Innovation and Practice of Music Education Path in Colleges and Universities Under the Popularization of 5g Network

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Research Article

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Abstract

The value of music education in society and culture cannot be overstated. For students with exceptional needs, music education plays a vital role. Student benefits from community-based arts education programmes range from social to academic. The issue is that music education, like other arts programmes, is frequently not taught in special education classrooms. We propose fifth-generation (5G)-based music education for cognitive computing for tailored behavioural intervention utilizing 5G in this article. Cognitive computing is a multidisciplinary sector of study that aims to develop computational designs and decision-making procedures depending on brain neurobiology, cognitive science, and psychology. Cognitive-behavioral techniques aim to change students' perceptions, alter their behaviour, and increase their pain control. Music and other cognitive therapies try to regulate the stress response by effectively mediating emotional responses. These objectives can be met by using behavioural treatments that influence the individual's affective response, which is influenced by prior experiences, prior knowledge, and emotions. The suggested system's performance is evaluated and compared to existing approaches.

I. Introduction

The degree of music education and teaching has been improved by conducting investigation on the curriculum reform of musical education majors in higher normal institutions, which can completely mobilize students' learning enthusiasm and thus better promote the continuous improvement of students' professional standards. Teachers should continue to study effective curriculum reform approaches in integration with particular teaching material as part of their practical research in order to help students build their professional abilities and better ensure that students' professional level improves. Music instruction should be combined with curriculum-setting principles, individualized development under the guidance of general rules, teaching co-construction principles, a focus on developing the students' disciplinary quality, guiding them to generate more appropriate artistic inclination and ability, and finally training students to become high-quality educational talent with comprehensive ability and application level. As a result, in order to continuously form a more complete compulsory course system, teachers must closely integrate students' individual conditions, such as focusing on the systematic construction of students' subject skill courses, and in each semester, it is a must to promote the implementation of various teaching tasks in accordance with the requirements of class hours [1].

People, music, and education are the three most fundamental and significant factors of modern music education. People are the major component of music, and people produce music. Music, as the substance of educational practice for the major body of human actions and also for the existence of art, is a man-made creation, and this quality dictates the quality of music included in the color of human nature. People have a more complete and thorough awareness of the humanity included in music education as a consequence of the continual improvement and advancement of musical culture and musical education. Music is increasingly being recognized as a kind of art and culture [2].
Several domestic college music classrooms are still teacher-centered, with books at the center, and everything in the established order. Most people agree with what the books say: teaching materials in chapter order are the first theoretical knowledge works, memory calculation, from music situation, understand the way to learn the fundamental knowledge of music, the music will miss their learning opportunity, enjoyment, artistic fundamentals in teaching image, not to have reverence in the learning experience of students autonomy and distinguishable character. Furthermore, some of the courses, as well as instructor appreciation, are not organized according to the features of the students and must be adjusted, ignoring students’ weaknesses, even in basic music, blank instilling voices, orchestration, musical form, and professional knowledge method. Many music professors disregard their students’ interests and needs; yet, teachers and students collaborate to allow them to dilute. The educational effect is barely passable in the music classroom teaching subject to lose interest, in awe of lovely music, read fast and without thinking [3].

Hence, this article concentrates on the innovation and practice of the musical education in universities for cognitive computing for personalized behavioral intervention using 5G. The further portion of the article is structured as shown. Part II provides the literature works associated with this paper and the problem statement. Part III explains the flow of the proposed method. Part IV analyzes the performance of the proposed system and compares it with the traditional music education systems. And finally, part V concludes the overall idea of the paper.

II. Related Works

The newest proof on the influence of music interventions on the advancement of primary school-aged students is reviewed by Dumont et al., (2017) [4]. From January 2010 to June 2016, four electronic databases were searched using the key phrases music, musical instructions, musical education, musical lesson, musical training, advancement, kid, students, and pupil. The studies were examined separately by two reviewers to see if they satisfied the stated inclusion criteria. The study structure, technological qualities, intervention elements, outcome parameters, and efficiency were all compared.

Lordier et al., (2019) [5] compared preterm infants to a preterm control group with no prior musical exposures and a complete-term group at 12 and 24 months to see how music hearing in the neonatal intensive care unit (NICU) affected their cognitive and emotional advancement.

Yun et al., (2017) [6] developed a robot system to help youngsters with autism spectrum disorder (ASD) with their behavioural intervention programmes. The discrete trial teaching approach was utilized to create an eight-session intervention programme that concentrated on two core social abilities: eye contact and facial emotion identification. Training element question, identification of human activities, coping-mode choice, and follow-up activity were the four modules in which the robotic interactions took place.

Hayward et al., (2021) [7] reported on the outcomes of teenagers with autism who attained Early and Intensive Behavioral Intervention (EIBI) during their childhood. Nineteen students (sixteen males) who got
two years of EIBI beginning at the age of two years and eleven months were tracked for a mean of 12
years. The participants' cognitive and adaptive standardized values improved substantially over the
course of the EIBI's two years, and these improvements were maintained during the 10-year follow-up.
Between the time of intake and the time of follow-up, participants showed a significant reduction in
autistic symptoms. None of the individuals had obtained any new mental diagnoses or were taking any
psychotropic medication at the time of the follow-up. The results show that the benefits of EIBI treatment
are sustained throughout adolescence.

**Millett and Gooding (2017)** [8] analyzed how successful two distraction-based music therapy strategies
were at lowering preoperative concern in younger pediatric surgical victims and their caretakers. Using a
meta-analytical method, **Geipel et al., (2018)** [9] examined and quantified the impacts of music-dependent
therapies in lowering internalizing indications in children and adults.

According to **Honing et al., (2018)** [10], investigation on the impact of musical education on cognitive
capacities has piqued the scientific community's curiosity. Longitudinal investigation on the benefits of
formal musical education on cognitive sub-functions, however, is relatively uncommon. Executive
processes like planning, working memory, and inhibition appear to be vital candidates for examining a
link between academic accomplishment and musical training.

**Holochwost et al., (2017)** [11] investigated whether musical instruction was associated to enhanced
educational achievement and executive function (EF) behavior. 265 school-aged students were selected
by lottery to engage in an after-school programme, which offered personalized and large-ensemble
orchestral instrumental training. Educational attainment was measured using normalized test values and
grades in English language arts and math from participants' educational details, while EFs were
examined utilizing a digital battery of general EF tasks.

Background music performed in the classroom, according to **Tounsi (2021)** [12], is an educational
intervention that has been shown to improve student behaviour management. Several studies, by the way,
have demonstrated the impact of music when listened to by students with special needs. An ABAB with
drawl design was employed to demonstrate a functional relationship between music background and
student engagement behaviour in 13 individuals with modest intellectual disability participating in two
self-contained gross motor activity courses. The results of a visual study of a repeated-measures graph
and statistical analysis for the two classrooms indicated that Mozart music had no significant effect on
the students' engagement during gross motor activities.

**Stapp and Hall (2020)** [13] investigated an innovative strategy to reducing transition durations and
enhancing engagement during transitions by using music and movement as interventions. Twenty-one
first-graders from a northwest Mississippi elementary school took part in the study. Throughout the four
stages of the trial, information was gathered using a student engagement checklist, which included
transition start and stop times, behavioural engagement, and stability of the body language of the
students and attentiveness following the treatments. Transitions required the smallest amount of time at
the time of stage four while musical and motion treatments were used, according to the findings.
addition, both morning and afternoon transitions boosted involvement, and a positive trend in body language and attentiveness occurred across every four stages of the investigation. The findings imply that musical and motion therapies can be used to improve students' cognitive and behavioural engagement in the classroom as well as transitions.

**Self-regulated learning (SRL)** was examined in the context of music by McPherson et al., (2018) [14]. SRL has the potential to improve the efficiency of musical talent acquisition in all elements of music performance education. We’ll start with a look at some recent study on skill acquisition when learning to play a musical instrument. Despite the fact that the literature on this subject is continually rising, much of it is fragmented and theoretical. Furthermore, music scholars prefer to focus on behaviour and cognition as independent and somewhat unconnected theoretical concerns, ignoring affect. They analyzed these flaws and presented a literature review that combines research-based information on behaviour, cognition, and affect into a unified SRL framework. The current and future research priorities are then outlined, along with methods for maximizing music practice, teacher-student relationships, and effective approaches to learning complicated musical skills. The final section summarizes the conversation and discusses the consequences for SRL’s adoption in the music education field.

**Valero et al., (2019) [15]** attempts to investigate the factors that influence musical student’s motivation, like judgments of their own abilities, fulfillment with accomplishments, attempt, the relevance of music in one’s life, and perceptions of the sacrifices done. To incorporate positive psychology into the motivational domain of musical education, two models were designed, one of which contained the variable of gratitude. The first indicates that effort will be put forth, while the second indicates that thanks will be expressed. A total of 84 music students were used to test the models. To explore the link between variables, both designs were fitted employing Bayesian examination approaches and displayed appropriate goodness of fit. In music education, such theories highlight the significance of cognition and motivation, as well as the relationship between effort and thankfulness.

**Turchet et al., (2018) [16]** proposed a concept in which the Internet of Musical Things (IoMusT) connects digital and physical worlds through suitable information and communication technology, supporting new musical operations and benefits. The IoMusT ecosystems include interconnected technologies and applications that interconnect artists and listeners to facilitate musician-musician, audience-musician, and audience-audience relationships. They first outlined a vision for the IoMusT and its motives in this paper. They then went over five instances to show how the Internet of Musical Things may help: 1) virtual and augmented reality concerts; 2) listener engagement; 3) distant workouts; 4) musical e-learning; and 5) smart studio productions. They outlined important skills that are currently lacking in current systems and reviewed the investigation that will be required to enhance these capabilities across a variety of trans disciplinary issues.

**Baratè et al., (2019) [17]** explored and shown how emerging 5G technology can alter current e-learning methodologies. Thanks to the primary features of 5G technology, particularly enhanced bandwidth, durability, and mass of gadgets in a region, it is possible to formulate and introduce innovative education
opportunities affluent in multimedia data, assisting multi-modal communication, and infinitely flexible relying on consumers’ prerequisites and unique needs. They showed a music technology program that might profit from this different manner of demonstrating pedagogic effectiveness.

M. Zhang and H. Zhang (2021)[18] expected that, with the use of modern technologies, musical training would offer highly creative educating scenarios. The novel art teaching method of "integration of multi-source practice teaching," "cloud space intelligent teaching," and "network collaborative City Teaching" is very suitable to music teaching's development and promotes it. The introduction of 5G methodology shall allow children in musical education to reflect more fun. Students will learn increasingly extensive themes and will no longer be constrained by their understanding of literature in a musical classroom.

**Problem Statement:**

One of the most crucial aspects of college education is online music education. Traditional education, on the other hand, is very old to foster student's inventive alertness and aptitude to practice music. With the advancement of Internet technologies, significant alterations have occurred in a variety of disciplines, including the curriculum structure and manner of musical education in colleges and universities. This study builds the classroom platform of online musical education in colleges and universities, depending on the background of “5G,” and proposes clear regulations on educational content, instructional techniques, and teacher training for cognitive computing for tailored behavioural intervention.

**iii. Proposed Work**

In this paper, the music education based on 5G is proposed for cognitive computing for personalized behavioral intervention of the students. This section explains the proposed workflow. The schematic representation of the proposed method is depicted in figure 1.

**Input dataset:**

The dataset employed in this study is MediaEval [20], which is freely available. It comprises 1802 songs in MP3 pattern, each with 260 low-level feature values and a sampling frequency of 44100 Hz. Every 45 seconds, every music is examined, and the values of every feature are extricated every 0.5 seconds.

**Data Preprocessing:**

Some modifications on the initial MediaEval dataset are conducted in this first stage. The primary goal is to create a correctly segmented training and test datasets. Certain equalization solutions were built and evaluated due to the dataset's recognized imbalanced structure.

**Labeling**

Every song is identified by the binary class to which it corresponds.

**Selection of data**
A percentage of information is chosen for training, validation, and testing. Default settings are 80% for training and validating and 20% for testing. The validating data is typically 20% of the training dataset and is determined by the early stop parameter. A stratified technique is used to divide data between training and testing, enabling data to be isolated while retaining class dimensions.

**Data balance**

To estimate the class propagation in the training dataset, a variety of methodologies have been used. Imbalanced dataset has a negative effect on minority class categorization measures. Over-sampling, under-sampling, and a mix of both are three data balancing procedures that are examined and reviewed.

**Feature Extraction using Principal Component Analysis:**

The features are the signal's representations. As a result, prior to categorization, appropriate feature extraction is critical. Eventually, one or more audio signals are converted into a feature vector using an appropriate feature extraction approach. The chosen features are intended to have attributes that allow them to represent the audio signal and distinguish it from others. The majority of machine learning researchers feel that accurate feature extraction is the key to building an effective prediction model. The time and frequency domains of the audio signals can be used to create a variety of features. We've looked at the most often utilized time and frequency domain features. The origin and mathematical explanations are progressively revealed.

PCA is a multivariate analytical method based on linear transformations that is frequently used to reduce data dimensionality, extract important information from massive data, analyze variable structures, and so on. In this paper, the PCA method was utilized to reduce the dimensionality of the audio signals. Considering all channels for feature extraction adds to the effort because the audio signal's spatial resolution is inadequate. We can use PCA in this circumstance since it can determine the largest variation from the higher input dimensions. As a result, a set of audio signals can be combined into a single signal to reduce the number of channels of interest.

**Classification using Deep Convolutional Neural Network:**

This article's deep convolutional neural network (CNN) framework consists of three convolutional units interspersed with two pooling procedures, accompanied by two completely associated networks. The feed to the system is time frequency patches generated from the log-scaled mel spectrogram description of the musical data, comparable to already described feature learning algorithms employed to environmental audio categorization. Using Essentia, we extricate log-scaled mel-spectrograms with 128 elements encompassing the audible frequency interval with a window size of 23 ms and a hop size of the similar time. Because the length of the excerpts in the assessment dataset varies (up to 4 seconds), we set the input time frequency-patch \( X \) to 3 seconds, i.e. \( X \in \mathbb{R}^{128 \times 128} \). Time frequency patches are extricated at random from each audio excerpt's entire log-mel spectrogram during training, as stated below.
Provided the feed $X$, the system is developed to study the specifications $\circ$ of a combined non-linear operation $F(\cdot|\circ)$ that maps $X$ to the output $Y$:

$$Y = F(X|\circ) = f_N(\cdot...f_2(f_1(X|\emptyset_1)|\emptyset_2)|\emptyset_N)$$

Here every function $f_n(\cdot|\emptyset_n)$ is termed as a layer of the system, with $N = 5$ units in the suggested framework. The initial three units, $n \in \{1, 2, 3\}$, are convolutional, represented as:

$$Y_n = f_n(X|\emptyset_n) = h(K * X_n + b), \emptyset_n = [K, b]$$

Here $X_n$ is a 3-D input tensor comprising $L$ feature maps, $K$ denotes a combination of $P$ 3-dimensional kernels, $*$ indicates a logical convolution, and $b$ denotes a vector bias factor. Hence, the structures of $X_n$, $K$, and $Y_n$ are $(L, e_0, e_1), (P, L, p_0, p_1)$ and $(P, e_0-p_0+1, e_1-p_1+1)$ accordingly. Notice that for the initial unit of the system $e_0 = e_1 = 128$, that is, the measurements of the feed time frequency-patch. The strided max-pooling is employed following the initial two convolution units $n \in \{1, 2\}$ utilizing a stride measurement equivalent to the pooling measurements that decreases the measurements of the output feature maps and hence accelerates training and develops some scale invariance into the system. The final two units, $n \in \{4, 5\}$, are completed-connected and comprises a matrix product instead of a convolution:

$$Y_n = f_n(X|\emptyset_n) = h(KX_n + b), \emptyset_n = [K, b]$$

Here $X_n$ is leveled to a column vector of length $L$, $K$ possesses structure $(P, N)$, $b$ denotes the vector of length $P$ and $h(\cdot)$ is a point-wise activation function.

The suggested deep CNN framework is parameterized as shown:

$n_1 : 24$ filters with a receptive field of $(5,5)$, that is, $K$ contains the structure $(24,1,5,5)$. It is succeeded by $(4,2)$ strided maxpooling over the final two measurements and a rectified linear unit (ReLU) activation operation $h(x) = \max(x, 0)$.

$n_2 : 48$ filters with a receptive field of $(5,5)$, that is, $K$ contains the structure $(48, 24, 5, 5)$. It is succeeded by $(4,2)$ strided max-pooling and a ReLU activation operation.

$n_3 : 48$ filters with a receptive field of $(5,5)$, that is, $K$ contains the structure $(48, 48, 5, 5)$. It is succeeded by a ReLU activation operation.
$n_4$: 64 hidden layers, that is, $K$ contains the structure (2400, 64), succeeded by a ReLU activation operation.

$n_5$: 10 output layers, that is, $K$ contains the structure (64,10), succeeded by a softmax activation operation

**Deployment of 5G framework:**

5G connection technologies that provide fast speeds, reduced latency, and extensive coverage, could expand opportunities for the growth of web collaborative learning as times and civilization progress. The 5G period's smart data atmosphere has started to affect our style of living and work, and it has now spread to include our learning strategies. A large amount of high disciplines in the traditional education have had a massive effect owing to the quick progress of computer and communication technology in today's environment. This research suggests a method for incorporating digital technology into the expansion of musical education in order for musical training to stay up with the times in this modern generation. Not only can digital technologies be used to improve music education instructional techniques, but it can also be used to improve musical education itself.

**Energy-aware routing algorithm:**

*Firstly, accredit trust value as zero for every 5G node*

*Calculate packet delivery ratio for every 5G node*

*Set the time interval as $[t_1, t_2]$*

*The sender node transfers the path request packet to all the neighbouring nodes*

*The neighboring node attains the request and it shall authenticate if it is a destination or not. If it is a destination then it transfers the acknowledgment to the neighboring nodes*

*Estimate the initial trust score for all the nodes*

*Estimate the second trust score for all the nodes*

*Estimate the entire trust score for every node*

*Estimate the threshold value for the network scenario*

*To find the malicious nodes utilize the below conditions:*

- If trust score $>\text{threshold}$ and standardized value $N>0.8$ during $[t_1, t_2]$ then the node is normal in $[t_1, t_2]$
- If trust score $\text{TR}_j < \text{TR}_M$, then the node is malignant or unusual

*Finally, find all malicious nodes from the network scenario and isolate malicious nodes $M_1, M_2, ..., M_K$*
Iv. Performance Analysis

In this part the performance of the suggested 5G network for musical education is analyzed and then compared with the traditional approaches.

Figure 2 shows the bar chart of the pretest, posttest, and follow-up mean behavioral intervention levels of the students in experimental and control groups.

Figure 3 shows the estimated marginal means for the experimental and the control groups that is estimated by the Behavioral Intervention Questionnaire.

Figure 4 shows the comparative analysis of the various performance measures for the traditional and the suggested approaches.

V. Conclusion

At this work, a system for music education innovation and practice in universities is offered, as well as cognitive computing for individualized behavioural intervention using 5G. Additionally, various restrictions connected to the dataset's properties, such as size, class balance, annotation quality, and sound attributes accessible, are reflected in this work. The goal of this project was to create a 5G-based music education system using the MediaEval dataset. In spite of the analytical time window chosen to perform the classification, the F-measures remain nearly constant. However, a more detailed study will be conducted, taking into account changes and alterations in time window duration. It's possible that the labeling mechanism was influenced by the mood of the listeners or something else that might have a negative effect on the qualities of the emotional annotations in the musical pieces. The results reveal that in spite of the length of the time window, the categorization F-measures in four quadrants are nearly fixed. The efficacy of music-based cognitive computing for individualized behavioural intervention among students has been demonstrated.

References


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**Figures**

![Diagram](attachment:image.png)

*Figure 1*
Flow of the proposed method

Figure 2

Comparison of the pretest, posttest, and follow-up mean behavioral intervention levels of the students in experimental and control groups
Figure 3

Interaction graph of time and treatment as estimated by Behavioral Intervention Questionnaire
Figure 4

Comparison graph of the performance measures for the traditional and the suggested method