Analyzing the Impact of Teachers' Technological Skills on Their Teaching Skills in Music Education

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Abstracts

Music education increasingly integrates digital technology to enhance teaching effectiveness and student engagement. This study investigates the impact of technology proficiency on music instruction by analyzing data from 80 music teachers and their students, aged 10-18 years, gathered through a detailed questionnaire. SPSS software was utilized for statistical analysis, including factor analysis, Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM). SEM analysis revealed that Community Influence (CI) and Achievement Prediction (AP) significantly impact Psychological Forecasting (PF), while Technical Expertise (TE) and Educational Technology Proficiency (ETP) have minimal direct effects. Specifically, CI and AP positively influence PF, whereas TE and ETP do not significantly impact PF. The results highlight that social factors and performance expectations are more influential in enhancing teaching outcomes than technological skills alone.

Keywords: Music Education, Technobgy Proficiency, Structural Equation Modeling (SEM), Community Influence, Achievement Prediction, Psychobgical Forecasting.

Introduction

Information and communication technologies (ICT) are revolutionizing educational procedures in primary and secondary schools, contributing to broader social and cultural changes [3]. Digital technology is widely used in all aspects of modern life, even among young people. Digital technology is recognized as a valuable resource in music classrooms worldwide [10]. It is regarded as an essential and desired component of the learning environment. These countries have invested heavily in integrating technology into music instruction. The investigation was conducted to evaluate the effectiveness of employing technology in music lessons to enhance the comprehension and enjoyment of music [17]. Music education is exploring whether digital technology may enhance learning, promote self-expression and creativity, and increase accessibility to all demographics. The use of digital technologies in music instruction is bringing about a significant shift. These technologies offer innovative educational and creative options for music learners as well as educators [7]. They present new issues and questions regarding their effectiveness and impact on music education. This aligns with teacher professional growth as a "touchstone for not only becoming, but also learning" as educators. On a global scale, there is a call to enhance teacher education, increase resources, and eliminate hurdles to progress [1]. The results of this endeavor aim to improve musical teacher education using a combination of classic and creative approaches, leveraging modern resources. Music instruction in online environments entails teaching and learning music using technology such as virtual classrooms, video lessons, and interactive apps [5]. It enables students to access resources, practice, and receive criticism remotely, frequently through interactive resources that improve their comprehension of music theory, composition, & performance. Internet music classes provide flexibility, diversified content, and opportunities for collaboration, making it available to a broader spectrum of students. Regardless of geography, online education requires digital competencies for teachers and students, with older teachers being particularly affected. Students need to be equipped with the necessary tools and self-regulated learning skills for effective remote learning. Mandatory stages & commercially accessible goods are used most. Traditional classroom learning is more effective than online education [2]. Music teaching has not significantly altered, despite ICT inventions. The pandemic led to a reconsidering of procedure however, adopting effective strategies for the internet setting provided new perspectives. The importance of personal contact in the process of music education & instrument lessons is widely accepted. Individualized instrumental training provides a unique experience for both students and teachers, promoting mutual attentiveness [11]. According to research findings, employing various techniques & tools is an effective basis for inspiration in music teaching. Active participation in musical endeavors, intrinsic drive, and happy performances of music can significantly improve the effectiveness of music courses using various techniques [15]. Despite the availability of digital activities and games for music instruction, they are rarely used in classroom settings. Computers and cell phones have become ubiquitous in students' daily lives, both at home and school. These pupils belong to Generation Z and have a natural ability to learn and use digital tools [16]. The result explains why the transition to digital remote learning was completed quickly at the beginning of the pandemic.

Key contributions

- Gathered data from 90 music teachers via a questionnaire, focusing on variables such as technology proficiency, community influence, and teaching effectiveness.
- Hypothesis formulation, developed hypotheses to examine the impact of community influence, achievement prediction, technical expertise, and educational technology proficiency on teaching outcomes.
- Statistical analysis, applied factor analysis, CFA, and hypothesis testing to validate constructs and analyze the relationships between variables.
- Result interpretation, found that community influence and achievement prediction positively impact teaching effectiveness, while technical expertise and educational technology proficiency show limited direct effects.

The paper is organized in five stages, Stage 1: Introduction outlines the research context and aims. Stage 2: Related Work surveys prior research. Stage 3: The Main Objective of the Hypothesis establishes research goals and proposes a hypothesis. Stage 4: Methodology describes the experimental approach. Stage 5: Result showcases the findings. Stage 6: Conclusion synthesizes the results and their significance.

Related work

The use of telematics platforms to support the employment of programmed methods for statistics analysis in teaching and learning was detailed in the study [4]. The study included 1,327 students in the first year of required high school in Spain, and it assessed their equal of development of the vital skills described as cultural & artistic. The outcomes are evaluated with the K-means categorization method. The target was determined based on the degrees of development of fundamental musical capabilities.

The work [14] explored MET-AI approaches have become more closely associated with contemporary science & technology, hence boosting melody education. The use of machine learning in music teaching has tested the predictable approach of music instruction, mainly in terms of digital music or novel musical applications in private institutions, greatly enhancing the standard for music instruction as well as the teaching model for music education. The results of the trial indicate the internet-based education environment at Band Massive could be continually enhanced with machine learning technology.

An integrated research approach was used in the study [9], which comprised semi-structured conferences, teacher explanations, and an assessment of learning fulfillment. The current study looks into whether 122 high school students in Hong Kong learned Shubailan, a type of folk-talk melodic, utilizing a portable equipment app. The strategy described above effectively encourages and develops music knowledge among Shubailan students. The end result is one-of-a-kind educational methods for teaching music online during challenging conditions.

The purpose of the research [12] was to carefully evaluate if using technology in therapy helps improve children with ASD's motor and social skills through music and sound-based activities. In May 2020, a comprehensive search was conducted across databases like Science Direct and Cochrane, resulting in 5,179 papers. After filtering, 27 studies were selected. They analyzed these studies' key characteristics, strengths, limitations, and offer insights and recommendations for future interaction design to better support autistic children through music therapy.

The work by author [8] divided into two main sections: first, it examines college musical education in comparison to other cultural instruction and the role of multimedia technology in enhancing school music education. Second, it uses brain computing and deep learning algorithms to analyze and monitor musical training. The study also covers the plan and development of linkage hypermedia courseware, providing a theoretical framework and comparison for integrating hypermedia knowledge into college music education in China. The result is effectiveness and reliability in musical education.

The function that technology integration plays in helping college and university students build their technological skills is examined in the article [13]. A questionnaire was administered to 217 learners from three Portuguese universities (north, center, and south) to identify areas needing enhancement and understand the implications. According to the report, students' growth as individuals, interaction with others, & professional prospects are all dependent on a balanced development of technology abilities. The findings emphasize the importance of fostering these skills for future success.

The current research design [6] incorporates multiple scenarios of quantitative analysis. The findings revealed that the intricate nature of the foreign language instruction procedure stems from EFL learners' social and cognitive demands, which are often overlooked, either purposefully or unconsciously. Second language learning often involves anxiety and peer pressure, making song and music effective language acquisition tools without overwhelming students with academic burdens.

Methodology

The study employed a questionnaire to collect data from 80 valid replies, validated components using statistical analysis, & tested hypotheses about the effect of technology skills on music instruction effectiveness.

I. Data collection

This study, aimed at evaluating how technological proficiency enhances musical teaching skills, invited 400 music teachers to complete a questionnaire. Out of the total invitations, 90 responses were received, and after error checking, 80 were confirmed as valid. The data collected offers valuable insights into how teachers' digital skills contribute to their overall teaching effectiveness and musical instruction, shedding light on the influence of technology use on coaching practices & learning outcomes in music education are displaced in Table I.

II. Hypothesis Development

The core objective of the study is to examine how teachers' technology skills affect their effectiveness in teaching music, specifically analyzing the roles of digital proficiency, Community Influence, and performance expectations in improving teaching outcomes in various educational settings.

H1: Community Influence (CI) will positively influence Psychological forecasting (PF).

H2: Achievement Prediction (AP) will positively influence Psychological forecasting (PF).

H3: Technical Expertise (TE) will positively influence Psychological forecasting (PF).

H4: Educational Technology Proficiency (ETP) will positively influence Psychological forecasting (PF).

H5: Educational Technology Proficiency (ETP) will positively influence Community Influence (CI).

The hypotheses were based on the characteristics of the participants, and investigated the influence of various factors on psychological forecasting. Hypothesis 1 argues that Community Influence (CI) has a favorable effect on high blood pressure. H2 suggests that Achievement prediction (AP) improves PF. H3 suggests that Technical Expertise (TE) contributes to PF. H4 proposes that Educational Technology Proficiency (ETP) has a favorable influence on PF. H5 proposes that ETP has a positive effect on Community Influence (CI), highlighting the relationship between technological understanding, pedagogical knowledge, and social impact on behavioral outcomes are displayed in Figure I.

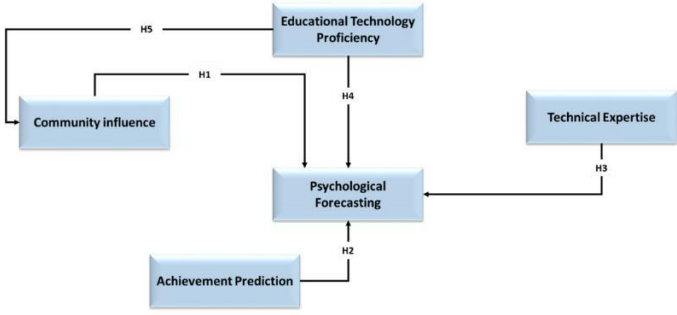

Fig 1 Conceptual framework

III. Statistical analysis

The study employed SPSS to examine the impact of several factors on music education results. Descriptive data presented an overview of participant demographics, demonstrating a variety of ages, genders, and levels of education. Validity research indicated that dimensions like

community influence and achievement prediction were internally consistent, with strong factor coefficients and AVE values. CFA yielded excellent fit for all models, as evidenced by significant chi-square values. Correlation analysis indicated strong correlations among variables, indicating their interdependence. Hypothesis testing revealed that community influence and achievement prediction have a considerable impact on teaching results, whereas technical expertise & educational technology proficiency had negligible direct effects on psychological forecasting. This indicates that social variables and performance expectations have a greater influence on improving instructional effectiveness than skills in technology itself.

Result

The results indicate that Community Influence and performance expectations improve teaching outcomes in music education, although direct technology knowledge has less impact, implying that other elements are more important (Table I).

Table I Characteristics of Study Participants

Components	Category	Frequency	Percentage %
Age	Young (24 years old)	30	37.5%
	Middle-aged (45 years old)	30	37.5%
	Senior (60 years old)	20	25%
Gender	Male	30	37.5%
	Female	45	56.25%
	Non-binary	5	6.25%
Years of Coaching Experience	0-4 years	20	25%
	5-11 years	20	25%
	12-21 years	25	31.25%
	22+ years	15	18.75%
Educational Background	Undergraduate Degree	30	37.5%
	Postgraduate Degree	30	37.5%
	Doctoral Degree	15	18.75%
	Specialized Training	5	6.25%
Prior Knowledge of Music	Beginner	25	31.25%
	Intermediate	35	43.75%
	Advanced	20	25%

The study explores at the way teachers' technical skills affect their music instruction performance. Participants represent various age groups, genders, and educational levels. The age spans from young (37.5%) to senior (25%). The gender breakdown is: male (37.5%), female (56.25%), and non-binary (6.25%). Experience ranges from 0 to 5 years (25%) to 21+ years (18.75%). Bachelor's degrees (37.5%), doctoral degrees (18.75%), master's degrees (37.5%) & specialized training (6.25%) are the most common educational backgrounds. Class sizes range from small (31.25%) to large (25%), and prior music experience is classified as beginner (31.25%), intermediate (43.75%), or advanced (25%).

Table II Validity and Reliability of the Measurement Model

Elements	Metric	Deviation	Factor coefficient	CR	R^2	AVE
Community Influence	CI1	0.701	0.699	0.921	0.788	0.754
	CI2	0.721	0.631		0.477	
	CI3	0.651	0.789		0.743	
Achievement Prediction	AP1	0.754	0.854	0.930	0.851	0.864
	AP2	0.732	0.831		0.555	
	AP3	0.786	0.853		0.721	
	AP4	0.666	0.797		0.977	
Technical Expertise	TE1	0.731	0.621	0.874	0.866	0.752
	TE2	0.842	0.652		0.754	
	TE3	0.865	0.689		0.571	
Educational technology proficiency	ETP1	0.568	0.755	0.899	0.857	0.651
	ETP2	0.872	0.764		0.744	
Psychological Forecasting	PF1	0.799	0.723	0.916	0.899	0.870
	PF2	0.751	0.876		0.779	
	PF3	0.782	0.632		0.681	
	PF4	0.698	0.777		0.784	

The evaluation measures key elements of teaching performance, including community Influence, Achievement prediction, technical expertise, Educational technology proficiency, & psychological forecasting as shown in Figure I. It investigates how well these ideas are measured, focusing on their validity and reliability. Table II analyzes the validity and reliability of constructs related to performance in teaching. The metrics, which include factor coefficients, CR, and AVE, demonstrate that components such as community influence, achievement prediction, and technical expertise are highly reliable and valid. For example, Community Influence items (e.g., CI1 = 0.699) & Achievement prediction items (e.g., AP = 0.854) have high factor coefficients and AVE values, demonstrating that the measuring model accurately represents and expresses teaching performance characteristics, resulting in reliable and valid assessments. The overall complete pathway diagram of the comprehensive measurement model is shown in Figure II.

Table III: Correlation Matrix

Implicit Variable	TE	PA	CI	ETP	PF
TE	0.894				
AP	0.866**	0.855			
CI	0.834**	0.837**	0.875		
ETP	0.739**	0.752**	0.799**	0.755	
PF	0.880**	0.811**	0.734**	0.739**	0.821

Note: (***), (**) and (*) represent highly significant, significant and marginally significant

Table III displays a matrix including the squared root of the AVE with correlations between variables important for this investigation, Technical expertise (TE = 0.894), Achievement prediction (AP = 0.855), Community Influence (CI = 0.875), Educational technology proficiency (ETP = 0.755), and Psychological Forecasting (PF = 0.821). The diagonal AVE values exceed the off-diagonal correlations (e.g., TE and AP = 0.866, AP and CI = 0.837), showing high validity for discrimination. This demonstrates that the variables we used are distinct and dependable,

supporting the study's goal of examining the way technological abilities influence teaching quality and student results.

Table IV Fit Metrics and Outcomes of Confirmatory Factor Analysis for Each Framework

Framework	x^2	p	df
Technical expertise	13. 209	1.000	85
Achievement prediction	14.820	1.000	87
Community Influence	2.079	1.000	79
Educational technology proficiency	0.615	0.990	8
Psychological Forecasting	0.567	1.000	9

Table IV displays the metrics from CFA, which examines how well several frameworks correspond with the data. Chi-square (χ^2) values and p-values for frameworks such as Technical Expertise (χ^2 = 13.209, p = 1.000) and Achievement prediction (χ^2 = 14.820, p = 1.000) show an impressive fit and excellent statistical validity. These results indicate that the models successfully capture their constructs, hence supporting the frameworks' reliability and validity in assessing the effect of technological expertise on teaching.

Table V Outcomes of Hypothesis Evaluations

Hypothesis	Pathway	SE	Appraisal	Normative Estimation	p	Outcomes
H1	CI→PF	0.269	0.892	0.789	< .001	valid
H2	AP→PF	0.288	0.876	0.732	< .001	valid
H3	TE→PF	0.175	0.766	- 0.057	0.456	invalid
H4	ETP→PF	0.165	-0.135	- 0.022	< .001	invalid
H5	ETP→CI	0.292	0.799	0.644	< .001	valid

The hypothesis tests investigate the influence of several factors on teaching results. H1 (Community Influence → Psychological Forecasting), H2 (Achievement prediction → Psychological Forecasting) are valid, implying that Community Influence along with performance expectations have a major impact on Psychological Forecasting in music education. However, H3 (Technical expertise → Psychological Forecasting) & H4 (Educational technology proficiency → Psychological Forecasting) are invalid, indicating that both technical and pedagogical knowledge have no substantial impact on forecasting. H5 Educational technology proficiency → Community Influence) is valid, indicating that pedagogical technology competence enhances social impact in music education are presented in Table V.

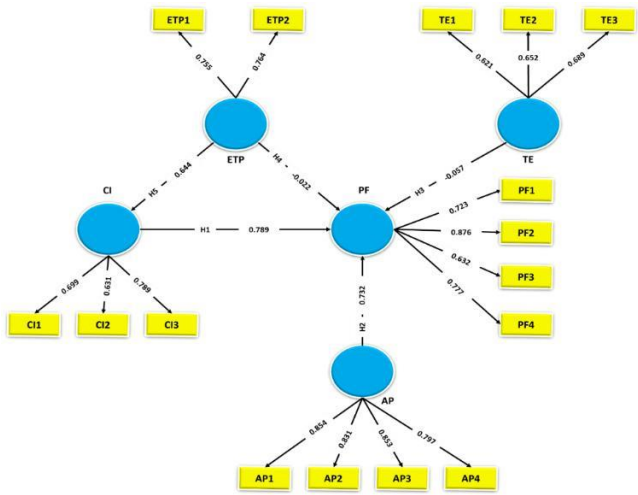

Fig 2 Complete Pathway Diagram of the Comprehensive Measurement Model

Conclusion

The study conclude that community influence & performance expectancy greatly improve psychological forecasting in music instruction, implying that these aspects are critical for better teaching outcomes. Educational technology proficiency has a beneficial effect on community influence, indicating that competent technology use may enhance social relations in educational contexts. However, technological knowledge and experience in pedagogical technology have little direct impact on behavioral predictions. These findings emphasize the relevance of social and performance-related variables in teaching efficacy, and they suggest that more study is needed to investigate how various technology aspects influence music education practice. Future studies ought to look into the influence of developing technology, such as AI & virtual reality, and music education, as well as examining how demographic factors and longitudinal technology integration affect teaching effectiveness and student engagement.

List of Abbreviations

Abbreviation	Definition
ICT	Information and Communication Technologies
MET-AI	Music Education and Teaching using AI

ASD	Autism Spectrum Disorder
EFL	English as a Foreign Language
CI	Community Influence
PF	Psychological Forecasting
PA	Achievement prediction
TE	Technical Expertise
PTE	Educational technology proficiency
CR	Composite Reliability
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
χ^2	chi-square
SE	Standard Error

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