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Designing Social Studies Brain-based Lesson Plan using Activation, Connection, and Transfer (ACT) Model

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ABSTRACT

Purpose of the study: This study develops a model for designing brain-based lesson plans in Secondary Social Studies. The developed model may serve as a reference for developing brain-based lesson plans grounded in an understanding of how the brain learns and works effectively.

Methodology: This study employed a developmental research design. The research data were gathered through the validation of lesson plans, observation of lesson try-outs, focus group discussions, semi-structured interviews, and other techniques such as student behavioral measures, emoticons, ratings, and metaphors. Descriptive statistics were used to analyze the quantitative data, while a thematic analysis was utilized for analyzing qualitative data.

Main Findings: The results indicated that when applying the ACT Model in instruction, Social Studies teachers should begin by activating students' brains through engaging and enjoyable learning activities that present essential concepts at the start of the lesson. This should be followed by connecting the lesson to the students' life experiences. Lastly, to demonstrate relevance, the Social Studies lesson should conclude by transferring students' learning into their lives more realistically, allowing them to practice and internalize the content.

Novelty/Originality of this study: This study advances academic discourse on applying brain science to social studies education. It highlights the importance of integrating neuroscience with social studies education to design scientifically sound teaching methods. Additionally, it contributes to the field of research by outlining a process for developing a learning model aimed at enhancing social studies education.

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1. INTRODUCTION

Educational neuroscience, a new branch of brain science, seeks to answer the question of how genes and cerebral processes affect teaching and learning [1]. With the development of technologies such as functional magnetic resonance imaging (fMRI), educational neuroscientists have studied the human brain, discovering neural connections and their associations with human learning. From this emerging field of brain science, along with advancements in technology, a new teaching approach known as Brain-Based Learning (BBL) has surfaced.

To effectively utilize BBL, it is essential for teachers to grasp how the brain works and to plan instruction accordingly [2]. The published works of Connell [3], Jensen [4], and Sousa [5] has identified key principles of brain-based learning, summarized into nine essential characteristics. These include: 1) Incorporating novelty in the classroom, 2) Focusing on emotion, 3) Facilitating meaningful learning through patterning, 4) Promoting social interaction, 5) Celebrating the uniqueness and diversity of learners, 6) Integrating arts and movement into lessons, 7) Addressing the physiological needs of learners, 8) Attending to the physical environment for learning, and 9) Embracing natural and authentic learning. Utilizing these principles can help educators design instruction that fosters meaningful connections and transfers knowledge effectively. Numerous researchers, both locally and internationally, have employed this new approach to enhance student engagement. Studies demonstrate that integrating brain science into instructional design increases the likelihood of students achieving higher learning outcomes [6], [7].

Despite the promising potential of BBL, challenges remain, particularly in social studies education. The primary goal of social studies is to develop the knowledge, skills, attitudes, and values of young people by enhancing their critical thinking abilities [8]. This prepares them to contribute proficiently and efficiently as informed citizens in a democratic and culturally diverse society, strengthen mutual understandings, and equips them to find solutions to various local, societal, and global issues using identifiable community resources [9]-[11]. However, literature revealed that social studies still facing several issues and problems like being dull, gray, and irrelevant as perceived by secondary students locally and abroad despite its importance and promising goal to develop critical thinking, active citizenry with values and respect to humanity, and many more. For instance, studies by Byford & Chiodo and Hoge & Zhao indicate that many students perceive social studies as a dull and boring subject, often ranking it as their least favorite compared to other disciplines [12], [13]. Additionally, many students feel that this subject is irrelevant to their future needs, as they struggle to see the correlation between their learning in social studies and real-life applications [14]. Conversely, the study by Alazzi & Chiodo found that while secondary school students regarded social studies as valuable, it was not their favorite subject [15]. These issues may stem from the didactic teaching methods employed by some teachers [14].

Recognizing these challenges, this study aims to develop a model for designing brain-based lesson plans in social studies. By integrating BBL strategies, this research seeks to provide a potential solution to the longstanding issues associated with teaching social studies. Furthermore, it addresses a significant gap in the literature: the lack of integration of brain-based learning strategies in social studies, as most existing studies focus on hard sciences like biology, physics, and mathematics. Additionally, there is limited exploration of the role of emotion in learning, despite social studies being a subject rich in emotional and value-based content.

The objective of this study is to develop a model for developing brain-based lesson plans specifically for secondary social studies and to investigate how these framework can enhance student learning outcomes and emotions in the discipline. Through this research, it is hope to contribute valuable insights that promote more effective teaching practices in social studies, ultimately enhancing student interest and achievement in the subject.

2. RESEARCH METHOD

This study employed a mixed-method type of research within the framework of a developmental research design to create a model for designing brain-based lesson plans in Social Studies. Mixed-methods studies are characterized by their ability to collect and combine both quantitative and qualitative data, yielding more comprehensive and nuanced findings [16]. The combination of methods can occur at several levels during the research process depending on the specific goals of the study [17]. This approach is particularly effective in studying educational interventions or model building, where both efficacy and the implementation process or experience are under consideration [18].

In the context of developmental research design, mixed methods are typically utilized to facilitate both systematic development and rigorous validation of the intervention or model. Developmental research involves the systematic study of designing, developing, and evaluating instructional programs, processes, and products that meet the criteria for internal consistency and effectiveness [19]. It aims to address complex educational problems and enhance knowledge about the characteristics and processes involved in planning interventions by designing and developing approaches such as teaching-learning strategies, programs, and systems [20]. In this kind of research, both teachers and students act as co-designers of the product or program through collaboration with the researcher [21]. Additionally, it employs a variety of approaches and methods from both quantitative and qualitative research paradigms to gather the necessary data for developing and evaluating the intervention [22]. In this study, the researcher collected both qualitative and quantitative data from expert validators during the validation stage, as well as from process observers and students during the implementation stage.

There are three groups of participants involved in this study. The first group consists of expert validators who evaluated the developed brain-based lesson plans. These validators were selected based on their professional backgrounds and expertise in educational neuroscience, curriculum and instruction, and social studies education. The second group comprises two social studies teachers who acted as process observers during the implementation of the brain-based lesson plans. These experienced teachers were purposively selected due to their high positions in the social studies department and their extensive experience teaching the subject. Furthermore, as the study aimed to observe the implementation of brain-based lessons in actual classroom settings, a census sampling technique was used, encompassing all students from both class sections scheduled for social studies at the Grade 11 level. The census sampling technique, or commonly known as total population sampling, refers to a non-probability sampling method in which the entire population is selected to participate in the research, rather than just a subset chosen through random or stratified procedures [23]. In this study, both class sections included all Grade 11 students available for the intervention; one section had twenty-nine students, while the other had twenty-three. Both sections underwent the five-day implementation of the developed brain-based lesson plans. A post hoc power analysis indicated that with a total sample size of 52 students divided into two groups (n = 29, n = 23) and assuming a medium effect size (d = 0.5) at an alpha level of 0.05, the statistical power of this study was approximately 0.43. This suggests a modest ability to detect medium to large effects, but limited sensitivity for small effect sizes. These parameters were estimated using G*Power software and are consistent with power standards commonly reported in educational intervention research.

For the research instruments, the developed brain-based lesson plans were validated using an adapted instrument to determine their quality, appropriateness, and compatibility with principles of brain-based learning. The validation instrument had four key criteria: (1) Content Accuracy, (2) Instructional Design, (3) Learner Engagement, and (4) Integration of Brain-Based Strategies. This checklist was rated on a 5-point Likert scale, ranging from 1 (Needs Revision) to 5 (Highly Valid). The data were analyzed through interrater agreement and the calculation of mean validity ratings across all criteria. The derived overall mean score of 4.78 indicated that the developed brain-based lesson plans fell into the "Highly Valid" category. Moreover, the low variability noted among the scores provided by the validators ensured high interrater agreement, thereby confirming the internal reliability of the validation results. This confirms that the lesson plans align with the theory and pedagogical underpinnings of brain-based learning, making them suitable for use in social studies learning environments.

Additionally, the survey form developed by the researcher, which was used to collect data from students, also underwent a validation process. This survey form facilitated students in articulating their learning achievements and experiences throughout the implementation stage and underwent a comprehensive validation procedure to ensure its quality and suitability for the study. A panel of three expert validators specialists in curriculum and instruction, social studies education, and brain-based learning evaluated the instrument for clarity, relevance, and alignment with the study's objectives. The Content Validity Index (CVI) was employed to assess the relevance and representativeness of the items related to the construct under investigation [24]. The calculated overall CVI of 0.93 reflected an exceptional level of content validity, indicating that the items were considered highly suitable by the validators. To further assess the internal consistency of the survey form, Cronbach's alpha coefficient was calculated [25]. The resulting value of 0.87 demonstrated a strong degree of reliability, implying that the items within the instrument were consistent and stable in measuring students' learning achievements and experiences. These findings affirm that the survey form was both valid and reliable for application in the study.

In collecting the data, the developed brain-based lesson plans were administered over five days. To gather data regarding the implementation stage of the lesson plans, the process observers used the standardized observation tool provided by the Department of Education to give their feedback and recommendations during their evaluations; therefore, validation of this instrument was unnecessary. Along with the collection of quantitative data, the researcher conducted two separate sets of focus group discussions: one with the students and the other with the process observers. Additionally, individual interviews were conducted with the students. To document his day-to-day experiences, observations, and insights during the implementation of each lesson plan, the researcher maintained personal journals. These journals helped him refine certain aspects of the lesson plans and contributed to the data analysis of both qualitative and quantitative data collected through the study.

For data analysis, the survey results from Grade 11 students in two class sections who participated in the five-day implementation of the developed brain-based lesson plans in Social Studies were analyzed using the Statistical Package for the Social Sciences (SPSS). A student survey was conducted using a 5-point Likert scale (where 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and 1 = Strongly Disagree) to assess students' perceptions of the brain-based lessons concerning their engagement, motivation, participation, and relevance. The results revealed that students exhibited high levels of engagement and motivation throughout the five-day implementation. The overall mean of 4.45 indicated that students generally strongly agreed that the developed brain-based lessons enhanced their participation and learning experiences. The low standard deviation values (0.41–0.48) suggested that responses were consistently positive across both class sections, with minimal variation among students. The findings imply that the brain-based lesson plans successfully fostered active learning, sustained motivation, and improved classroom interaction among Grade 11 students. The consistency of results between the two sections further supports the effectiveness and applicability of the developed instructional approach in Social Studies.

On the other hand, for the qualitative data, the thematic analysis framework by Braun and Clarke was used by the researcher for a manual analysis of the qualitative data collected from interviews and focus group discussions [26]. The results confirm that the developed brain-based lesson plans were effective in fostering active participation, motivation, and deeper learning among students. The recurring themes of engagement, understanding, and a positive classroom climate demonstrate that students not only enjoyed the lessons but also perceived them as meaningful and beneficial to their learning process. These insights complement the quantitative results, reinforcing the overall effectiveness of the brain-based instructional model in social studies.

Lastly, to ascertain the validity and reliability of the qualitative data, the researcher applied the process of member checking by re-presenting the formulated categories back to the process observers and students to ensure the accuracy of the findings. This process also provided the researcher with the opportunity to conduct interviews after the survey, enabling participants to express their comments on the findings.

3. RESULTS AND DISCUSSION

The developed Activation, Connection, and Transfer "ACT" model aims to transform the way the teacher plans his/her lessons by being grounded on the scientific explanation of how the brain processes the desired Social Studies knowledge, skills, and attitude. This model champions the idea that emotion and learning are intertwined in Social Studies and this was evident from the results of this study. Thus, in using this model, the Social Studies teacher will be more creative and critical in selecting strategies suited to the purpose of the lesson and in considering the students' emotions as they learn.

3.1 Five Preliminary Steps in Designing Brain-based Lesson Plan

When designing a brain-based lesson plan using the ACT model, the Social Studies teacher should first go through five preliminary steps. These are the actual steps used by the researcher when developing brain-based lesson plans for this study.

Identify the Learning Competency of the Lesson

In this step, the teacher should first identify the learning competency of the lesson to be discussed, which can be found in the existing K to 12 curriculum guide of the subject as mandated by the Department of Education. The teacher should also consider the allotted number of days for that specific learning competency when planning the lesson.

Analyze the Identified Competency by Answering the Three (3) Whys

After identifying the target learning competency of the lesson, the next step is to analyze it by answering the three Whys. This step is crucial for clarifying the purpose of the lesson.

1) *Why do I need to teach this lesson?* Answering this question will help the teacher envision the knowledge, skills, and behaviors that they want their students to acquire.
2) *Why do my students need to learn this lesson?* This question helps the teacher understand how the lesson applies to students' real lives.
3) *Why is the lesson relevant to my students?* This question aids the teacher in identifying the relevance of the lesson to students' past, present, and future experiences.

Formulate the Purpose of the Lesson

After answering the three Whys, the teacher can formulate the purpose of the lesson, which will serve as the overall goal to be achieved by the students. Formulating the purpose will help the teacher clarify what the students will learn and how they will apply that knowledge. This purpose differs from the lesson objectives; it is broader, long-term, and generally not measurable, whereas the objectives are more specific and concrete.

Identify the Brain-Based Principles Related to the Purpose of the Lesson

After formulating the purpose of the lesson, the next step is to identify the brain-based principles that explain the neural processes involved in learning. This can be accomplished by reviewing neuroscience literature to determine effective teaching strategies aligned with the lesson's purpose. In addition to identifying these principles, the teacher should integrate the following five general elements into the brain-based lesson plan, regardless of the lesson's purpose:

1) Processing Learning. The teacher should provide sufficient time for students to process their learning [27]. This can be facilitated through follow-up questions, reflection periods, and equal opportunities for individual sharing.
2) Frequent Feedback. The teacher should provide immediate feedback to inform students about their performance and suggest improvements, whether through grades, narrative comments, positive reinforcement, discussions, expressions, or symbols [28], [29].
3) Use of Rubrics. Since many activities in a brain-based lesson plan are authentic and subjective, having rubrics is essential to guide students in performing their outputs and providing criteria for evaluation [30], [31]. It is suggested that the rubric be shared before students begin their work.

4) Appropriate Type of Music. The use of different types of music during lesson discussions should be tailored to the learning activities and blocks [32]. For the Activation block, energetic and joyful music can engage learners and stimulate their brains. For the Connection block, calming and relaxing music is recommended, allowing students to process information and connect it to prior learning and experiences. Finally, for the Transfer block, emotional music can help students reflect on and realize insights about the lesson.
5) Collaborative Learning Activity with a Small Number of Members. To ensure successful collaborative learning, it is advisable to limit group sizes. Ideally, groups should consist of three (3) to six (6) members to provide each student an equal opportunity to share their ideas and suggestions, making the collaborative experience more meaningful and engaging. The purpose of this is to improve students' understanding abilities and intelligence as well as building critical thinking skills [33].

Integrate the Learning Competency, the Purpose of the Lesson, and the Brain-Based Principles into Learning Objectives

Guided by the learning competency, the identified purpose of the lesson, and the brain-based principles, the teacher can now formulate learning objectives that specify what students should be able to do. These objectives provide direction for acquiring the necessary knowledge, skills, and attitudes. Unlike the lesson purpose, which is broader, lesson objectives are more specific, measurable, and time-bound, as they are expected to be achieved by the end of the lesson discussion.

3.2 Learning Blocks of the ACT Model

After accomplishing each preliminary step, the teacher may begin planning the lesson using the model. The structure of this lesson plan model is divided into three learning blocks: Activation, Connection, and Transfer. Each learning block includes specific steps aimed at achieving its objectives.

Activation Block

This is the initial block of the brain-based lesson plan that captures students' interest by activating their cerebral cortex. The cerebral cortex, also known as the gray matter of the brain, is the outer layer where the neocortex resides. This area is responsible for the executive functions of the brain, such as higher-order thinking, planning, vision, meaning-making, and pattern recognition—all of which are essential for making learning meaningful [34]-[36]. The cerebral cortex can be activated by incorporating novel movements, music, colors, and scents. This learning block is most effective for presenting all target learning concepts of the lesson through enjoyable and engaging activities. Brain-based experts like Sousa and Whitman & Kelleher support the notion that lessons are best remembered when introduced at the beginning of class [5], [37]. Therefore, the teacher should avoid using this block for non-learning tasks such as taking attendance or giving lectures. Instead, attendance can be taken once students begin their learning activities. Additionally, the desired emotional response during this learning block should be enjoyment of the lesson content. Under this block, the teacher should follow its HOOK steps, which are essential for achieving its objective:

1) House Rules. This step involves establishing classroom house rules based on an agreement between the teacher and students. Scaddan notes that learners are more motivated when they understand the process and have some control over it [38]. It is crucial to explain that house rules create a safe classroom environment, free from fear and anxiety, by helping students understand which behaviors are desirable and which are not. Thus, at the start of the lesson, the teacher should set classroom rules with predetermined consequences to inform students of what to expect, thereby minimizing feelings of threat and anxiety. In addition to establishing rules, the teacher may invite students to participate in a brain gym activity to activate their brains and prepare them for the lesson.
2) Opening Activity. In this step, the teacher should create games and other learning activities relevant to the lesson content that will stimulate students' curiosity and foster positive emotions of enjoyment. To enhance student engagement, the opening activity should be novel and aligned with the lesson content. This aligns with a brain-based principle which states that the human brain responds more to unique and different stimuli [5]. This idea is also consistent with Caine & Caine, who state that the brain's local memory system is motivated by novelty and curiosity [39]. Furthermore, the opening activity should be fun and safe.
3) Orientation on Lesson Objectives and Purpose. In this step, the teacher provides an overview of the lesson by orienting students about the target objectives and purpose identified in the preliminary steps. The aim is to outline the knowledge, skills, and attitudes that are expected to be achieved after the lesson, guiding students toward those learning goals. Erlauer supports the brain-based learning principle that the human brain is always searching for connection and meaning [34]. Clearly communicating the learning objectives and purpose helps students see the connections and meanings within the lesson. When students know what is expected of them, they are more likely to value learning and participate

actively. According to Scaddan, lessons without clear targets lead to limited perseverance and vague outcomes among students [38]. Therefore, this step is crucial for informing students of expectation.

4) Key Inputs. In this last step of the activation block, the teacher is expected to give a short input focusing on the key points of the lesson. Here, the teacher will discuss the essential concepts through direct instruction, providing only correct and accurate information while avoiding guessing games that could lead to misconceptions. Discussing the key inputs of the lesson can be done within thirteen (13) minutes to maximize students' "opportune time periods for learning," a term referred to by Erlauer [34]. The opportune time periods for learning refer to the first ten (10) to twenty (20) minutes of the lesson, which is the optimal time for students to absorb the learning content. This is supported by Jensen, who states that the human brain has a limited attention span ranging from ten (10) to twenty (20) minutes before fatigue and boredom set in, causing students' focus to wane [4]. This claim aligns with the Primacy-Recency Effect described by Sousa [5]. According to Sousa's model, the core concepts of the lesson should be presented at the beginning, as students remember information best when it is introduced at the start of the class. This will be followed by a short learning activity aimed at reviewing the key inputs, either in groups or with partners. Reviewing the lesson is important for the brain, especially in detecting and correcting errors. This concept is grounded in the idea that students tend to make more mistakes during the early stages of learning; therefore, the teacher should provide opportunities for students to review their learnings during the activation block to correct these mistakes through immediate feedback. Brain research suggests that review is a trial-and-error activity that activates both positive and negative emotional structures in the brain. It involves the anterior cingulate, which is responsible for detecting discrepancies between expected outcomes and actual experiences [4]. Brain-based learning also supports this notion, stating that frequent reviews and other rehearsal activities can strengthen neural connections [34]. This is also referred to by Sousa as 'rote rehearsal,' which aims to help students store knowledge precisely when it is placed into working memory [5]. Additionally, this constitutes a form of formative assessment in evaluating students' understanding of the lesson content. Finally, direct instruction, accompanied by review and practice, provides a clear path toward achieving meaningful learning experiences for students.

Connection Block

This is the second learning block of the brain-based lesson plan, which links or connects the learning content to students' lives, making learning more meaningful and relevant by activating their hippocampus and medial prefrontal cortex (mPFC). Prior knowledge significantly impacts the encoding of new learning experiences and is critical in forming new knowledge. Recent findings in neuroscience suggest that the connection between prior knowledge and new learning occurs via interactions between the hippocampus and medial prefrontal cortex [21]. The hippocampus encodes and retrieves sequences of events that compose episodic memories. In contrast, the medial prefrontal cortex (mPFC) is involved in the retrieval of remote long-term memories, supports and consolidates memories, and mediates decision-making [40]. Thus, to activate these brain regions, teachers should design experiential and reflective learning activities that connect students' prior knowledge and experiences to the lesson. Teachers can also prepare discovery learning strategies which can significantly improve students' conceptual understanding and scientific attitudes, directing them toward self-acquired knowledge [41]. Students typically experience their "AHA" moments during this learning block as they discover insights by combining their previous knowledge with new information. The term "AHA moment" appears frequently in various brain-based learning literatures. This surprising moment may occur for students in a brain-based learning classroom through games and other activities. This learning moment results from neuronal activity in the brain, creating new patterns that encode as new learning. Although this literature describes student learning moments, it does not specify the part of the lesson where these moments typically occur. The researcher addresses this gap by demonstrating that students' "AHA" moments predominantly arise after connecting new knowledge with their prior knowledge and experiences. This claim is supported by the brain-based principle indicating that the human brain is motivated to create meaning through patterning [42], [43]. Activating prior knowledge is crucial to learning since the brain prefers to see patterns or connections between incoming information and previously stored experiences [37]. The more an experience connects to new learning, the greater the likelihood of improved retention. Furthermore, during this learning block, students will begin to experience various emotions, such as happiness and sadness, especially when recalling their past experiences. These emotions may lead to feelings of surprise due to their discoveries. In terms of duration, this learning block requires more time compared to the others, as it is designed for exploration, reflection, and discovery. Finally, the teacher should follow the LINK steps for this learning block to achieve its objectives.

1) Life Experience Activity. In this step, the teacher will design an activity that surfaces the learners' experiences related to the key ideas of the lesson. When designing this activity, the teacher should remember that not all activities and materials are appropriate for every student. Only those that align with their knowledge and experiences should be used, especially when discussing and eliciting ideas

about current societal issues [44]. Answering the following questions will help the teacher create an appropriate life-experience activity: (1) "Does it relate to my students?" and (2) "Does this have meaning for my students?" These questions will guide the teacher in designing a meaningful activity that connects students' past experiences with their present learning. This strategy helps students engage and develop a deeper understanding of the lesson, as it is perceived to be relevant to their lives.

2) Introspection Question. In this step, the teacher will pose questions to encourage learners to examine their life experiences and how these either contradict or complement the key ideas discussed. Effective questioning plays a crucial role in helping students reflect on and explore the connections between their life experiences and new learning. This concept is supported by brain science, which states that the brain learns through constant questioning [4], [38]. The teacher also plays an important role in elaborating on students' responses by providing feedback. It is essential for the teacher to be sensitive to tone of voice, facial expressions, and body language while asking introspection questions, as students may become emotional when recalling their experiences.
3) New Knowledge. In this step, the teacher will provide an opportunity for students to express their insights about the lesson and their actual life experiences. New learning creates new synapses in the brain, especially when the lesson and activities are perceived as challenging [34]. To stimulate students' brains, the teacher should provide reflective questions or creative learning activities that encourage students to showcase their discoveries [45], [46].

Transfer Block

This is the final block of the brain-based lesson plan, providing opportunities for students to transfer their learning through practice and internalization. Engaging in practice and internalization activates two brain areas crucial for emotion, learning, and memory. The first is the amygdala, which plays an important role in learning the emotional components of experience, impacting many other elements of memory and cognition. The second is the prefrontal cortex, part of the cerebral cortex that governs intellectual or executive processes. It is also vital for working memory function, directly participating in both the storage of information and the organization of information needed for future thought and action. Activating the emotional control of the amygdala and the cognitive regulation of the prefrontal cortex is essential for achieving optimal integration of emotional and cognitive processing, which are critical aspects of transferring students' learning. Transferring learning is important for applying new knowledge in other contexts [47]. Moreover, for transfer to be successful, new learnings must be perceived by students as useful for the present and the future [5], [38]. Therefore, the teacher should design learning activities that allow students to solve authentic problems guided by their new learnings so they can see the relevance of the lesson to their current and future lives. In addition to practicing learning through a problem-solving approach, this learning block aims to provide closure through reflection and synthesis of the lesson.

This block also activates both cognitive and emotional aspects of students, what Connell refers to as "hot cognition" [3]. Engaging the hot cognition of students is essential for internalizing and characterizing the lesson, as students learn best when their emotions are engaged [48], [49]. Furthermore, this learning block is referred to by the researcher as the "emotional learning block" of the brain-based lesson plan, as it elicits a range of students' emotions by providing opportunities for reflection and recollection of experiences. Depending on the issues at hand, it can trigger five common human emotions: happiness, sadness, anger, fear, and optimism. Among these emotions, students are expected to foster a sense of optimism a positive outlook that encourages them to improve their situations guided by the lessons learned. The researcher considers optimism to be the "highest type of emotion or outlook in life" that every student may experience at the conclusion of each brain-based social studies lesson. Therefore, teachers should provide reflective activities that allow students to share their realizations and insights with the rest of the class. This process also enables students to assess their learning using brain-based authentic assessments. Like the first two blocks, the teacher in this learning block should follow the LOCK steps to achieve the desired outcomes.

1) Life-Based Activity. In this step, the teacher will design activities that enable learners to practice their newly acquired knowledge. This approach is grounded in the brain-based principle which states that practice strengthens neural connections in the brain, thereby improving retention [5], [43]. This principle is further supported by Whitman & Kelleher, who assert that deliberate practice enhances recall speed due to the process of myelination [37]. Myelin is a fatty sheath that covers the long axon trunk of neurons and thickens when a person engages in deliberate practice. The thicker the myelin, the greater the opportunity for long-term retention of learning. Thus, when students put in more effort to practice their knowledge, the neural pathways become more active, leading to increased myelin build-up. One effective learning activity to reinforce learning is through problem-solving. By tackling authentic problems, students can apply their knowledge and see the relevance of the lesson to their current and future lives. This notion is echoed by other brain-based learning experts who state that the human brain is inherently designed for problem-solving [3], [34], [36]. Problem-solving serves as a

powerful learning experience, transferring knowledge into meaningful experiences as it engages various areas of the brain responsible for reasoning, critical thinking, and higher-order thinking skills.

2) Open Sharing. In this step, the teacher will encourage learners to share their thoughts on their "practice activities". Sharing insights whether realizations or reflections- about the application of the lesson can enhance respect, participation, and foster strong relationships among students [50], [51]. This idea aligns with the brain-based learning principle that emphasizes the human brain's hardwiring for social interaction [47]. Research indicates that learning produced through collaboration characterized by sharing, feedback, discussion, critical engagement, or conversation is more robust than that generated by individual thinking alone. Furthermore, Sprenger posits that students learn best by sharing ideas and experiences due to the activation of mirror neurons [52]. These neurons imitate the actions of others and absorb their ideas or emotions. They fire both when an individual acts and when they observe similar actions performed by others. Consequently, students can empathize with their peers and learn from each other's ideas and experiences. During this step, the teacher should exercise caution as students may become emotional and eager to share their reflections.
3) Closure. In this step, the teacher will synthesize what transpired in class through a summary of key points. Synthesizing learnings at the lesson's conclusion is a powerful strategy for processing information, which is essential for retention. This claim is supported by the brain-based learning principle that states processing new information enhances brain neural connections [3], [5]. Jaeger & Ratzer [47] also assert that synthesis catalyzes transfer, providing students with their last opportunity to attach meaning to new learning. Thus, the teacher should prepare activities that summarize or synthesize learnings at the end of the lesson; these could take the form of journal writing, singing, writing poems, and more.
4) Knowledge Assessment. This step involves the teacher designing a brain-based authentic assessment to evaluate students' learning. Since the entire process of the brain-based lesson engages students' minds, bodies, and emotions, the assessment activity should also be brain-based. A brain-based authentic assessment aims to evaluate students' holistic learning development, encompassing their mind, body, and emotions. It is primarily subjective in nature and performance-based. This assertion is supported by the brain-based learning principle, which states that human intelligence involves different parts of the brain [37]. Thus, assessing students' learning should not be limited to surface knowledge or factual data [53]. When evaluating assessment strategies, particularly the authentic ones, a well-planned rubric should be utilized. This rubric should be presented and explained to students before the assessment begins, providing them with clear goals to target the specified criteria [54]. Once the assessment is completed, the students' scores should be shared with them to serve as feedback, which can be accomplished within five minutes. This will be followed by independent practice equivalent to an assignment or agreement in the existing lesson plan format within the basic education system.

Table 1. Matrix of ACT Model in Designing Brain-Based Lesson Plan.

Learning Block	Steps/ Components	Brain-Based Principle	Target Emotion
Activation	House Rules	The human brain responds best in a positive emotional state and relaxed environment.	Enjoyment
	Opening Activity	Curiosity and anticipation stimulate the brain.	
	Orientation on the lesson objectives and purpose	The human brain is always searching for connections and meaning.	
Connection	Key Inputs	The human brain has a limited attention span.	Surprise
	Life-experience activity Introspection questions New Knowledge	The human brain is motivated to create meaning through patterning.	
Transfer	Life-based activities	Practice strengthens connections in the brain.	Happines, Sadness, Fear, Anger, Optimism
	Open sharing	The human brain is hardwired for social interaction.	
	Closure	Processing new information can enhance neural connections in the brain.	
	Knowledge assessment	Human intelligence involves different parts of the brain..	

The developed ACT Model emphasizes the importance of engaging students' brains when planning brain-based lessons for Secondary Social Studies. To achieve this, teachers should initiate the lesson with enjoyable and interesting learning activities that effectively present essential concepts. This engagement at the beginning of the lesson sets a positive tone and sparks students' interest in the material. Following this initial engagement, it is crucial to connect students' life experiences to the lesson content. By linking the concepts being taught to real-world contexts that students are familiar with, educators can create a more relatable and impactful learning experience. This connection not only helps in retaining students' attention but also fosters a deeper understanding of the subject matter.

Furthermore, to make abstract concepts in Social Studies more concrete, they must always be related to the students' existing experiences and knowledge. This study revealed that not all societal issues are appropriate for classroom discussions; rather, those topics that align with students' current understanding and experiences facilitate meaningful sharing. It is essential for educators to select issues that resonate with students, as this relevance encourages active participation and enhances their ability to engage with the material on a personal level. When students see their own lives reflected in the curriculum, they are more likely to contribute thoughtfully to discussions and internalize the concepts being taught. Finally, to illustrate the relevance of what students are learning, Social Studies lessons should conclude by translating learning into realistic applications in their everyday lives. This involves providing opportunities for students to practice new skills, reflect on their learning, and draw personal realizations. The study found that such reflective practices are effective in helping students construct personal meaning regarding the lesson content. Additionally, recognizing that each learning block is associated with target emotions highlights the intertwined nature of learning and emotional engagement. By addressing both cognitive and emotional aspects of learning, educators can ensure that students derive maximum benefit from the lesson and develop a lasting understanding of the material.

The developed ACT model holds great promise for revolutionizing the teaching of social studies by aligning instructional practices with the principles of brain-based learning. The model presents significant practical implications for social studies teachers and curriculum designers. By utilizing this model, teachers can effectively redesign social studies instruction with a focus on how the brain learns best. The ACT model outlines clear steps and procedures that facilitate the integration of brain-based principles and strategies into lesson planning, empowering teachers to transform their teaching methodologies both inside and outside the classroom. One of the most compelling aspects of the ACT model is its provision of specific strategies and elements that teachers can implement to enhance student engagement and understanding. This structured approach encourages teachers to consider cognitive and emotional factors, ensuring that they address the diverse needs of learners in the social studies classroom. As a result, the ACT model facilitates a more dynamic learning environment where students are encouraged to connect with the content on a deeper level, making social studies a more relevant and stimulating subject.

The novelty of this research lies in the advancing of academic discourse surrounding the intersection of brain science and social studies education. By emphasizing the critical need for integrating neuroscience with pedagogical practices, it opens up new avenues for designing teaching methods that are not only effective but also grounded in scientific research. This innovative approach underscores the potential of neuroscience to inform educational strategies, thereby facilitating deeper learning experiences for students in social studies. The novel integration of cognitive principles into curriculum design can lead to a more nuanced understanding of how students engage with historical, geographical, and cultural contexts, ultimately enhancing their ability to think critically about complex social issues. Moreover, this study contributes to the field of research by outlining a systematic process for developing a comprehensive learning model specifically tailored to improve social studies education. This model not only aims to bridge the gap between theory and practice but also serves as a valuable resource for educators seeking to implement evidence-based strategies in their classrooms. By providing a framework that emphasizes the application of cognitive science, this research paves the way for future investigations into the effectiveness of these methods in fostering student engagement and retention of knowledge. The novelty of this study lies in its dual focus: it not only advocates for the reimagining of social studies pedagogy through neuroscience but also lays the groundwork for ongoing research and development in this vital area of education.

However, it is essential to acknowledge the limitations of this study, which present opportunities for future research to build upon its findings. First, the effectiveness of the ACT model on students' academic achievement has yet to be thoroughly tested under a rigorous experimental design. It is recommended that future studies employ a quasi-experimental design or other type of experimental research design suitable to assess the impact of these brain-based lesson plans on students' learning outcomes. Such research would provide valuable insights into the efficacy of the ACT model in real classroom settings. Additionally, the limited duration of the implementation phase in this study constrains the ability to fully understand the long-term effects of the ACT model on student learning and behavior. Future research should consider extended implementation periods to observe how sustained exposure to brain-based lesson plans influences student engagement, retention, and overall academic performance. Lastly, the scope of this study was restricted to a single grade level (Grade 11 social studies). To enhance the generalizability of the findings, it is crucial for subsequent studies to explore the application of the ACT model across various grade levels, particularly from Grades 7 to 12. By doing so, researchers can obtain a broader understanding of the model's effectiveness and adapt it to meet the needs of diverse learner populations within different educational contexts.

4. CONCLUSION

Social Studies is fundamentally an affective- and value-based discipline, connected with the cognitive domains of learning. In the infusion of the principles of brain-based learning into the process of developing lesson plans, the study showed that the cognitive and emotional domains of learners play a similarly significant role in achieving high levels of meaningful comprehension, emotions, and engagement in Social Studies. The development of the ACT Model is a paradigm shift in the traditional way of presenting Social Studies, that is generally considered uninteresting and passive, by making the subject more interesting, applicable, and focused on the learner. It is a scientifically-based framework that is compatible with the inherent process of the brain when learning, enables the activation of previous knowledge, the incorporation of new principles, and the generalization of learning into everyday situations. Its application has advantages as much for the learner as the teachers: students achieve deeper understanding and greater motivation, teachers receive a framework that is systematic and adaptable, compatible with neuroscientific explanations. From a comprehensive viewpoint, the ACT Model serves to bridge the divide between the realms of science and social science, illustrating that interdisciplinary integration can significantly improve pedagogical methods and foster comprehensive learning experiences. Theoretically, it adds to the expanding body of research concerning brain-based teaching methodologies and their contextual application within the field of Social Studies. Practically, it provides a framework for curriculum developers and teachers who aim to innovate instructional practices in the classroom with the brain in mind. At the policy level, the research highlights the necessity for teacher education institutions and curriculum designers to embed neuroscience-informed educational frameworks into both instructional design and professional development initiatives. Ultimately, this study affirms that when brain science and Social Studies collaborate effectively, teaching becomes more humanized, reflective, and efficacious, rooted in the principles of how the brain optimally acquires knowledge, thereby enhancing the success of every learner.

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