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Teaching Chemistry and English Language with Mnemonics as a Mindfulness Strategy for Students' Academic Struggles

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Abstract

Globally, Students with Low Academic Achievement (LAA) are usually presented with lack of mindfulness' symptoms which are the signs of stress and anxiety. Also, the growing rate of highly competitive job market, poverty, hunger and general inflation in price of goods and services occasioned by COVID-19 could be held responsible for additional stress and anxiety among science students. Consequently, Mindfulness Strategies aiming at relieving students stress and anxiety will be of great benefit to the students trying to cope with the attendant struggles and improve their performance in core science subjects chiefly Chemistry and English Language which is a core subject for all secondary school students. This study hereby aims to examine the teaching of Chemistry and English Language with the Mnemonic Devices for Science Students' Mindfulness in Nigerian Secondary schools. Through the literature reviewed, it was found that the use of mnemonics in the teaching of Chemistry and English Language improves students' interests, retention, academic achievement, and mindfulness among science students. It was however concluded that the use of mnemonics is a mindfulness strategy which could be used to improve Science students' academic achievement and retention. It is hereby suggested that science and English Language teachers should learn to use mnemonics devices regularly in their classrooms to ensure that the science students benefit from its mindfulness potentials.

Keywords: *STE; English Language; Chemistry Education; Mnemonics Students' Mindfulness*

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Background to the Study

Science and Technology Education (STE) is a vital tool especially in the emerging global economy for self-reliance and jobs creation. It enhances the promotion of nations from the group of consumers to the group of producer economy. STE is the systematic study where students are engaged to experience the richness and the excitement of the natural world through inquiry, critical thinking, and demonstration of skills (Svendsen, 2021). It is the field of study that deals with how scientific discoveries are made, disseminated, and applied in the technological inventions and for solving daily problems including the improvement of standard of living. Since a river does not flow without a source, STE needs the synergy of science subjects at the secondary school level to strive both at the tertiary institution and in the world of work.

In Nigeria, as an example, the teaching of Science started in 1867, when Nature Study and Hygiene were introduced into the school Curriculum but later reformed into Biology, Chemistry and Physics (Adepoju, 2014).This development was viewed necessary by Orimogunje, (2018) who argued that no student could have been allowed to study a Science oriented discipline in a tertiary institution as at that time without at least a five credit passes in science subjects including Mathematics and English Language. Consequently, experts in each of the science subjects intensified efforts towards investigating and proffering remedies to students' learning predicaments. Hence, the chemistry teaching community rose to the occasion and pushed for the emancipation of Chemistry Education as a research field (Taber, 2015). That is, Chemistry teaching has been in existent in one form or another as there has been chemistry, but as a research field, it is a relatively young area of study with its origin dated back to the 1970s (Tsaparlis, 2017).

Chemistry Education is a comprehensive term which refers to the teaching and learning of Chemistry (Nja, Idiege & Obi 2017). It is a systematic process of acquiring the fundamental knowledge with which man can shape and reshape the world using the in-depth knowledge of matters. The goal of Chemistry Education is to enable students gain scientific literacy and account for some daily event using scientific principles, knowledge, and skills. But, this may not be possible without innovative teaching techniques. While supporting this assertion, Eilks and Hofstein (2015) reported that one of the goals of Chemistry teaching community is to develop more effective and scientifically aligned strategies for the teaching of chemistry. Nevertheless, the teaching techniques expected in the Chemistry classrooms should be the types that provide meaningful learning opportunities to learners by making connections to daily life activities. The method should provide remedies to students' learning challenges such as poor learning outcome, low retention, negative attitudes, unfavorable scientific world-view and lack of mindfulness.

Apart from the attendant challenges associated with the Chemistry learning opportunities in schools, the present-day national challenges such as the paper-crazy system and its infamous post-graduation unemployment have further aggravated the situation. The students are getting more worried about their future. Coupling with the present day economic bad shape occasioned by COVID-19, the struggle among chemistry students is becoming more intense

academically. As a result of this, a close observation of chemistry students during examinations have shown many of them experiencing signs of academic stress such as loss of memory, examination tension, blurred eyes sight, fainting and even crying in the examination hall. As reported by Legg and Cafasso (2018), when students are stressed, their bodies release stress hormones "cortisol" which has been proven experimentally to greatly impair human's memory process, especially their ability to retrieve longtime information. The duo discovered in animal study that stress and depression shrink human brain and reduce its ability to retain important information.

Since observation of students during examination has proven that the stress signs were predominantly noticed among low performing students, low retention capacity and fear of poor academic performance are responsible for lack of mindfulness. Ugo and Akpoghol, (2016) explained that where students cannot get the attention, they deserved for effective learning they might get frustrated and be discouraged. It is however needed to be acknowledged at this juncture that; strong support system is vital for human emotional brain health. By implications, stress, depression, and anxiety are signs of academic struggle causing lack of mindfulness.

On the other hand, English Language has been in existence as far as the origin of Britain. It is the Language of the British Colonial masters that amalgamated the Southern and Northern protectorates of Nigeria in 1914 and from whom Nigeria as a nation got independence. After the euphoria of independence that greeted Nigeria on October 1st, 1960, the country being a multiethnic and by implication a multilingual nation with over 250-ethnic languages adopted English Language as her official Language. Since then, it has become the language of communication for teaching Chemistry in Nigerian Schools. The student must understand and speak English Language to understand Chemistry in the classroom. Also, a minimum of credit pass in English language as a subject in Nigerian Science Colleges is a criterion upon which students' success or failure are measured. Therefore, the relevance of English Language to Chemistry cannot be over-emphasized not only in its teaching but also as the language of research communication in Nigeria. English Language is very much important for communicating scientific discoveries and impact knowledge gained by the scientific community to a larger audience and to better the society.

These among other benefits have prompted scholars, globally to emphasize greatly on the needs for Chemistry and English Language in schools for the production of much needed Science and technology-based workers who are capable of fluently educating the public through effective communication. These enormous benefits and the bid to keep the knowledge progressing from one generation to another have motivated nations to create these disciplines and establish their departments in tertiary institutions. In this mission to greatness, Nigeria cannot be an exception. The world is revolving, and everyone must strive to acknowledge these paramount subjects for the modern-day learners. If these goals must be realized, the teaching of English Language and Science chiefly Chemistry in Science colleges must be taken seriously. This has made English Language one of the most suitable languages for communicating Sciences teaching and discoveries in many countries of the world. This

indicates that Chemistry and English Language are important criteria; without credit passes no science-based student will be offered admission into tertiary institutions to study science and technology courses.

This study considers the use of Mnemonics as a panacea to the numerous chemistry learning challenges. The process of formulating the codes such as acronyms, abbreviations and Mnemonics is referred to coding and encryptions. In order to accomplish coding effectively, using certain strategies might be required during learning opportunities. According to Onen and Kocak (2011), memory support strategies help coding by developing relationships and associations which do not exist naturally in the content to be learnt. In this situation, such strategies constitute artificial links among similar and different information. Memory support strategies also help learners to remember words, terms, and facts. Essentially, the memory support strategies can be classified into coding with images and coding with verbal symbols. Thus, this study is capable of helping chemistry teaching community to understand their students' learning challenges which were stated earlier and opportunity to test the possible remedies such as the use of codes in the teaching and learning processes where permissible.

Conceptual Clarifications

Mnemonics are acronyms, abbreviations, codes, Images, songs, and diagrams used in the teaching and learning process. The use of Mnemonics in chemistry teaching and learning is referred to as the Mnemonics Instructional Strategy (MIS). The MIS works generally with the principle of associations meaning associating the study content with funny words, sentences, phrase, songs, images, important dates, diagrams, and a host of others. This instructional strategy involves logically associating the learning contents with the Mnemonics devices. Mnemonics device could be in the form of acronyms, abbreviations, songs, or rhymes. According to Legg and Cafasso (2018), Mnemonics have been tested since the 1960s as an effective strategy for students' learning. In this relation, Onen and Kocak (2011), explain that this method involves encoding and encrypting system. For instance, in "Electrolysis and Redox reaction", student could easily remember the charges on the electrodes using "PANIC" (Positive Anode, Negative Is Cathode); "CAP" (Cations Are Positive), "AA" (Anions migrate to Anode); "CC" (Cations migrate to Cathode); "Oxidation=+ON+O-H-E"(Oxidation can be defined as increase in Oxidation Number, addition of Oxygen, removal of hydrogen and the process of electron loss).

Technically, memory is a skill which is an integral part of who the learners are. Just like any other skills, it can be improved with practices. According to Legg and Cafasso (2018), the scientific study of how human brains amazing capacity to change and grow new neural connections on daily basis is called neuroplasticity. Research on neuroplasticity have shown that human memory capacity is not fixed even at old age but rather malleable like plastic. Medically, Legg and Cafasso (2018) stress further that, apart from meditation, using all senses, sleeping, and eating well, managing stress, grouping learning information, exercise and socializing, acronyms, abbreviations, and Mnemonics have great ability to strengthen human memory capacity. The learners' memory capacities predict their learning retention capacity, academic performance, and the type of struggles they are likely to encounter while learning

multidimensional subjects of the chemistry category. As a result of this, the essence of memory improvement is to increase learners' memory retention capacities and academic performances. Retention capacity has to do with the learners' ability to remember and retrieve the information they have received over time. However, the primary aim of bringing mnemonics devices such as abbreviation, encryption, diagram, and music into chemistry teaching is to improve the students' interest, classroom participation, learning retention capacity and academic performance.

The concept of mindfulness has gained universal attention recently as a way of lessening students' stress and anxiety to enable them focus attention mainly on their study. According to Holly (2020), mindfulness can be expressed as an act of paying attention to purpose in the present moment without judgment. In relation to this, Gerritsen and Band (2018), explained further that mindfulness practice provides a break from the constant stream of thoughts and worries about the past or future. Mindfulness gives a break from unfavorable thoughts, allowing the students to be gentle, relaxed and show compassion to self and others. Mindfulness teaches that emotions are temporary feelings that will surely come to end. Nevertheless, despite knowing that thoughts about the past or future can be stressful in nature, yet students cannot stop thinking about their past results and the implication of graduating with a bad grade or becoming a school dropout on their future due to unemployment scenario and bad shape of the economy.

In the recent decade, Miller, Borsatto and Al-Salom (2019), explained that mindfulness is increasingly popular in education system leading to creating its centers in Colleges and Universities because there are evidence that it improves learning and the test scores. In this relation, Passmore (2019) emphasizes that there is a growing body of research showing positive effects of mindfulness practices. This author explained further that mindfulness is beneficial to learning in the Colleges environment because of its ability to; improves students' attention span, manage stress and emotion, improve resilience and ability to self-regulate, encourage self-reflection, decreases depression, and improve both students and teacher communication skills. It is hereby very clear, that the use of Mnemonics in the teaching and learning of chemistry has similar benefits with mindfulness. And so, it could be a good compliment or catalyst to mindfulness practices for schools and colleges. Thus, the use of codes in chemistry teaching and learning could be seen as an extension or a systematic integration of mindfulness practices into the classroom settings. However, the use of codes in chemistry teaching for the purpose of mindfulness could be achieved by makes it a component of or an independent teaching method.

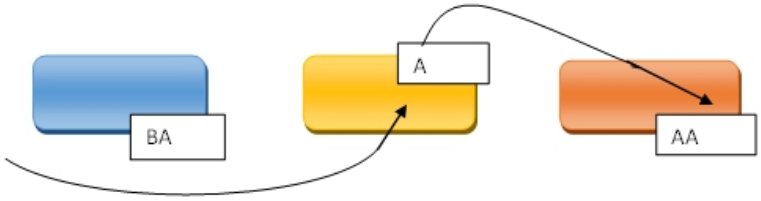
Theoretical Framework

Theoretically, Kay and Kibble (2016) asserted that changes in educational research have increased the need to understand and apply learning theories to teaching, research and practices. Hence, *The Victor' Theory of Academic Class Struggle (VTACS)* is considered central to discussion of students' academic struggles in secondary schools. This theory assumed that students generally belong to one of the three performance classes, vis-à-vis Below Average (BA), Average (A) and Above Average (AA). The theory assumed that students are in struggle

to sustain their present classes and gather momentum for migration into the higher classes. The theory also assumed that the over-zealous struggle to jump a class during the migration process is responsible for many uncommon students' challenges which are either academic, health, immoral or emotional crisis witnessing among the students.

By implication, the Victor's Theory of Academic Class Struggle account for the primary source of academic struggles witnessing among the students which are causing lack of mindfulness. The theory believes that since Mnemonics Instructional strategy has the ability to improve students' academic achievement and induce high level of Memory retention, it will enhance students' mindfulness potential. In a recent empirical study conducted on Chemistry Education students in a university using Mnemonics-enhance tutorial method, it was found that over 50% of the students on probation in their first year in the University escaped from dropout syndrome and have their Mindfulness potentials increased significantly (Babalola, 2023)

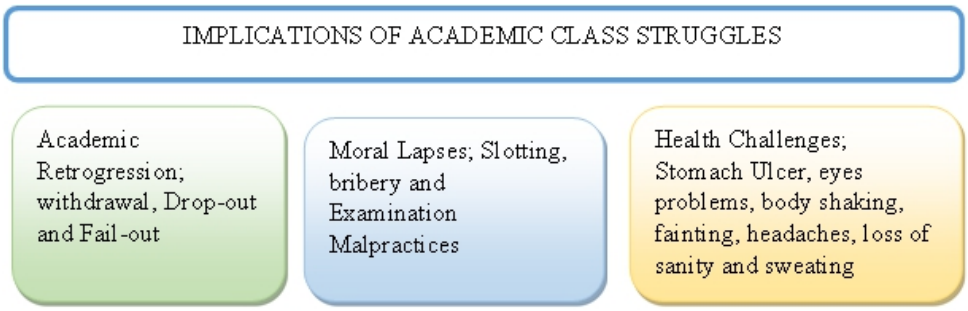
Figure1: Model of Victors' Theory of Academic Class Struggle



Source: The Authors

Normally, low performing students are expected to move gradually from BA to A and finally to AA. However, there are many students who deemed it possible to achieve overlapping migration from BA directly to AA without a rest on "A", as seen in fig.1, it is a very dangerous game called the over-zealous struggle. Therefore, a critical analysis of the educational challenges under investigation shows that the problems vary across the students' academic classes.

Figure 2: Implications of over-zealous Academic Class struggles among Chemistry students



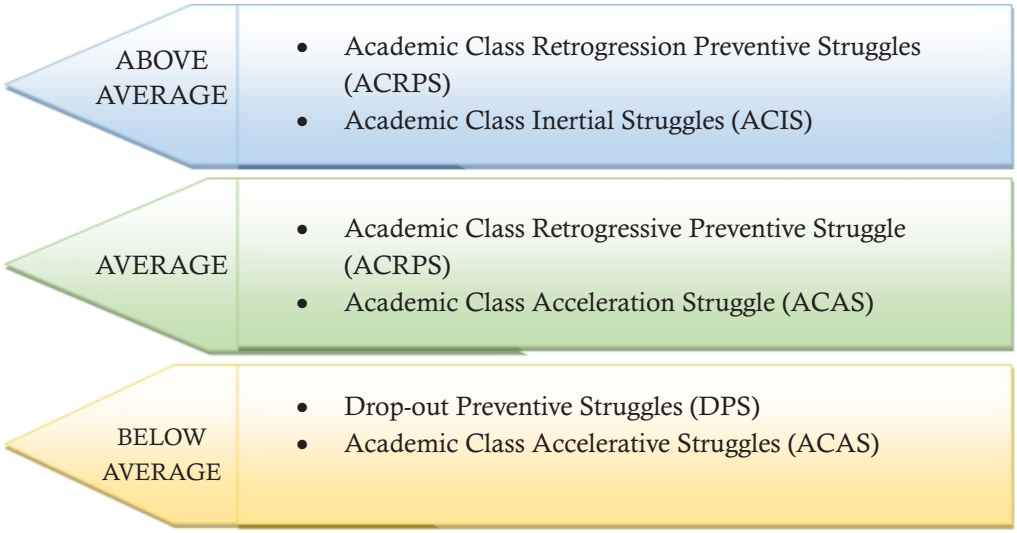
Source: The Authors.

The numerous repercussions of academic class struggle among chemistry students are group as;

Academic Consequences

Apart from poor memory retention, lack of interest and bad perception, the major academic implication is called Academic Class Retrogression (ACR). This is a situation whereby the students' Academic performances went down the drain from AA to BA. These include; the normal and the disastrous ACR. Normal type is a situation whereby the students' academic performances went down gradually from AA to A and finally to BA while the disastrous type is a critical situation in which students' performances accidentally went down from AA to BA. This is the most terrible implications of ACR to cope with for students, since it often led to students 'dropout or fail-out which is a critical wastage in Education (Babalola, 2014).

Fig.3: Model of Academic Retrogression versus Acceleration Struggles (MAR vs AS)



Source: Emphasis is mine; Babalola (2020)

No matter the types of ACR the students involve cannot be okay due to the thought of stigmatizations associated with school drop-outs. So, in order to avoid being school drop-out, they tend to find themselves into struggles such as;

1. **ACR Preventive Struggle (ACRPS):** As shown in fig2, students in "BA" and "A" involves in two types of academic class struggles one of which is the ACRPS.
2. **Drop-out Preventive Struggle (DPS):** This is a common type of struggle among the "BA" students including those in the probation category in tertiary institutions.
3. **Academic Class Accelerative Struggle (ACAS)***:* This is common with students in "BA" and "A" who are usually in a struggle to migrate to "A" and "AA" respectively.
4. **Academic Class Inertial Struggle (ACIS):** This can also be referred to as retrogression preventive struggle. It is common among the "AA" students who are in struggle to maintain their academic classes.

Health Consequences

Health is wealth. It is the state of mental, physical, and social well-being of an organism like students and teachers not merely, the absence of illness or infirmity. The over-zealous struggle coupled with poverty and epileptic power supply has prompted many students to forget eating while reading causing them hunger induced stomach Ulcer. Similarly, many students have turned to drug addicts as a sleeping prevention strategy to enable them read at night. When drug abuse is combined with sleepless nights, this may cause temporary or permanent loss of sanity. Other health implications observed among the students include signs of anxiety such as examination tension, crying or fainting in the examination hall and hand vibration and sweating profusely.

Emotional Consequences

As reported by Holly (2020), despite the improved understanding of the human brain, mental health among students in schools and universities is a major concern. Therefore, encountering Students that are experiencing high levels of stress and anxiety is a common occurrence for many chemistry teachers. Holly, (2020) stress further that many instructors themselves might have learned chemistry in environments emphasized not on the importance of well-being for effective learning. So, they are likely to be overlooking the impact that emotional issues have on learning. Therefore, whenever students are experiencing ACR, they tend to be emotionally disturbed especially if it is a disastrous type. They are likely to experience inferiority complex, phobia and emotional stress, loss of memory, sleeplessness, and fainting in the examination hall. These are usually the precursors of many mistakes such as; omission of words, wrong spellings, wrong sentences' construction and examination mal-practices usually witnessed by many students during the tests and examinations. At the long run, if this situation is not properly managed, it may lead to poor performance and finally, school dropouts. In this relation, David and Charles (2018) explain that Chemistry, being a subject that most students are afraid of, requires the teachers to use appropriate teaching ingredients that will arouse the students' interest and encourage them to develop positive attitude towards learning. This presents a rationale for the proposition of teaching chemistry with codes such as abbreviation and Mnemonics.

Moral Consequences

Some students, at this level came up with an immoral ideology which states that "use what you have to get what you want". In this framework, low performing students perpetrate slotting with brilliant students or teachers. This category of students are usually found sitting closer to their brilliant counterparts during tests and examinations to copy. Oral interviews with few students in this regard shows that many students call this nefarious act "trade by batter" and teachers who failed to cooperate may be blackmailed if careless. *Therefore, this moral decadence among the students is motivated by the fear of drop-outs and that of uncertainty in the future labor markets. Thus, all students are in struggle to move from lower to higher academic class.*

Mnemonics Instructional Strategy (MIS)

This is a situation where the mnemonics devices (code of knowledge) such as abbreviation, rhymes, images, and other familiar dates are used by the teacher during the preparation and

dissemination of information to students in a logical and understandable manner. However, we should not forget that no single teaching method could be used to teach all aspects of chemistry due to its multidimensional structure. This is one of many reasons Science education scholars encourage science teachers to be more innovative and creative in the use teaching strategies. Adzape (2015) emphasizes in this regards that teaching and learning of chemistry was too teacher-centered; the teachers usually dominate the explanation of concepts, thereby making students the passive recipient in the classroom. However, mnemonics instructional strategy is very much unique as it could be used either as teacher centered or learner centered which is an indication of its suitability for the teaching of both children and adults. Based on this proposition,

Mnemonics instructional strategy is also unique in handling a multidimensional subject like chemistry including remembering important dates by associating such date with an unforgettable date such as ones birthday, independent day, children day among others by means of plus or minus. It can also be used to solve calculations involving formula like that of Electrolysis. Take for instance, M=MrIt/ef=MrQ/efwhere; M= Mass of the substance deposited in the electrolytes; Mr=Relative molecular mass of the electrolyte; Q= Quantity of electricity passed through the electrolyte; I= current passed through the electrolyte; t=time in seconds; e=charge/oxidation number on the deposited metal ion and finally, F=Faraday Constant. This is an almighty formula capable of solving most calculations in Chemical Electrolysis. Also, CAP could mean "Cations are positive". If Cations are positive, "Anions must be negative". Therefore, in an Electrolytic Cell, AA means "Anions migrate to Anode" and CC Means "Cations migrate to Cathode". If cations which are positively charged migrate to Cathode, it means Cathodes must be a negative Electrode. If Cathode is a negative electrode, Anode must be a Positive electrode. If anode is a positive electrode in an electrolytic cell, it means electrons flow from the Anode through the connected wires through the Cathode into the electrolyte to complete the electric circuit.

Mnemonics devices keep students in suspense in the classroom; thereby sustaining their attention and interest throughout the teaching period. The students dislike losing attention due to the enthusiasm in knowing the study content attached new mnemonics. Mnemonics devices are very suitable where chemistry and English language concepts are to be remembered serially. The teacher, during the preparatory section of the class must be creative enough to fabricate interesting and funny codes which could be used to explain and to ensure students' retention. According to Babalola and Abdullahi (2016), the following are the advantages of Mnemonics.

1. The method helps the students to develop interest in classroom attendance, participation and prevent school absenteeism among the students.
2. It gives students enough confidence to face examinations without malpractices or phobia.
3. It involves the use of senses and improves memory retention capacity and academic performance, especially if funny codes are use.
4. It is very flexible enough to be used as a teaching method, learning method, teacher-centered, learner-centered or mixed-centered.

5. The method helps low performing students to prevent over-reliance on fellow brilliant students or teachers which often leads to diverse immoral repercussions.
6. It makes the class interesting and promotes creativity among the learners.

This is when codes/mnemonics are used by the students while preparing for examination or during independent learning in the absence of the teacher. The students try to convert difficult areas of their study into interesting, funny and unforgettable codes, which could be the names of objects, fruits, village, country and others. Whenever students successfully coded large area of their learning content, they become computer and gain special confidence to face any examination in that area covered without anxiety. This often relieves them from emotional stress.

Conclusion

The ideology that is behind this study is that chemistry students generally are in different academic classes such as above average, average and below average and as well going through different struggles. The essence of the struggle is either to sustain their present Academic classes or to migrate into a higher class which often manifested informs of anxieties and its related challenges. Therefore, the chemistry teaching community should be concerned with the challenges affecting the students' academic performances. They are expected to be approachable, intelligent, and creative and well committed to researching into the student learning challenges. Observations have shown the struggles result into many more challenges such as anxieties, low memory capacities, low retention capacity, eyes defect and poor academic performances. The quintessence of this research is not to mock the learners but to create awareness and provide solutions to these challenges as much as possible. In this regard, the use of codes such as abbreviations and Mnemonics has been extensively discussed as a memory coping strategy which could be used as a complement or catalyst to mindfulness which has been considered effective for learners' coping skills. However, the use of these codes has been used to form a teaching and learning method called Mnemonics instructional Strategy. The method is anchored on the use of association strategies in the encoding process such as Mnemonics which has been tested empirically by many scholars and found to be effective in improving students' test scores.

Suggestions for Improvement of Chemistry Teaching and Learning

1. Chemistry teachers should learn to use mnemonics devices while teaching chemistry to ease the stress and anxiety of students experiencing different types of academic struggles.
2. Teachers working with students' results should refer students with disastrous academic retrogression to professional counselor who will guide them on the use of mnemonics.
3. The school Administrators should make Counseling services available in their schools and ensure the in-service training and cross-fertilization of ideas of its staff members.
4. The school counselors should encourage the students that are experiencing academic class struggles to employ mnemonics devices in their learning strategies to reduce their test anxiety and examination tensions.

5. Chemistry and English language text-book authors are encouraged to utilize more mnemonics devices in the description of concepts in their textbooks to help improve the students' mindfulness, retention and academic performance.

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