REVIEWS

Enhancing clinical nursing education for Gen Z students through brain-based learning

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Received: February 18, 2024 **Accepted:** April 8, 2024 **Online Published:** April 22, 2024
DOI: 10.5430/jnep.v14n7p42 **URL:** https://doi.org/10.5430/jnep.v14n7p42

ABSTRACT

Clinical nursing is the most significant aspect of nursing education. An early exposure to clinical practice can be beneficial for nursing students, fostering a deeper comprehension of real-life nursing care. However, this experience may induce stress among students who might feel underprepared for the significant responsibilities involved. To ensure students attain their utmost potential in acquiring clinical knowledge and skills to deliver high-quality care, it becomes imperative for clinical instructors to critically reflect on their teaching methodologies. Incorporating innovative teaching methods is crucial for engaging students actively and instilling a sense of challenge and motivation during bedside clinical nursing. To involve nursing students actively in clinical learning, instructors need to connect brain neurotransmitters in the quest for learning. Without sufficient stimulation of the brain and its neurotransmitters and hormones during the learning process, students may struggle to grasp and retain knowledge over the long term. This literature review highlights the significance of using the brain-based approach in clinical education to address the needs of Gen Z students. Embracing a brain-based approach can lead to a revolutionary change in nursing education and clinical practice. By associating the brain's physiology and leveraging advanced learning processes, clinical instructors can adeptly cultivate patient-centered, critical-thinking, practice-ready nurses.

Key Words: Brain-based learning, Nursing clinical, Gen Z learners, Clinical instructors, Innovative teaching style

1. INTRODUCTION

A key aspect of nursing education is the participation of nursing students in clinical practicums which leverages their readiness to enter the nursing profession. This opportunity promotes students' critical thinking, ability to make clinical decisions, confidence, and determination in providing compassionate, high-quality nursing care.

In today's era of Generation Z (Gen Z) learners, nursing educators and clinical instructors need to possess innovative methods of teaching to cater to their students' needs. This generation of students is deeply influenced by technology, an integral part of their lifestyle that shapes their communication, response, behavior, and learning. Given their frequent interaction on social media platforms and reliance on visually appealing, fast-paced online resources for education, Gen Z students expect an equivalent level of engagement to sustain their interest or motivation.[1,2] To effectively cater to this generation's learning requirements, nursing instructors need to adeptly understand how these students perceive information and respond to it.[1]

Clinical experience is substantial in nursing practice as it exposes nursing students, who are entering into their professional practice, to the reality of how healthcare works. In this period, students go beyond their classroom learning to

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apply their knowledge and skills to a real-life clinical setting. Clinical instructors play a significant role in preparing practice-ready nurses[3–5] and engage nursing students in the clinical learning process. Thus, clinical instructors hold responsibility for identifying their students' learning needs and ensuring they have a meaningful experience in their clinical practicum which can often be challenging as they attempt to keep students engaged at clinical site learning. Nursing clinical education has shown a significant transformation from a traditional apprentice model to instructor-based learning to concept-based learning.[6,7] The traditional use of the didactic style of teaching from which clinical instructors may have learned when they were initially beginning their professional practice, may be outdated and is not necessarily student-centered.[6] Gen Z learners need innovative teaching and learning styles to gauge them in the scholarship of clinical education. If clinical instructors possess knowledge of how to engage the brain in a clinical environment, which is often considered stressful, and allow learners to connect their brain neurotransmitters in the learning process, this may lead to more practice-ready, confident future nurses.[1] To bridge the gap between theory and practice and connect the brain to the bedside, it is essential for clinical educators to utilize brain-based learning strategies in clinical settings to engage future nurses in the pursuit of clinical learning.

1.1 Purpose

The purpose of this literature review is to identify the significance of brain-based strategies in clinical teaching to create practice-ready, patient-oriented, confident future nurses.

1.2 Review question

What approaches can be implemented to engage the brain chemistry of nursing students during clinical teaching to cultivate nurses who are patient-oriented?

2. METHOD

A literature review was conducted to review the relevant findings based on the posed question. The databases used to perform the review included EBSCOhost, CINAHL Plus with Full Text, Ovid MEDLINE(R), and Google Scholar. To develop the literature search, Keyword combinations used in the search included: "Brain-Based teaching*" or "Brain" and "Clinical Education", "Clinical teaching*" or "Clinical Nursing Education" and "GenX" and "Nursing Students*", "Nurse Educator*", and "Nursing Instructor*".

This paper aims to underscore the importance of using brain-based learning techniques in nursing clinical education. It delves into how clinical instructors can seamlessly incorporate these techniques to cultivate future nurses who prioritize patient-oriented care. This literature review acts as a guide for clinical instructors to devise teaching approaches that acknowledge the learners' brain physiology and cater to their specific learning needs. Aligning teaching strategies in accordance with brain physiology will open the door for inventive and innovative future nurses.

2.1 Background

2.1.1 *History foretold on brain-based learning*

In the late 1970s, Len Vygotsky introduced the idea of the zone of proximal development (ZPD).[8] He explained the importance of guidance in the process of problem-solving. Vygotsky defined the ZPD as "the distance between what a learner can do and a proximal level of what they may attain through guidance and collaboration with a more knowledgeable other".[5,8] Students learn new skills under the guidance of teachers or parents, and they can transfer them from their learned-skill zone to a new experiential zone of learning.

Later, in the 1980s, Stephan Krashen, an educational researcher and activist, also supported the idea of the ZPD, which he termed comprehensible learning. He explained the negative impact of stress on students' learning and proposed a theory about the "Affective Filter".[9] According to Krashen, when information enters the neural networks, the neural response of reacting or reflecting on the information highly depends on factors such as stress, emotions, and fear, among others. If knowledge transfers when the environment and behaviors are non-threatening, non-discrimination, and friendly, then that knowledge will become meaningful to learners.[9] Therefore, for effective clinical teaching, the learning environment needs to be non-threatening, friendly, and open. A clinical instructor's attitude and approach towards learners matter a lot, and it may augment or diminish the learners' interest.

2.1.2 *Understanding the brain's physiology in brain-based clinical learning*

The brain components involved in the process of learning include the hippocampus, the amygdala, the lower involuntary brain, and neurotransmitters.[10,11]

1) Hippocampus

The hippocampus is associated with learning and memory, which is directly influenced by attention. The hippocampal system is responsible for encoding contextual memory, which considers minute details that are perceived by the senses and eventually stored in long-term memory.[12] For short-term memory to be stored and retrieved from long-term memory, explicit attention is required. When students are exposed to a new learning environment, their brain attempts to pick up different sensory cues which they then perceive as

a learning experience. In a situation where nursing students perceive the environment as threatening or stress-provoking, their attention may be diverted, which in turn reduces their ability to process sensory cues to be stored as a memory.[12, 13] Furthermore, the hippocampus works closely with the amygdala to associate experiences with certain emotions.

2) Amygdala

The amygdala is an almond-shaped set of neurons located in the medial temporal lobe.[11] It is part of the limbic system, which instantly responds to danger, fear, and anger as well as to positive emotional influences. It is also another brain filter that Krashen[9] call the affective filter, which determines whether the information is transmitted to the lower involuntary brain or the higher-thinking brain. When there is actual or perceived stress or any kind of emotional instability in the learning environment, the amygdale will not carry the knowledge into the thinking brain but sends it to the lower involuntary brain, students react to the situation, and their coping systems are activated.[13] If the environment is stress-free, friendly, and emotionally supported, however, then the amygdala carries the given knowledge to the PFC, and it later becomes part of the learners' intellectual memory.

3) Reactive brain/involuntary brain

When sensory inputs are carried to the lower involuntary brain, it will start a reactive action against perceived stress stimuli, and the fight, flight, or freeze response will occur.[13] If the environment is stressful, power-dominated, inflexible, and unwelcoming of students' suggestions, then the brain gatekeepers will transfer the given knowledge to the involuntary reactive brain, which will then ignore the information (flight response), fight against the negative experience, or avoid the stressful situation as a freeze reaction. If shared knowledge is routed to this area of the brain, then it is unlikely that learning will occur, and the students will not be able to retain the knowledge for very long.[13] For example, if the clinical teacher is rigid, power-dominating, and unfriendly towards the learners in a clinical setting (which is already a stressful environment), then the students will not feel that they are in a safe learning environment; the thinking brain will not process the instruction that they have received even though they might consider them important. As a result, knowledge is deposited into the reactive brain. If students fear failing their clinical, they might participate in post-conferences or on clinical rounds (as a reaction to the fight and flight response), but they completely abandon the beauty of learning. Furthermore, the knowledge they gain may not be retained in their memory, and they may come to view clinical settings as stressful environments that do not prepare them for real-world nursing practice. The fear of making mistakes at the bedside due to anxiety over clinical learning can have a detrimental effect on patients and the quality of nursing care.

4) Cortisol

The cortisol hormone in the human body is responsible for regulating stress. When cortisol levels increase, the body experiences significant changes as a response to the stressor such as increased heart rate and respiratory rate, elevated blood sugar, and anxiety. Cortisol is a long-term stress hormone that activates the autonomic nervous system. Studies have shown that stress hormones interfere with learning and attention.[13] As a response to elevated cortisol levels, the hippocampus, and amygdala, which are all involved in learning, memory, and attention, are significantly impacted. In clinical settings, where nursing students begin to use their foundational knowledge to make clinical decisions, increased stress can interfere with their ability to recall information or even consolidate new information.[13] Clinical instructors must be able to identify that clinical settings can be stressful for nursing students as they practice complex skills under supervision. To minimize stressors in clinical settings, instructors acknowledge the intensity of the nursing program and incorporate methods that facilitate learning through meaningful engagement within the clinical placement.

5) Dopamine

Dopamine is a significant neurotransmitter that is associated with pleasurable feelings, excitement, novelty, motivation, and focus. Dopaminergic activation leads to the stimulation of the reward pathway that relays feelings of pleasure and excitement about performing particular tasks.[14] With regard to learning processes, the level of dopamine released in a student's brain determines their motivation to learn and their drive to perform skills. In the scholarship of clinical teaching process, if the dopamine level increases, it encourages students to participate actively in various clinical tasks or solve challenges.[4] Increased levels of dopamine improve learning and increase cognition and memory retention.

However, if the dopamine level decreases in response to a mistake, the brain responds negatively, and to avoid mistakes in the future, it will begin to analyze the situation. Negative experiences change the neural circuit, and the learner will think twice the next time before addressing an issue to avoid a negative response.[15] It helps the brain to predict what will happen the next time in response to an action. The greater the prediction error, the more dopamine is released in the brain, and the more the learner will become immersed in the learning process. Scaffolding clinical scenarios and skills with increasing complexity will stimulate the student's cognitive and critical thinking to resolve the intensity of a complex situation.[5, 16] Thus, the rise or fall of dopamine is

directly linked to the student's learning, alertness, memory, and decision-making. Positive or negative feedback will affect the brain's prediction error process, and in the future, the learner will respond accordingly to a complex situation. However, the environment must be stress-free for greater learning (see Figure 1).

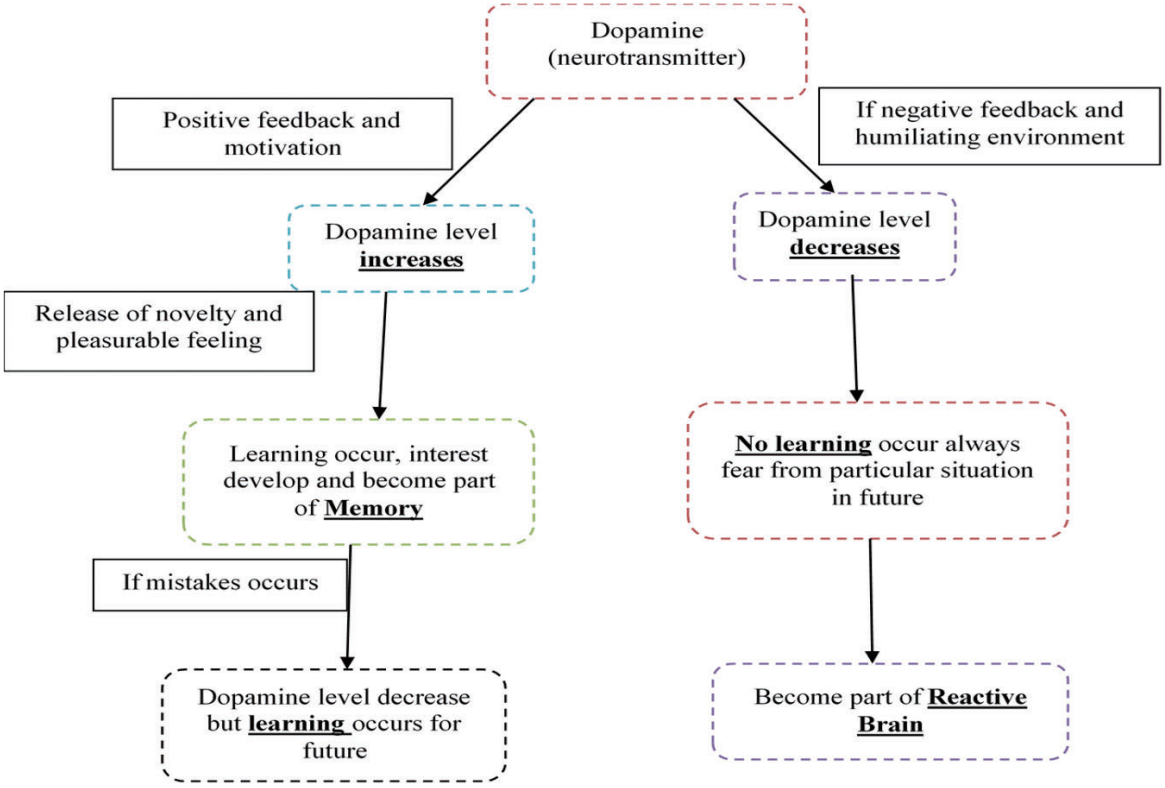

Figure 1. Dopamine and Learning Process

3. Discussion

Brain-based learning represents a distinct approach to education, focusing not only on the ability to acquire and retain information in the brain but also on actively engaging the brain for extended periods and promoting critical thinking across diverse scenarios. This approach is particularly vital in nursing, where clinical settings have high demands and stress is prevalent.[17] Nurses need to have the ability to quickly learn and apply new knowledge practically. They should be able to make sound decisions, and constantly develop their skills through active learning. However, the current clinical nursing education system has several limitations that nursing students face. These challenges include retaining vast amounts of information, establishing good relationships with patients and colleagues, dealing with burnout and disinterest, and the fear of uncertainty.[3] While current strategies aim to prepare nursing students for the profession, it is important to evaluate their effectiveness in promoting critical thinking and readiness for real-world practice. In contrast to other cognitive approaches, brain-based learning prioritizes the learner, emphasizing a positive and fulfilling learning experience.

Through the integration of brain-based learning strategies, nursing instructors can gain valuable insight into how the brain facilitates learning and how learning processes are directly connected to brain functions. This understanding is critical for instructors to adopt a student-focused approach, tailoring teaching methods to meet diverse learning needs. The aim is to foster students' growth into proficient and confident future nurses who engage in reflective practice, rather than merely executing nursing tasks.[6] Nurses are crucial in representing the voices of patients, acting as leaders and advocates for patients' access to healthcare.[18] Therefore, it is important for nurse educators to instill the necessary skills of patient advocacy and critical thinking in nursing students.

Considering the physiology of the brain and how it impacts learning, memory, and attention during clinical education, clinical instructors must incorporate purposeful strategies that are focused on student-centered learning. The paper proposes five key objectives that can serve to meet students' learning needs and engage them in active learning. The clinical instructors must focus on 1) Reducing Stress and Fear of Mistakes, 2) Observation and Constructive Feedback, 3)

Connecting with Prior Knowledge, 4) Spurring Novelty, and 5) Using Multisensory Approach.

3.1 Reducing the stress and fear of mistakes

Being in a clinical setting can be quite intimidating for students as they are exposed to an unfamiliar environment where they are expected to apply their knowledge and skills to solve real-life problems and make crucial clinical decisions. In such situations, students may perceive their responsibilities as a burden if they are not provided the opportunity to be vulnerable and express their learning needs. Stress or the fear of making mistakes in front of their classmates will impede student learning. To encourage students to become engaged and exchange ideas, the instructor needs to decrease the amount of stress in the learning environment.[5] If teachers encourage students to think, share, and participate in clinical discussions or conferences, no matter whether their responses are correct or incorrect, dopamine is released in the brain, and their thinking brain becomes activated.[3] Instructors must adopt learning styles that promote critical thinking and incentivize students to share ideas. This could further motivate students to take the initiative to reflect on their practice and learn from their mistakes rather than blindly following directions.[5,6,16,19] As a result, learning is promoted, and students will enjoy the process of learning.

Brain-based learning differs from traditional teaching methods and other cognitive approaches by prioritizing the learning process itself. Rather than solely measuring students' ability to retain knowledge and perform clinical skills, instructors using brain-based learning focus on creating a personalized experience for each student, ensuring their satisfaction in acquiring new knowledge and feeling confident in applying it. These instructors aim to evaluate students' progress in terms of their engagement, confidence, and competence in real-world clinical settings, with the ultimate goal of ensuring that students are equipped to take ownership of their learning journey.[3,4,19] While some of these strategies may overlap with those used in other cognitive learning approaches, this paper advocates for instructors to prioritize the evaluation of student emotions alongside skill demonstration. By doing so, instructors can tailor their teaching methods to maintain student engagement, leveraging their strengths while addressing areas needing improvement. The ultimate objective of this approach is to create an environment where students feel supported, viewing every challenge as an opportunity for growth rather than a source of stress.

The fear of making mistakes decreases students' active participation and inhibits their receipt of knowledge because the instructions (sensory input) cannot pass through the gatekeeper (the RAS and amygdale) and be carried to the thinking brain.[9,11] Subsequently, the learning does not proceed to their long-term memory and will not become part of their wisdom. Emotions play a major role in the learning process. If clinical instructors have friendly, stress-free relationships with their students, the students will be in a less anxious state of mind, will participate more in the exchange of knowledge, and will learn promptly. If instructors spend one-to-one time with students during clinical, remember their students' first names, allow students to share their challenges in clinical learning openly, and use humour in the process of exchanging knowledge, this will allow students to develop trustful relationships with the instructor.[3,4,9,19] Trust between students and clinical instructors releases neurotransmitters and triggers a sense of novelty, and the students' thinking brains will become stimulated for learning.

3.2 Observation and constructive feedback

Constructive feedback and observation are important techniques utilized to create a learning environment that can enhance the quality of education. It is vital to highlight the learner's strengths and identify their weaknesses as opportunities for growth.[17,20] Feedback should be delivered in a non-threatening way to encourage active participation in the learning process. This will help create knowledgeable professionals who can critically apply their expertise to address patients' needs in a clinical setting.[2,4,21] Spending one-on-one time with students, observing them during clinicals, giving them feedback, and helping them to identify how they can improve are persuasive strategies to activate the thinking mind. Such strategies implemented by instructors will ensure that students feel valued as they explore new knowledge and skills within their practice. When students feel stressed or anxious in their clinical practice, they may likely experience reduced focus which could lead to disinterest or burnout.

Students might demonstrate behaviors such as being distracted, distracting other students, showing attention deficit, and losing interest.[2] To avoid these fight-or-flight behaviors, students' reflective brain needs to be engrossed in the learning process. With proper guidance and timely, productive feedback, the dopamine levels will increase; the RAS will activate; and, through the amygdala, the stimulus will activate the PFC, where new memories are created, and meaningful learning occurs.[11] Using brain-based teaching techniques has been shown to increase the levels of cortisol and activation of the frontal lobe in students.[17] This enhances their behavioural observation skills and clinical judgement skills, which are meaningful for effective patient outcomes in healthcare settings. By adopting a brain-based approach of giving constructive feedback and performing observations in a non-threatening environment, future nurses

can be better prepared to be more patient-oriented and use critical judgment in clinical contexts. This will create more person-centred nurses who are not afraid to step out of their comfort zone to improve patient health outcomes.

Feedback is not always teacher-generated; self-feedback, reflection in action, reflection on action, and peer feedback are also innovative ways to activate student learning zones.[21–23] Group work or teamwork in a clinical environment is also an ideal technique to give learners immediate peer feedback on their actions and behaviors in a friendly learning environment. Students can more easily talk about the challenges that they face in clinical settings with their peers than with their clinical instructors. Although peer feedback is practiced to some extent in clinical settings, this form of learning method can be enhanced if students are properly trained to provide constructive feedback that helps set realistic and sustainable goals.[23]

3.3 Connecting with prior knowledge

The constructivist theory proposes that new knowledge is constructed from old[24,25] and that teachers must make connections between the new information that is being presented and the student's prior experiences through their personal and real world to stimulate novelty in the process of learning. Nursing students bring unique experiences and diverse backgrounds, enriching the educational process with a variety of ideas, values, and perspectives.

Incorporating students' prior experiences and forming connections with real-world practice is essential for reinforcing their identities and fostering a sense of personal value.[25] In the context of brain-based learning, which places a strong emphasis on the learner, integrating students' previous knowledge and experiences into the learning process can significantly enhance their motivation and confidence. By recognizing and leveraging their existing skills and insights, students are empowered to innovate, make informed decisions, and solve complex problems.[2,21] Instructors play a crucial role in motivating students to draw upon their past experiences and knowledge, emphasizing their relevance to nursing practice. By encouraging students to apply their unique perspectives and insights to address real-world challenges, instructors foster a culture of innovation and critical thinking.[3] Integrating these diverse experiences not only enhances the educational experience but also promotes a relational approach to nursing. This approach emphasizes essential values and skills such as empathy, compassion, cultural competence, and advocacy, facilitating holistic patient care and promoting positive outcomes.

When students understand this relationship in their learning, their brain-cell activity increases, their dopamine level rises, and they achieve long-term memory storage and retrieval of information.[11] Increased dopamine levels help to predict and understand the relationship of new information to prior knowledge. This bridge of connectivity with their prior knowledge helps students to retain the new information and think critically to predict its outcomes, and it becomes part of their memory. Strategies such as brainstorming, reflecting, engaging in class discussions, watching videos, using case studies, concept mapping, storytelling, and connecting prior knowledge with the current learning scenario help the brain to link previous knowledge and create new memory patterns and signals in the brain.

3.4 Spurring novelty

New learning or new, challenging environments stimulate the brain as a part of survival. When new learning occurs in a challenging environment, the information will move into the reactive brain; but when the environment is supportive and friendly, then the learners will try to adjust to the new environment. As a result, when new stimuli are reintroduced, the RAS system is activated, and learning occurs in the frontal brain.[11] It is important that clinical instructors do not give too much new information at a time, give them breaks, and allow them to reflect on new learning before giving further new knowledge.[21] The brain needs time to assimilate the information and make it a part of memory. It is also crucial to repeat new concepts and skills frequently so that the students can develop a level of comfort.[7,20] In collaboration with students, concepts can be assessed and ranked based on their difficulty, enabling the arrangement of concepts from initial to advanced learning stages. During clinical placements, students can present various topics to their peers, taking on an instructional role that is typically reserved for instructors. This encourages active participation and peer-to-peer learning, which may not typically occur with traditional teaching methods.[23] By engaging in teaching responsibilities, students gain insights into their learning requirements and those of their peers, fostering a deeper understanding of the concepts and enabling strong reflection on their practice. Such experiential learning promotes critical thinking and creativity, stimulating the brain to explore innovative approaches to problem-solving.

Challenging environments cause dopamine to be released, and learners enjoy different levels of instruction and skills. Piquing their curiosity about different treatments or assessment techniques in a clinical setting also promotes learners' sense of novelty and activates the RAS system. Learning activities that spur this novelty in clinical teaching include field trips, the use of videos, hands-on practice with clients or

simulators, case-study analysis, challenging simulator-based scenarios, virtual experiences, and training sessions.[20]

3.5 Using multisensory approach

The human brain is a multitasking machine, and we all have different and unique styles of learning. Multiple use of strategies to activate multiple senses will create new learning synapses. Recent brain research has shown that the brain pathways are strengthened with the use of a multisensory approach; often requiring four exposures (touching, seeing, hearing, and doing) before the pathway is strong enough for long-term memory recall.[26] When information is presented in a variety of ways such as audio, tactile, or visual, it activates the memory storage areas such as the auditory inputs (temporal lobe), physical movement (cerebellum and basal ganglia), and other cortical regions.[26] The practical application of learned concepts in an appropriate way encourages cognitive learning. Experiential learning and the use of different senses to enact that learning increase the dopamine level, and the new knowledge is paired with students' existing knowledge, which generates interest in the scholarship of learning. Activities such as: encouraging students to conduct health assessments or use different skills with clients in a clinical site, showing informative and engaging videos, displaying clinical instruments in clinical areas, and allowing the students to use them under supervision, taking risks for students' experiential learning, using eye-catching pictorial graphics, and creating a safe, encouraging environment will lead to effective clinical learning.[2]

Many of these techniques are increasingly being integrated into nursing clinical education today. Expanding upon these methods within a brain-based learning framework involves exploring how diverse settings can enhance clinical education. Traditionally, nursing education revolves around classroom and clinical settings. However, instructors can broaden the scope by incorporating additional settings, such as simulation labs, standard patient simulators, and virtual reality, which will be beneficial for nursing students to care for critically ill or disabled persons in a safer environment.[27,28] Currently, lab simulations are often limited in access and not well equipped to prepare students to care for marginalized people, such as individuals with a physical or mental health disability or pediatric shock, which can result in insufficient practice and heightened stress among students when transitioning to practice settings.[27] Providing different approaches to teach real-life skills such as virtual labs, and standardized patient simulators where they are mentally and physically engaged in performing health assessments, doing complex dressings, and creating interdisciplinary care plans will be meaningful to create more competent patient-centered nurses[27,28] Furthermore, instructors can create quiet spaces within clinical settings to promote mindfulness and reflection among students. These spaces allow students to express their thoughts and emotions about their clinical experiences and facilitate debriefing sessions with the instructor and peers. Such environments encourage self-awareness and emotional processing, contributing to a more holistic approach to nursing education. As a result, students' perceptions of clinical learning will change from a stressful experience to one that provides a wide range of learning opportunities in which they could become fully immersed and engaged in the scholarship of clinical learning.

4. Conclusion

A brain-based approach is a distinctive approach to engaging Gen Z learners in the pursuit of clinical learning. When clinical instructors possess knowledge of the brain's physiology and skillfully integrate it into the clinical process, the result is the development of more knowledge seekers, critical thinkers, and patient-oriented nurses. Despite many research studies on clinical nursing, the incorporation of brain neurotransmitters into the realm of clinical learning is still in its infancy. To enhance the clinical learning experience for nursing students, further research on incorporating brain-based learning into established curricular objectives is necessary. The incorporation of brain-based techniques into clinical settings has the potential to deepen students' understanding of the nursing profession and foster an interest in connecting theoretical knowledge to practical applications. Brain-based techniques will help future nurses to be practice-ready and engage their brains in the learning process so that mistakes are viewed as opportunities for growth and the clinical environment transforms from being a source of stress to one of reward.

Acknowledgements

We would like to thank and acknowledge Dr. Florence Myrick for her support and guidance in writing about this topic.

Authors contributions

Sadaf Murad Kassam drafted the manuscript and conducted the literature review. Shrinithi Subramanian was responsible for revising and formatting the manuscript. Both authors read, edited, and approved the final manuscript.

Funding

Not applicable.

Conflicts of Interest Disclosure

The authors declare that there is no conflict of interest.

INFORMED CONSENT
Obtained.

ETHICS APPROVAL
The Publication Ethics Committee of the Sciedu Press. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

PROVENANCE AND PEER REVIEW
Not commissioned; externally double-blind peer reviewed.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

DATA SHARING STATEMENT
No additional data are available.

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REFERENCES
[1] Bradley CM. Teaching and Connecting with your Gen-Z Student. New Jersey Nurse. 2021; 51(3): 10.

[2] Schmitt CA, Lancaster RJ. Readiness to Practice in Generation Z Nursing Students. Journal of Nursing Education. 2019; 58(10): 604–606. PMid:31573651 https://doi.org/10.3928/01484834-20190923-09

[3] Dahlke S, O'Connor M, Hannesson T, et al. Understanding clinical nursing education: An exploratory study. Nurse Education in Practice. 2016; 17: 145–152. PMid:26775165 https://doi.org/10.1016/j.nepr.2015.12.004

[4] Raghavan D, Divya KY, Francis F, et al. Clinical Learning Triad in Nursing Education: Qualitative Analysis of Perceptions of Undergraduate Nursing Students. International Journal of Research in Education and Science. 2021; 7(3): 735–746. https://doi.org/10.46328/ijres.2046

[5] Stănesu-Yadav DN, Lillekroken D. Nurse preceptors' experiences of promoting and teaching fundamental care to undergraduate nursing students: A qualitative study. Journal of Advanced Nursing. 2023; 79(3): 1094-1106. PMid:35855499 https://doi.org/10.1111/jan.15372

[6] Berg E, Lepp M. The meaning and application of student-centered learning in nursing education: An integrative review of the literature. NURSE EDUCATION IN PRACTICE. 2023; 69: 103622. PMid:37054488 https://doi.org/10.1016/j.nepr.2023.103622

[7] West EA. Constructivist Theory and Concept-Based Learning in Professional Nursing Ethics: Implications for Nurse Educators. Teaching Ethics. 2016; 16(1): 121–130. https://doi.org/10.5840/tej201633129

[8] Lambright K. The Effect of a Teacher's Mindset on the Cascading Zones of Proximal Development: A Systematic Review. Technology, Knowledge and Learning. 2023; 1–17. https://doi.org/10.1007/s10758-023-09696-0

[9] Rahman B, Hamid S, Gul A. The Impact of Stress on the Performance of University Students in the Light of Krashen's Affective Filter Theory. Liberal Arts and Social Sciences International Journal. 2020; 3(2). https://doi.org/10.47264/idea.lassij/3.2.7

[10] Owens MT, Tanner KD. Teaching as Brain Changing: Exploring Connections between Neuroscience and Innovative Teaching. CBE Life Sciences Education. 2017; 16(2): fe2. PMid:28450442 https://doi.org/10.1187/cbe.17-01-0005

[11] Willis J. Powerful Classroom Strategies From Neuroscience Research. Learning and Brain Workshop. 2014; 1-35.

[12] Goldfarb EV, Phelps EA, Chun MM. Memory-Guided Attention: Independent Contributions of the Hippocampus and Striatum. Neuron. 2016; 89(2): 317-324. PMid:26777274 https://doi.org/10.1016/j.neuron.2015.12.014

[13] Vogel S, Schwabe L. Learning and memory under stress: implications for the classroom. npj Science Learn 1. 2016; 16011. PMid:30792896 https://doi.org/10.1038/npjscilearn.2016.11

[14] Zsuga J, Tajti G, Papp C, et al. FNDC5/irisin, a molecular target for boosting reward-related learning and motivation. Medical Hypotheses. 2016; 90: 23–28. PMid:27063080 https://doi.org/10.1016/j.mehy.2016.02.020

[15] Diaz FC, Caffino L, Fumagalli F. Bidirectional role of dopamine in learning and memory-active forgetting. NEUROSCIENCE AND BIOBEHAVIORAL REVIEWS. 2021; 131: 953–963. PMid:34655655 https://doi.org/10.1016/j.neubiorev.2021.10.011

[16] Coffman S, Iommi M, Morrow K. Scaffolding as active learning in nursing education. Teaching and Learning in Nursing. 2023; 18(1): 232-237–237. PMid:36339966 https://doi.org/10.1016/j.teln.2022.09.012

[17] Ji YA, Woo H. Brain-based medical education model for expert's clinical decision making. Korean Journal of Medical Education. 2023; 35(3): 275–283. PMid:37670523 https://doi.org/10.3946/kjme.2023.265

[18] Nesime D, Belgin A. Impact of Education on Student Nurses' Advocacy and Ethical Sensitivity. Nursing Ethics. 2022; 29(4): 899-914. PMid:35176913 https://doi.org/10.1177/09697330211050997

[19] Thien S, Lavis CC, Williams KA, et al. Assessing a Faculty Development Program for the Adoption of Brain-based Learning Strategies. Journal of Faculty Development. 2016; 30(1): 57–69.

[20] Duane BT, Satre ME. Utilizing constructivism learning theory in collaborative testing as a creative strategy to promote essential nursing skills. Nurse Education Today. 2014; 34(1): 31-34. PMid:23608232 https://doi.org/10.1016/j.nedt.2013.03.005

[21] Gunnarsdottir TJ, Henriksen J, Löfmark A, et al. Customising clinical studies for the new nursing generation. Nordic Journal of Nursing Research. 2022; 42(1): 3-6. https://doi.org/10.1177/20571585211018353

[22] Altmiller G, Deal B, Ebersole N, et al. Constructive feedback teaching strategy: A multisite study of its effectiveness. Nursing Education Perspectives. 2018; 39(5). PMid:30096111 https://doi.org/10.1097/01.NEP.0000000000000385

[23] Rodriguez R, Hambley C, Wisner K. Taking the Fear Out of Peer Feedback: A Brain-Friendly Peer Feedback Program. JONA: The Journal of Nursing Administration. 2024; 54(1): 40–46. https://doi-org/10.1097/nna.0000000000001375

[24] Abualhaija N. Using Constructivism and Student-Centered Learning Approaches in Nursing Education. Int J Nurs Health Care Res. 2019; 7: 093. PMid:38117151

[25] Epp S, Reekie M, Denison J, et al. Radical transformation: Embracing constructivism and pedagogy for an innovative nursing curriculum. Journal of Professional Nursing. 2021; 37(5): 804-809. PMid:34742508 https://doi.org/10.1016/j.profnurs.2021.06.007

[26] Esplendori GF, Kobayashi RM, Püschel VA. Multisensory integration approach, cognitive domains, meaningful learning: reflections for undergraduate nursing education. Revista Da Escola de Enfermagem Da USP. 2022; 56. PMid:35421209 https://doi.org/10.1590/1980-220x-reeusp-2021-0381

[27] Bozkurt SA, Samia R, Gazarian PK. Using standardized patient simulation in undergraduate nursing education: a scoping review. Clinical Simulation in Nursing. 2023; 74: 3-18. https://doi.org/10.1016/j.ecns.2022.10.003

[28] Chen FQ, Leng YF, Ge JF, et al. Effectiveness of Virtual Reality in Nursing Education: Meta-Analysis. Journal of medical Internet research. 2020; 22(9): e18290. PMid:32930664 https://doi.org/10.2196/18290