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Effects of Electronic Dance Music on Academic Performance among Medical Students: A Narrative Review

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ABSTRACT

Music always influences how a person thinks and communicates with others. Research on the relationship between music and education has been growing for several years. Some scholars suggest that listening to music may improve cognitive capabilities, while others believe that it may slow down complicated brain processes. Electronic dance music (EDM) is a subgenre of electronic music originally composed for use in bars, clubs and other venues that include dance-based amusement. Some scholars argue that EDM is a music style that benefits our brain activities, particularly their cognitive aspects. However, the use of EDM to enhance academic performance among students is still not widely practised globally. Furthermore, research on EDM usage among medical students is rarely conducted. Hence, this study aims to investigate EDM as a learning tool and discover whether it is helpful in improving medical students' academic achievement and overall growth. The study consists of a narrative review conducted according to the Scale for the Assessment of Narrative Review Articles (SANRA). Literature searches were performed in the databases of PubMed, ResearchGate, ScienceDirect and Google Scholar for the period between September 2012 and November 2022. The review revealed limited research on the use of EDM as an instrument to enhance academic performance among medical students. However, existing studies suggest that EDM may have cognitive benefits and positively influence brain activities, particularly in the cognitive domain. Although EDM is commonly associated with leisure and entertainment settings, its potential for learning remains underexplored in the context of medical education.

Keywords: *Electronic dance music, Academic performance, Students*

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INTRODUCTION

The musical genre known as electronic dance music (EDM) is an intriguing one, and this holds regardless of whether you are an enthusiastic listener or someone who is just starting to wonder what this genre is. Dancing and listening to EDM can bring considerable enjoyment due to the rhythms that are easy to remember and the sound embellishments that go well with them. However, the genre is an unexplored realm for many.

So, what is EDM? "Electronic dance music" is a broad definition coined in the early 1970s. It is an umbrella term that incorporates a wide range of comparable (but not equivalent) electronic dance subgenres. House, techno, trance, and drum and bass music are some of the most prominent types of EDM. Trap, breakbeat, dubstep, hardstyle, and garage are a few subgenres that fall under this larger category. An EDM song usually features a repeated percussion loop, and it will generally have a melody performed on a synthesiser that is layered on top of the drumming. Americans first used the term EDM in the early 1970s to refer to various popular-sounding electro-dance genres that are often performed at big festivals.

The impact of listening to EDM while studying medical subjects has become a hot topic. The authors aim to explore the beneficial effects of listening to this musical genre on medical students' learning processes. The authors also wish to determine how EDM can assist students in improving their cognitive functions and strengthening their academic effectiveness. The purpose of this study is to discuss the influence EDM has on the curricular activities that students participate in and discover whether this influence is advantageous to students' academic achievements.

INTRODUCTION OF EDM

Where did EDM come from? The early 1970s saw the birth of EDM in New York. At the time, this genre mostly took the form of disco and hip-hop music. In 1972, the Japanese electronics firm Roland made its debut in the industry with innovations that musical artists used to explore. In 1977, Donna Summer's disco smash hit "I Feel Love" introduced EDM to a wider audience for the first time. Giorgio Moroder, a disco music performer, was probably the earliest progenitor of mainstream dance music. The electronic compositions of Kraftwerk and Yellow Magic Orchestra are further instances of early works in the EDM genre. These musicians were active in the latter half of the 1970s, which was a time when disco music was on the cusp of experiencing a precipitous decrease in popularity. The early 1980s were a moment of musical exploration for individuals trying to develop new dance music after disco had almost died out. The increased use of synthesisers and drum tracks eventually led to the development of the many EDM subgenres that we are familiar with today.

What are the genres of EDM? EDM encompasses a wide variety of musical styles. However, the following are the three primary subgenres that makeup EDM:

1. House music: This kind of music is characterised by having percussion played at a medium pace, many hi-hats that shuffle, jazzy keyboards, and sounds from the tropics such as congas, timbales, and horns. House music emits a cozy mood and typically contributes to a more upbeat and happier atmosphere in the space.

2. Techno music: The direct opposite of the warm house music that was just addressed is techno, which some have described as cold or mechanical. A significant portion of the time, it aims to convey a sense of the future while also including a wide variety of strange sounds.

3. Trance music: As one would expect from the name of the musical genre, trance is a mesmerising kind of music. The emphasis is placed squarely on the song's development from beginning to end, with the melody serving as the primary focal point.

EDM has a unique composition of music, ranging from the minimalist rhythms of half-time dubstep to the repeated and hypnotising phrases of trance. The existence of regular beats that drive a sustained pulse in the music is one of the defining characteristics of EDM. This type of music is typically characterised by a 4/4 rhythm, a regular and symmetrical steady pulse resting customarily somewhere around 120 to 180 beats per minute (BPM) (1). The existence of repetitive beats is through the layering of different tracks of music, creating a multi-dimensional auditory experience. The "break routine" seen in EDM (shown in Figures 1 and 2), which is a rapid and significant reduction accompanied by an increase in the track's intensity, is largely responsible for the genre's meteoric rise in popularity among music fans, experienced as musical peaks also known as the "drop", which elicits pleasurable peak experiences among listeners (2, 3). The "velocity" of a musical piece is expressed as its tempo, which is described in BPM. The pace of EDM is often rapid, ranging anywhere from 120 to 160 BPM. EDM has developed into its unique cultural subgenre in recent years, one that is now backed by an institutional infrastructure that includes record labels, booking agencies, party organisers, disc jockeys (DJs), managers, festivals, and publications.

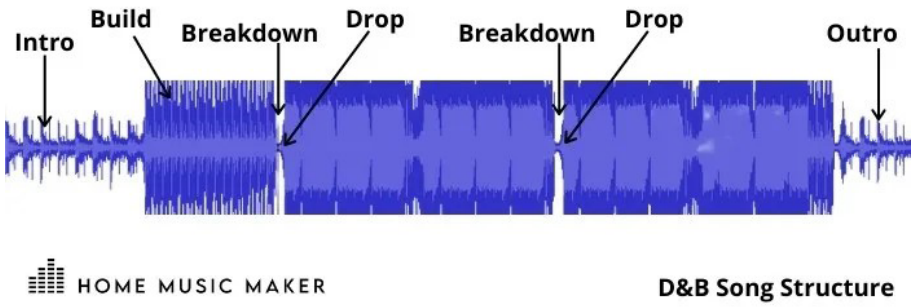

Figure 1: Visual representation of a break routine consisting of the musical passages' breakdown, build-up and drop (2).

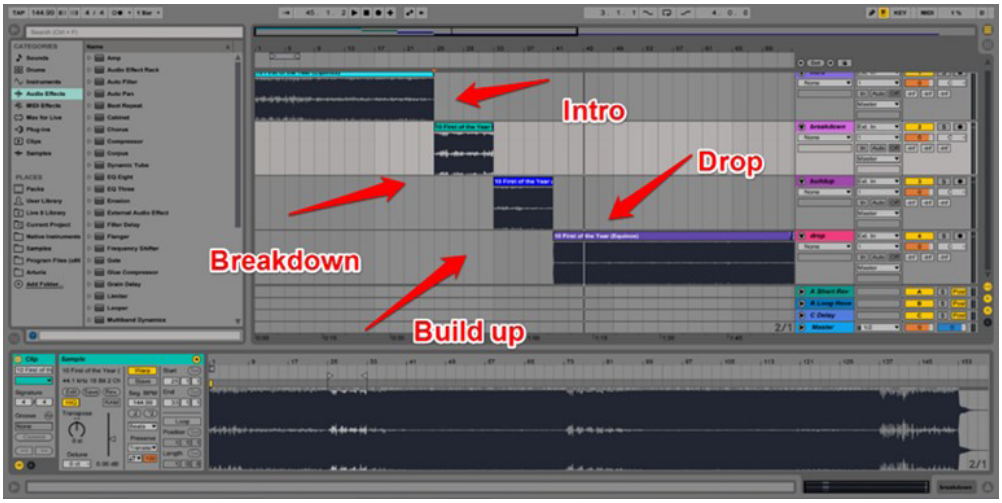

Figure 2: The composition of a typical EDM that consists of a break routine, which can be further divided into several musical passages: breakdown, build-up, and drop (3).

INTRODUCTION OF THE MOZART EFFECT

The practice of playing music in the background has been the subject of research for a considerable time. The primary foci of these investigations have been determining whether two competing hypotheses are correct: does music listening whilst studying hinder or enhance the learning process? In today's day and age, when so many technological advancements surround us, it is not uncommon for students to play music while doing their schoolwork. This tendency raises the issue of how listening to music influences one's ability to concentrate and perform when studying. Listening to classical music, such as that composed by Mozart, has been shown to raise a person's intellectual quotient (IQ), specifically in spatial thinking. This phenomenon is known as the "Mozart effect" (4). In 1993, Rauscher et al. (5) proposed a theory that the neurons in the brain fire in a precise sequence that may be influenced by certain frequencies, such as those seen in Mozart's music. The University of Windsor in Canada conducted a study to validate the benefit of listening to music, and their findings indicated that it had a beneficial influence on job performance (6). This study involved 56 software developers working for various software companies in Canada. The results, which were gleaned from the participants' narrative responses, demonstrated the importance of listening to music while working to facilitate positive mood shifts and improved perceptions of design (6). The writers also concluded that the quality-of-work and affect were at its lowest when music is not available, but this was compensated with a higher time-on-task when music was not played. The fact that there is a favourable association between music and IQ and job performance has sparked the question of whether playing music whilst studying is advantageous. This happens because the so-called Mozart effect only displays a favourable influence when listening to songs before taking a test rather than completing the exam itself, similar to how athletes listen to music prior to engaging in their respective sports (1, 2).

The term Mozart effect initially refers to the phenomenon in which college students experience a brief improvement in their spatial-temporal abilities and skills after listening to a Mozart piano sonata. This phenomenon has gained widespread popularity (6, 7). As time progressed, a large number of studies were released that conflated it with the Mozart effect. This collection of individual research papers supports or elaborates further on the impacts of music teaching that music is a solid foundation and operates as a core cognitive function (8). Separate researchers carried out these investigations. The Mozart effect is perhaps most efficacious and most proactive during neuronal development, precisely in the hippocampus, in which spatial reasoning is the most active, as shown in a previous study that was conducted in Korea and analysed the effect that music has on a person's ability to learn about space through spatial learning (9). Classical music listening may assist students in doing better on standardised tests, as shown by several studies (9). This theory is being used as a tool to determine how applicable EDM is, as well as how beneficial and effective it is in the process of learning for students, and how it can assist them in enhancing and strengthening their cognitive skills and functioning of the brain on their educational outcomes.

Medical education is a rigorous and demanding journey that requires immense dedication, concentration, and focus. As future healthcare professionals, medical students are entrusted with the responsibility of acquiring vast amounts of knowledge and developing critical thinking skills to provide the best possible patient care. However, the academic journey of medical students is often fraught with challenges that can adversely impact their performance and well-being. One such challenge is the influence of external factors on their learning environment, including the pervasive presence of music, particularly EDM. EDM has gained immense popularity worldwide, characterised by its pulsating beats, energetic

rhythms, and infectious melodies. It has become an integral part of contemporary culture, permeating various aspects of daily life. Medical students, like individuals from other fields, often turn to music as a means of relaxation, stress relief, and motivation. However, the impact of EDM on academic performance remains a subject of debate and inquiry.

One of the primary concerns associated with the influence of EDM on academic performance is its potential to act as a distraction. Medical students require a high level of concentration to comprehend complex concepts, engage in critical thinking, and retain information effectively. However, the energetic and immersive nature of EDM may divert their attention away from studying, hindering their ability to concentrate on the task at hand. Another critical aspect of academic performance is the ability to retain and recall information accurately. Medical education involves a vast amount of information that students need to internalise and apply during examinations and clinical practice. However, the impact of EDM on memory and information retention remains unclear. It is essential to explore whether exposure to EDM enhances or hampers students' ability to retain and recall crucial medical knowledge. The cognitive load theory suggests that cognitive resources are limited and can be overloaded by external stimuli (10). EDM's dynamic nature, combined with its strong rhythmic patterns and pulsating beats, might overload the cognitive systems of medical students. This potential overload can affect their working memory, information processing, and overall academic performance. Lastly, music has a profound impact on human emotions and can significantly influence motivation levels. EDM, with its uplifting and energetic nature, may enhance positive emotions and motivation among medical students. Conversely, it could also lead to emotional exhaustion and fatigue if used excessively or inappropriately. Understanding the relationship between EDM and emotional states is crucial for determining its impact on academic performance.

As we delve into the effects of EDM on academic performance among medical students, it is essential to consider the parallels with the Mozart effect. The Mozart effect suggests that specific frequencies present in classical music, such as Mozart's compositions, can influence neuronal firing sequences in the brain, particularly in the hippocampus, where spatial reasoning is most active (4). This concept has been associated with enhanced performance on standardised tests. Thus, we aim to determine the applicability, benefits, and effectiveness of EDM in the learning process for medical students, examining its potential to enhance cognitive skills and educational outcomes.

By combining the exploration of EDM's influence on academic performance and the insights from the Mozart effect, this narrative review seeks to provide a comprehensive understanding of how music, specifically EDM, affects the learning process and academic achievements of medical students.

METHODS

This narrative review draws upon research in the field of music and academic performance. Eligible study characteristics were: (1) noninterventional and interventional studies involving music and academic performance; and (2) conducted among children and adults regardless of ethnicities, cultural backgrounds, and nationalities. Meanwhile, the eligible report characteristics were: (1) published in English; (2) publication range from September 2012 to November 2022; and (3) published articles, review papers and meta-analysis. Validation studies, dissertations, theses, conference abstracts, monographs, commentaries, and brief reports were excluded to narrow down the search category.

First, in the literature search, PubMed, EBSCOhost, ScienceDirect, and Google Scholar search engines were used to retrieve relevant articles. The Boolean term "electronic dance music" AND ("academic performance" OR "student" OR "medical") was applied throughout the databases. PubMed produced 69 results, EBSCOhost produced 525 results, ScienceDirect produced 88 results, and Google Scholar produced 4,640 results.

Figure 3 illustrates the flow diagram of the search methodology. The search results were screened, and duplicates were removed, leaving a total of 4,232 articles. After reading the title, 2,853 articles were found to be relevant to the purpose of this study; 2,203 articles were removed during the abstract reading as the articles did not illustrate the correlation with this study. Afterwards, a full copy of 1,658 articles that met the initial screening criteria were selected to proceed to the reading stage. Fifty-four articles were excluded due to its availability and 1,083 articles were read thoroughly by the authors. After full reading, only 47 articles were included in the final writings.

The narrative review writings follow the six elements listed in the Scale for the Assessment of Narrative Review Articles (SANRA) (11). The findings are shown in Figure 3.

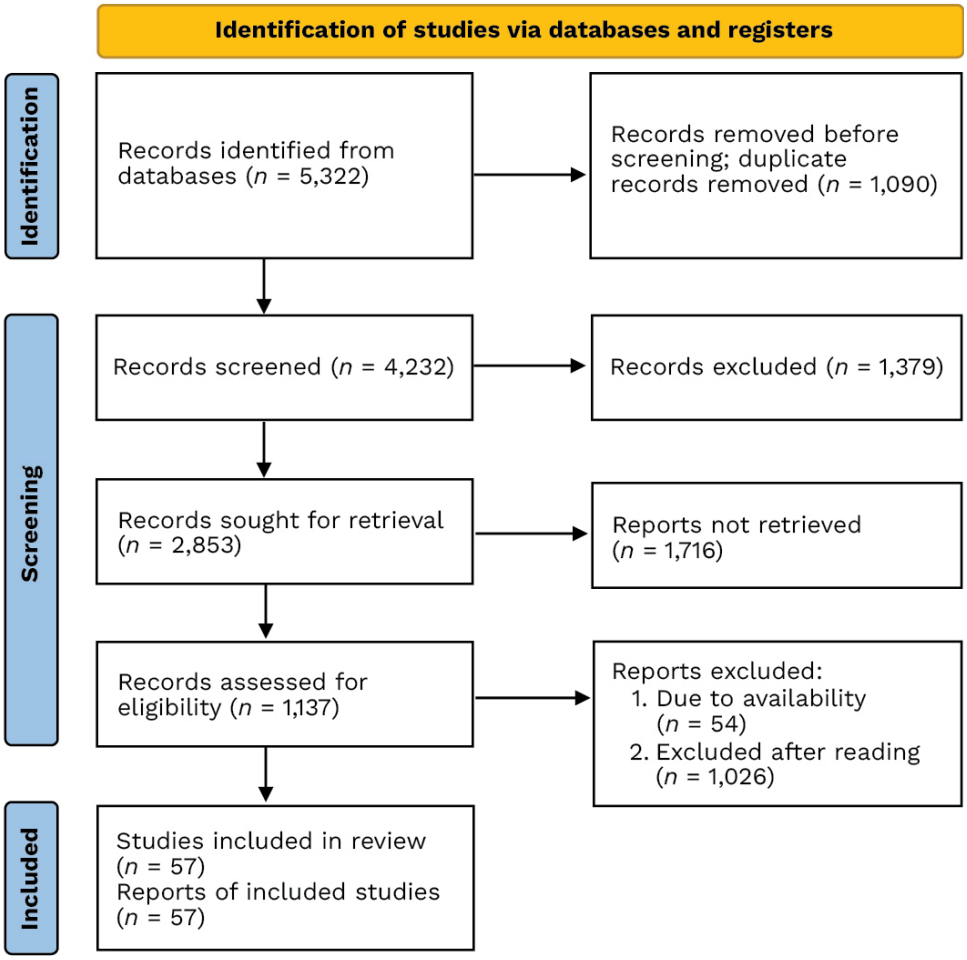

Figure 3: Flow diagram of the search methodology.

RESULTS

Evidence of the Effect of Listening to Music on Cognitive and Academic Performances

A previous cross-sectional study involved 200 Malaysian learners studying Bachelor of Medicine and Bachelor of Surgery (MBBS) in India; the participants represented three major ethnicities, namely Malay, Chinese and Indian. The study investigated the impact of music listening on concentration and academic performance, specifically the benefits of the Mozart effect when one listens to music while performing a test (4). Of the 200 students, 120 preferred to play music while studying, while the other 80 did not. The results of this study showed a much greater occurrence (75%) of correct responses when the participants were listening to music. Another study, conducted in 2002, investigated how listening to soothing music affected the mathematical and memorisation skills of students ranging in age from 10 to 12 years old (5). The findings indicated that the participants performed better in terms of both skills when they were in a condition characterised by soothing music as opposed to no music.

Research concentrating on EDM situations is still uncommon, despite the growing body of literature that indicates the positive effects that participating in musical activities may have on a person's psychological well-being (12). Students enjoy listening to a certain kind of music as they do their schoolwork, but many are unaware of the negative impact that this habit might have on their academic performance. When one is presented with a mentally taxing activity, a certain genre of music can have the effect of making the activity more difficult to understand. This may be because considerably fewer cognitive resources are available when the perception gets to the lyrical content, emotional responses, and remembrances, whereby certain music can contribute throughout the reading or study process, distracting and influencing the attention span and ability to focus (5).

Recent studies have focused on the question of whether the presence of background music of various genres affects the fundamental cognitive functions involved in learning (13). Music may be beneficial to certain people during their performances, even though it may also be a source of distraction for others. A recent article explored the potential for various genres of music to mask outside noise and boost productivity as part of research conducted in an office setting (14). The authors began by investigating how performance might be negatively impacted by ambient noise in the workplace and how performance can be improved by playing music. The participants were given a series of numbers to memorise and then remember, first in complete quiet, then while listening to continuous music, and finally while listening to average office noise. It was discovered that the typical background noise of an office considerably impaired digital memory.

On the other hand, it was proven that listening to continuous music could mitigate the negative impact that workplace noise had on people's ability to remember digits (13). Concerning the learning process, de Groot conducted research to evaluate the capacity and rate of picking up a language in either the presence or absence of background music (14). Music and quietness were the two environmental settings to which each of the 36 participants at the University of Amsterdam was randomly allocated. All the respondents were enrolled in their first year of studying psychology at the university. After that, they were instructed in several words in a foreign language while either listening to music or remaining silent. After the respondents had finished all three word-learning sessions, they

were given a reassessment of the language components that they had studied one week later. Interestingly, the respondents acquired new vocabulary in a foreign language better when music played in the background rather than when there was complete stillness (14).

In addition to positively affecting academic performance, music can also be used as a pre-revision motivator by converting students' intentions into action. According to a study, when young tennis players listened to music before a match, they reported higher arousal levels and a more pleasant mood (15). Music is often used in interpersonal and social contexts to produce various physiological states, which suggests that it is a precursor to obtaining a desired condition. As a result, music, especially EDM with beats and drops, can produce a more enjoyable physiological state of mind geared towards revision and study. Thus, EDM can be a motivating factor to bridge the gap between intention and action. This is crucial for students to have the self-determination and motivation necessary to start their difficult revision tasks. It has also been proven that music can cause behavioural changes in brain activity which can lead to increased studying/revision adherence and involvement. These effects are similar to those of the pomodoro technique developed by Francesco Cirillo. This technique was named after the tomato-shaped timer (pomodoro means tomato in Italian) that Cirillo used to divide his work and break time into 25-minute and 5-minute stints, respectively (16). Recently, this technique has gained popularity because it allows individuals to break large tasks into small ones with minimal interruption (17). After each pomodoro cycle, one will indirectly sense a feeling of accomplishment and gain more motivation. Therefore, EDM can be used as pre-revision music to boost students' motivation and achieve the target academic performance as well as an effective on-task background music to plan in advance the time frame for studying.

Researchers from McGill University proved that up-tempo, fast-beat music could make people recall exciting and happy memories. Evidence also showed that fast-paced music evoked the most pleasant emotion, making listeners more optimistic and enthusiastic about upcoming studying/revision. The students described many positive emotional experiences as being induced by the music during the research (e.g., enjoyment, alertness, confidence, and relaxation) (18), and positive emotional states like happiness and excitement were found to be more closely associated with concentration than anger, anxiety, and dejection. Hence, EDM, with its characteristic fast tempo and strong beats, which elicit excitement, can be the music to listen to before commencing a self-study or group study in medicine.

Music is often thought of as a positive emotion generator. When students try to study, listening to music that puts them in a good mood will help them concentrate better. Emeka Anyanwu (18) discussed the beneficial correlation between listening to music playing in the background and gaining knowledge from the experimental apparatus used in the dissection laboratory. Anyanwu expects that students would experience much lower stress levels due to listening to background music, which is shown by significantly increased cognitive test performance in participants exposed to background music compared to those without (19).

Rationale of the Practice among Medical Students

Medical students spend a significant amount of time studying, and their choice of study environment varies widely. Many students find it helpful to have background noise, such as music or television, while studying (13). Understanding the impact of music on cognitive function is particularly relevant in the context of medical education.

Listening to music, including EDM, has been reported as a means for medical students to relax and de-stress while engaging in challenging academic work (6). Music can alleviate the emotional consequences of stress and anxiety commonly experienced during tasks such as memorising complex medical terminologies or studying intricate physiological mechanisms (e.g., renin-angiotensin-aldosterone system). The popularity of listening to music while studying necessitates a deeper understanding of its impact on cognitive function (6).

Numerous studies have demonstrated the positive effects of music on performance. Research exploring the impact of musical distraction on cognitive tasks has provided evidence supporting the hypothesis that music can improve cognitive function (20). Moreover, listening to music, particularly up-tempo and fast-beat music, has been found to evoke positive emotions, enhance mood, and increase optimism and enthusiasm, which can be conducive to effective studying and academic performance (18).

In summary, while specific research on the effect of EDM on academic performance among medical students is limited, existing studies on music listening and cognitive function provide insights into the potential benefits of music, including EDM, on concentration, emotional states, and cognitive performance. Understanding the impact of EDM on academic performance among medical students can provide valuable insights for both students and educators in optimising study environments and strategies for improved learning outcomes.

DISCUSSION

Factors Modulating the Effect of Music on Academic Performance Among Students

According to several studies, listening to music while studying may harm academic performance. The participants in these studies did less well on a reading comprehension assignment while listening to music. However, some researchers have identified various elements that might modify this impact. For example, a person's working memory capacity (WMC) seems to be a factor (21). People with greater WMC seem less susceptible to the deleterious effects of listening to music, especially EDM, while reading, according to the available evidence. Furthermore, one study has shown that the impact of music is significantly influenced by the listener's personality and, more specifically, by their level of extraversion. Extroverts are not negatively affected by EDM, while introverts' academic performance suffers when this genre is played in the background while they read (22).

The features of the melodies are the second factor that plays a vital role in the way music influences how medical students learn medicine. According to some studies, various musical components might modify this impact. For example, music with lyrics is more distracting than instrumental pieces (23). Vocal music is often claimed to hamper memory performance more than instrumental music (including EDM, which is a sort of electronic instrumental music), particularly when the words of a song are in a language known to the listener (24). Additionally, the degree of difficulty of the music seems to be a key factor. In one study, the participants performed a reading task more effectively when they were exposed to extremely repetitious music with a limited tonal range compared to when they listened to music that was more complex or when there was no music at all (25). In short, EDM is the preferred type of music when it comes to boosting academic performance among medical students. Learners tend not to be distracted from listening to EDM while studying, as this genre consists mostly of electronic instrumental parts rather than lyrics (see Figure 4). EDM is highly associated with repetitive melodies that are suitable for improving learning outcomes.

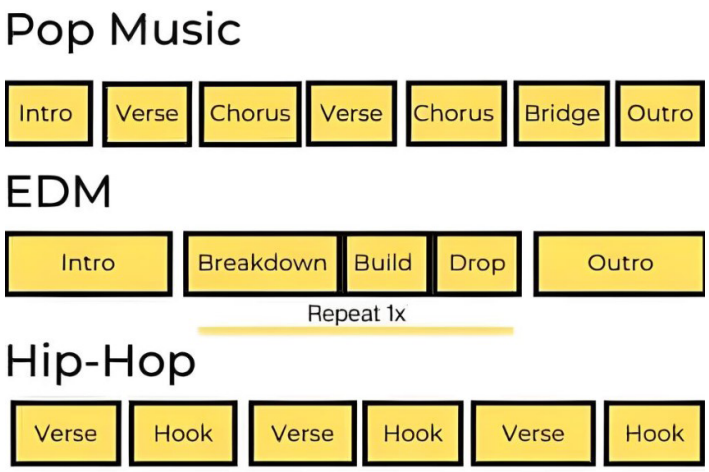

Figure 4: The breakdown-buildup-drop cycle in EDM.

Notes: The figure illustrates the cyclical nature of EDM compositions, involving a breakdown phase with reduced structure, dynamics, and texture, followed by a buildup of musical layers leading to a climax moment known as the "drop". Adapted from Starter (25).

The behaviours of individuals regulate the impact of EDM on cognitive performance, which is the most important aspect of learning medicine for medical students. In the case of associative learning, for instance, the presentation of EDM during the task causes a reduction in performance among individuals who do not typically listen to musical sounds while studying. However, it does not cause a reduction in effectiveness among individuals who are accustomed to listening to songs whilst still studying (26). In addition, while the data are inconsistent, there is evidence to indicate that the age of the participants could play a role in the influence that EDM has on the memory component. For instance, when it comes to associative memory tasks, it has been discovered that young people may benefit from music in addition to listening to songs just before an exam session or revision session. On the other hand, it has been found that only elderly individuals aged 60–75 years old can face harsh music's effects on their associative memory (27). This evidence shows that EDM suits medical students to listen for academic enhancement.

Positive Impacts of EDM on Academic Performance among Medical Students

Many research findings indicate that listening to music may improve memory performance. Positive benefits have been shown with a variety of memory activities, including the acquisition of new words (14), learning of a second language (28), recognition of words and their recall (29), in which they are essential for the improvement of academic performance among students studying medicine. Recent research suggests that the positive impact of music can be linked to the regulation of activity in the prefrontal cortex (PFC). When individuals acquire new information while listening to music, activity in the PFC considerably decreases, indicating a decreased strain on the PFC and, as a result, an enhancement of productivity via music (30).

Studies have been conducted utilising a variety of tasks, including arithmetic, verbal, spatial, and logical reasoning evaluations, as well as assessments of general cognitive capacity and fluid intelligence, to investigate the impact music has on analytical thinking and understanding (24). To conclude, music's impact on activities that need critical thinking and reasoning, the primary components in medicine, is a crucial feature for medical students

to consider while they are studying and revising. Medical students need to rationalise and integrate the anatomical, physiological, biochemical, and sociodemographic to pinpoint the diagnosis of a patient. At the same time, one needs to generate empathic phrases to show their concern during history taking while applying arithmetic calculations upon endorsing medications to the patients.

Attention does not constitute a cognitive activity, but it is considered here simply because it plays an essential part in the proper execution of the activities stated above, which are the common elements in the medicine study (24). A medical student may need long hours of revision and study on a particular topic. Many studies point to music's beneficial impact on attention and focus, such as when participants listened to music while doing tasks that measured selective attention (31) or sustained attention. It would suggest that a listener's particular tastes in music have an additional bearing on the outcome. Therefore, it is important to consider the significance of individual differences and musical features. The existence of music in the background has been shown to have a favourable impact on attentiveness and, as a result, task -productivity. Research team from the National Institutes of Health conducted a study with healthy volunteers to map the brain activity that flows when we learn a new skill, including playing a new song on the piano (32). They also revealed how taking short breaks from practise is a crucial component in the process of learning something new. The study's authors discovered that while the participants were at rest, their brains swiftly and frequently recreated quicker versions of the activity that was seen when they were practising typing a code, as shown in Figure 5 (32). There was a correlation between the number of times a volunteer practised an activity and the improvement in their performance during subsequent practise sessions, which suggests that rest strengthens memory (32).

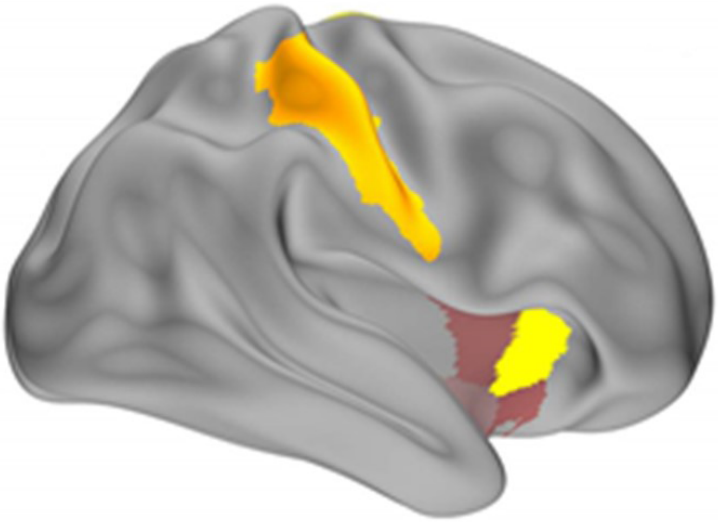

Figure 5: Map of the memory replay activity observed in a study (32).

The interspersal of periods of waking rest with practice is a factor that determines how well one learns. For instance, the spacing effect is the phenomenon in which the memory of a skill is improved when practice sessions are spaced out with rest rather than being performed in rapid succession (33). This makes for a better learning environment. This discovery, which was made for the first time by Ebbington in 1885 (34), has been frequently documented across all cognitive domains (35). The acquisition of new skills also benefits from getting enough sleep and relaxation. Early learning, which is characterised by a period of time in which

performance increases at an exponential rate, is mostly accounted for by micro offline gains that take place between practice periods rather than during the actual practice periods (36). As a result, a sort of wakeful consolidation of ability occurs over significantly shorter periods (i.e., seconds and minutes) than was previously imagined (36). Significantly, this kind of memory consolidation when awake is about four times more powerful than the overnight consolidation that has traditionally been researched. Overnight consolidation needs sleep (37, 38) and is maintained even when the amount of practice experience decreases by 50% (36). Some researchers have studied how the brain links, during waking rest, sequences of discrete motor acts learnt during earlier practice, which results in good consolidation of a skill (39). Hence, playing EDM may be advantageous for medical students who want to improve their academic performance.

Theories Supporting the Positive Effect of EDM on the Academic Performance of Medical Students

It is difficult to explain how music affects cognitive task performance, which refers to academic performance among medical students in this article, because of contradictory data. Theory-driven research is a valuable tool for improving comprehension of this subject. In this section, a few dominant ideas concerning the subject are focused on and an overview of each is offered. Although these ideas have been around for quite some time, they are still widely used to explain the impact of music, including EDM, on learning performance. Individual variations are seen in nearly all the studies on this topic.

Some scholars have proposed that a person's self-concept, specifically their extraversion, might moderate the influence background music has on academic achievement. This interaction is something that Eysenck's theory of personality predicts would occur (40). According to this idea, introverts exhibit greater degrees of physiological arousal in comparison to extroverts. This indicates that introverts demand minimal or no external stimulus to obtain optimum arousal levels and, therefore, maximum cognitive function. As a result, a moderate or strong extrinsic stimulant suc h as EDM should result in lower effectiveness among introverts, while it should have no detrimental influence on the productivity of extroverts.

The cognitive capacity hypothesis (CCH) is another theory regularly used in discussions of background music's impact (41). This hypothesis asserts that a person's cognitive capacity is finite; therefore, task performance is impaired if the cognitive load of a task is more than what the person can handle at any one time. Some studies provide compelling evidence in favour of this theory. For instance, the influence of music on vocabulary acquisition is most damaging when listening to songs with lyrics in a language already known to the listener, as opposed to playing music in a language not known to the listener or listening to silence (24). Listening to the lyrics of a song in a language already known to you may necessitate the same cognitive resources as acquiring new vocabulary (for example, the articulatory loop). This may result in excess processing and a hindrance effect. When listening to lyrics in a language unknown to the listener, the processing load of the work being performed remains largely unaffected, making it less likely that the individual will experience overload. EDM is a good musical medium to achieve this result as it mostly consists of electronic instruments and has few lyrics. Other studies show that individuals with poor WMC are more likely to display a significant hindrance impact from vocal music as opposed to the effect of instrumental music. This illustrates once again that a person's cognitive ability interacts with the influence that music has on learning performance (42). The CCH provides an effective method for explaining various cognitive task performances; this is because the

characterisation of the commodity is generic and may be defined flexibly. The CCH concept can indeed excellently clarify our discovery that people are likely to use music differently based on the task's complexity and type, including reading, writing, memorising, and critical analysis. People may be altering the amount of mental work they must do to an ideal level based on the resources required by each job. This supports the positive impact of EDM as a learning tool for medical students wishing to enhance their academic performance.

The distraction-conflict theory (DCT), which was first presented by Baron (43) and has just recently been embraced, is used to interpret background music's effect on cognitive function (44). The primary theme here is the relationship between the hardness of the assignment and the attention paid to it. The DCT operates on the presumption that a more complicated activity requires a greater allocation of attention to be completed than a simpler task does. In addition, according to this idea, it is easy for someone's mind to roam while doing a straightforward job since not all of one's attentional resources are being used in the activity. Let us imagine that another occurrence might happen simultaneously, including such music, which may compete for the listener's attention. Following the DCT, such a distraction would most likely result in sensory overload while carrying out a complicated activity, leading to a decline in the effectiveness of the work.

Nevertheless, while doing a straightforward activity, a diversionary tactic may improve efficiency by reducing instances of aimless thinking, boredom, and lapses in concentration (45). In other words, music listening may help eliminate distractions to the focus, leading to improved performance on the subject. In support of this notion, a study has shown that the effect of background music is modulated by the difficulty level of the tasks being performed (44). According to that study's findings, one of the most common reasons for listening to EDM whilst also studying was to improve the quality of learning on educational outcomes. On the other hand, the most probable explanation for not listening to music would have been to avoid being distracted from concentration, which appears to reach a consensus well with DCT.

The arousal mood hypothesis (AMH) is the last proposed explanation. The AMH had first been developed as an explanation for the so-called Mozart effect, which refers to an increase in a person's temporally improved spatial IQ performance because of listening to songs composed by Mozart (46). Rauscher and colleagues (5) argued that the music of Mozart is particularly well-suited to activate our brain to carry out the job more effectively. The AMH supplanted this first hypothesis by proposing that music generally affects cognitive function, causing changes in a person's level of arousal and mood (47). To be more precise, listening to enjoyable music would boost performance by elevating one's mood and maximising their arousal level, whilst undesirable music would act against optimal efficiency by lowering degrees of enthusiasm and excitation.

Furthermore, enjoyable music listening with a significant level of stimulation might result in excessive arousal and product degradation. Additional studies substantiated the hypothesis that perhaps the AMH represents the most viable candidate for explaining the Mozart effect (48). Several research demonstrates how the AMH might account for the beneficial benefits of background music; it was discovered that stimulating music listening may increase overall arousal and cognitive performance (48). Scientists first discovered that the most common reason individuals play music as they study is to boost their emotions, which directly supports the AMH. However, increasing focus was another common option, indicating that emotion may not be the only thing that motivates people to employ music as

a learning material while studying. In a nutshell, the AMH provides a rational justification for the beneficial impacts of playing music on cognitive function, such as while studying. This is an important theory to further support the usage of EDM as a musical tool to boost academic performance among medical students in their medical studies.

This study has a few limitations. First, most of the studies discussed here related to classical music rather than EDM. The authors were unable to identify the specific types of EDM that are most suitable for the current objectives. Second, the narrative nature of this study warrants a more quantitative and systematic approach in the future.

As a learning tool, listening to EDM music during study sessions enhances medical students' fundamental cognitive and logical abilities. The current results suggest that listening to music, including EDM, while studying and performing academic tasks can have both positive and negative effects on cognitive and academic performance. While some studies have shown benefits, such as improved concentration, memory and motivation, it is important for students to be aware of potential distractions and the impact of different musical genres. In this domain, the use of music should be modest and tailored to a person's characteristics. One should take note of its positive cognitive feedback and stimulation effect while considering its detrimental impact on attention span and distraction. Additionally, the choice of music should be personalised according to one's character, taste and current mood to avoid producing any unwanted negative effects (49). Overall, a balanced approach to incorporating music in learning environments based on individual preferences and task requirements can help students optimise their cognitive functions and enhance their academic performance. Finally, we hope that this review can help pave the way for future research that deepens our understanding of EDM and its effects on medical students' attention spans, neurological stimulations and academic outcomes.

CONCLUSION

EDM is not only a form of entertainment but also a tool with the potential to improve medical students' academic abilities and performance. This is an entirely untapped field. The current study adds to the small but growing literature that demonstrates how well EDM listening can be transferred to the routine practices of medical students to boost their learning outcomes. This research offers insights into EDM listening and medical students' study and revision using a plan that combines realistic audio-cognitive stimuli and positive cognitive feedback, which is crucial for the scholarly development of these students. It also presents an accessible and efficient method for academic enhancement based on EDM listening. Future studies will compare the efficacy of EDM listening among medical students and learners of other health-related sciences.

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