Work Education*

Principle	**Application in social work education**
1. The brain is a parallel processor.	Teaching of theory is operationalized into techniques & experiences specifically orchestrated by the instructor & followed into the field education experience. Role plays & simulations are followed by reflective exercises in which students explore their own emotional responses to activities.
2. Learning engages the entire physiology.	Self-care is actively embedded into the learning environment. Developmental stages of students is viewed from a life-span perspective & incorporates all phases of adult development as part of course delivery.
3. The search for meaning is innate.	Educators should provide stability & a culture of safety balanced with newness & novelty. Activities must be meaningful & provide opportunities for students to connect classroom activities, field experiences & their own life experiences to the learning process. Taking field cases into the classroom for dissection from student & educator perspectives provides this opportunity.
4. The search for meaning occurs through patterning.	Course content is delivered that provides opportunities for patterning. This means that students have opportunities to create meaning through themes that resonate with their own lives & experiences. Student-developed case scenarios & problem-solving activities provide these opportunities.
5. Emotions are critical to patterning.	Educators should incorporate ways in which students explore their own reactions & responses to material, activities & experiential learning. Establishing a learning environment that encourages curiosity, mutual respect, & cooperative learning is paramount. This includes embracing the students' professional & personal experiences as important to the learning process. Learning from students as well as teaching promotes a mutually reciprocal learning environment.
6. Every brain simultaneously perceives & creates parts & wholes.	Field / internship experiences provide an excellent opportunity for engaging students in interactive brain processing. The cumulative effect of classroom instruction coupled with experiences in the field make these connections. However, the process must be encouraged & supported by the field instructor & field supervisor working in sync to support the operationalization of skills practiced in the classroom setting.

Principle	Application in social work education
7. Learning involves both focused attention & peripheral perceptions.	Supporting the peripheral learning process may include using creative & interdisciplinary activities that stretch beyond the traditional curriculum. An interdisciplinary example was a partnership between social work & media arts in which social work students engaged in reflections of their reactions to photographs related to social justice issues in the community. Educators can also initiate check-in processes in which students make connections between their emotional state, physical state, & cognitive readiness for class.
8. Learning always involves conscious & unconscious processes.	Ensuring that activities are embedded in which students process their own behavior, how they are interacting in the learning environment, & learning style. Providing opportunities for students to guide the learning process, encourage meaning-making, & ownership of academic success. Activities to promote this may include the use of metaphors to recapitulate course content, & developing course content that students present to the class or field agency.
9. We have two types of memory: Spatial memory systems & rote memory systems.	Connect fact with experiences & emotions. Adding queries related to how the student experienced the classroom activity, and examining their impressions & emotional responses to case studies framed by theory & factual information to solidify the spatial & rote memory processes.
10. The brain understands & remembers best when facts & skills are embedded in natural spatial memory	Experiential learning via simulations that are close to real-life situations, demonstrations & field experiences promote spatial memory. Educators & students can engage in role plays, watch enactments of treatment sessions, attend community action events, participate in policy & advocacy activities, & connect these to curriculum.
11. Learning is enhanced by challenge & inhibited by threat.	Educators should encourage relaxed alertness in the classroom setting. Challenging material is best learned when balanced by the capacity to think clearly. High stress settings promote the down-shift or narrowing of the perceptual field, lessening the opportunity for learning. Settings that are not challenging enough also lessen the opportunity for learning. This balance between too much & not enough challenge can be difficult to meet. Educators should strive for high challenge, low threat classroom environments.
12. Each brain is unique.	Educators should prepare to teach using a multi-faceted approach. Integrating an individualized teaching practice is complex. However, using multiple methods of exploring material, engaging students, & presenting course curricula supports a brain-based approach. This should be underpinned by reflective practice, attunement to student's emotional states, readiness for learning, & triggers that may coincide with experiential learning practices. Allowing room for exploration of the emotional aspects of social work education promotes the brain-based approach & uniqueness of each student.

The concept of a safe learning environment can readily be operationalized in the social work classroom as well as in online courses. Providing specific instructions, guidelines, and expectations to students can reduce anxiety and stress and promote a safe environment (Freeman & Wash, 2013). Availability of the instructor is another way to enhance feelings of safety among students. Ultimately, the instructor is responsible for the climate of the classroom setting. This includes setting standards of respectful interactions among students and between faculty and students, holding students accountable when disrespectful behavior is witnessed or experienced by fellow students, and setting up an atmosphere in which students feel open to asking questions and seeking feedback (Freeman & Wash, 2013; Moffett & Fleisher, 2013).

One key barrier to the implementation of brain-based learning in higher education and specifically in social work education is the lack of knowledge instructors have about brain-based learning (Winter, 2019). Offering workshops on brain-based learning to social work faculty may be one way to encourage incorporation of these concepts into the classroom setting. Additionally, the connection between trauma, chronic stress, and learning has been established. However, the ways in which brain-based learning can mitigate these conditions requires continued research. Future research on the positive and negative influences of mitigating stressors such as adverse childhood experiences on motivation, meaningful learning experiences, and service learning will better position educators and students for successful academic outcomes. Additionally, more research on tools for faculty to address the extenuating levels of stress and trauma experienced by students is paramount in the current social environment. Future research could focus on brain-based learning approaches in social work field courses, and other areas in which experiential learning is paramount to the overall educational experience.

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