

# Orchestral Teachers' Technology Adoption and Its Association with Innovative Behaviour for Sustainable Music Education

Jiang Jialiang<sup>1,2\*</sup>, Che Fatimah Dinna<sup>1</sup>

<sup>1</sup> Faculty of Education and Humanities, UNITAR International University, Malaysia

<sup>2</sup> Faculty of Music, Guangdong University of Education, Guangdong, China

\*Corresponding Author: [jjl423900@gmail.com](mailto:jjl423900@gmail.com)

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**Abstract:** *The application of digital technology in music education has brought about changes to some extent in teaching concepts and ways for teachers of Western orchestral instruments, thus giving rise to new requirements for professional qualities of teachers of Western orchestral instruments. However, the theory research on the use of technology by teachers of the Orchestra is scarce. A conceptual framework for explaining the relationship between orchestral teachers' technology adoption and innovative professional behaviour. By drawing on the Technology Acceptance Model, teacher innovative behaviour theory and organisational learning perspective, this study integrates recent literature to propose that perceived usefulness and perceived ease of use serve as essential antecedents of innovation-oriented teaching practice. The framework expands the application of Technology Acceptance Research in a special scenario for music education and provides theoretical support for subsequent empirical studies. The study also provides some ideas for the professional development of teachers to promote innovation in orchestral teaching.*

**Keywords:** Technology Adoption; Orchestral Teachers; Innovative Behavior; Technology Acceptance Model; Music Education; SDG 4

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## 1. Introduction

With the rapid development of information and communication technologies, many changes will be unavoidable for teachers in their teaching. At present, although technology has been widely applied in the field of education, its role is mainly to assist in teaching; teachers generally do not fully utilise it for designing learning activities or guiding students' learning processes; thus, new forms of teaching cannot be achieved. The international policy system recognises the primary role of high-efficiency applications of new-generation information technology in improving teaching results, promoting teachers' professional development, and driving educational innovation (UNESCO, 2021; OECD, 2023).

Under the global framework of the United Nations' Sustainable Development Goals (SDGs), Goal 4 calls for access to inclusive, equitable and quality education as well as lifelong learning opportunities for all (UNESCO, 2021). At the heart of SDG 4 lies the development of teacher capacity to use new pedagogy appropriately and to engage in professional practice that is sustaining. Empirical and synthetic studies have shown that teachers' perceptions of digital technology, especially perceived usefulness and perceived ease of use, can affect their willingness to integrate technology into teaching and participate in change-oriented practices

(Kusumawati & Aljufri, 2025). Research on teachers' innovative practices has also shown that individuals' cognitive appraisals of teachers are combined with professional environments and institutional factors to trigger innovative behaviour (Messmann & Mulder, 2021; Thurlings, Evers, & Vermeulen, 2022). Subject-related investigations also show that the demands of specialised fields, such as orchestra and ensemble teaching, influence people's perception and application of technology, thus affecting the maintenance of high-quality music education aligned with SDG 4 (Zhao & Frank, 2023; OECD, 2023). Therefore, by examining the application of information technology by teachers of an orchestra and their relationship with innovative behaviour, we can draw conclusions directly related to SDG 4 on teacher effectiveness improvement and ensure sustainable high-quality education supply in music education.

### **1.1 Problem statement**

In this case, whether teachers are able to use educational technology has become a focal point of interest in educational research (Stumbrienė et al., 2024). Recent studies show that whether or not a teacher accepts technology is not entirely due to the availability of technological resources, but rather because of their perception of it (Akram et al., 2022). , among which perceived usefulness (PU) and perceived ease of use (PEOU) are commonly considered the primary factors affecting teachers' adoption of digital tools. Large-scale and meta-analytic studies in educational settings confirm that PU and PEOU are still robust predictors of teachers' technology acceptance across various countries, education levels, and subject areas (Scherer et al., 2021; Teo et al., 2021).

In addition to the application of technology itself, an increasing number of studies have examined the relationship between teachers' changes in their profession due to the use of this technology. Innovative Behaviour is usually referred to as the emergence, acceptance and use of new ideas or Approaches in teaching and learning to improve the quality of education that helps enhance teaching effects; It has become an indispensable aspect of Teachers' Professional Activities. Recently, it has been found that teachers' beliefs and attitudes towards technology are becoming more and more important as critical factors affecting their innovative behaviour; Messmann and Mulder (2021), Thurlings et al. (2022) also pointed out that changes in education caused by rapid technological advancements often lead to altered teachers' innovative practices. If teachers feel that the technology is useful and easy to operate, they are more likely to try new teaching methods and engage in innovative professional development activities (OECD, 2023).

Although there has been some expansion in the research on technology adoption and teacher innovation, most studies to date have concentrated on general classroom teachers or educators in mainstream academic subjects. Empirical research on the specific group of specialised professional groups, such as orchestral teachers, is lacking. Orchestral teachers operate in a teaching environment with ensemble cooperation, performance-based instruction and complex real-time interactions; Therefore, they may have different understandings and usages of technology. Recently, some research findings suggest that subject-specific teaching scenarios help shape teachers' perceptions of technology and their application habits, thus impacting their professional behaviour differently (Zhao & Frank, 2023).

### **1.2 Research Question**

In view of these shortcomings, this study selects orchestral teachers as the research subjects and explores their application of technology and its connection to innovative behaviour. According to current research results from the field of technology acceptance, this paper will

focus primarily on the construction of elements of PU and PEOU in technological acceptance, explore their interactive effect mechanism with innovative Behaviour among orchestra teachers. By situating the analysis within a special music education context, this study aims to provide empirical evidence for the literature on teacher technology adoption and innovation, as well as references for professional development and educational management in orchestral education.

## **2. Literature Review**

### **2.1 Technology Adoption in Educational Contexts**

The application of digital technology in teachers' teaching practices has been widely studied by scholars, and theoretical models explaining individual recognition of technology have also been proposed. Contemporary research consistently shows that teachers' adoption of technology is primarily influenced by their cognitive assessments of the technology, rather than simply due to the availability of technological resources. Among many theories, the Technology Acceptance Model (TAM) and its later modifications are still widely used to explain teachers' beliefs and behaviour regarding technology.

In recent years, a large number of empirical studies and meta-analyses on education have confirmed that in addition to the previous understanding, PU and PEOU still play a role as a stable predictor of teacher's technology acceptance across different educational backgrounds, subjects and cultures (Scherer et al., 2021; Teo et al., 2021). Perceived usefulness refers to teachers' sense that using technology can enhance their professional practice; Perceived ease of use is the degree to which they believe the technology requires little effort. Empirical evidence suggests that teachers are more likely to integrate digital tools into their own teaching when they perceive these tools as having good teaching application value and being user-friendly (Howard et al., 2021; Wang, 2021).

In addition, recent research indicates that PU and PEOU are not only related to the first use of the technology but also to continuous and substantive application of the technology. Teachers who view digital technology as a means to achieve their teaching objectives are more willing to take the time and energy required for learning, adaptation, and improvement of technology-supported practices (Scherer et al., 2021). Based on this, the constructs of TAM are still applicable to current educational research; Therefore, it can also be used in special teaching scenarios, such as music and orchestra education.

### **2.2 Innovative Behavior among Teachers**

Innovative behaviour has gradually become a significant part of the central tasks that teachers need to undertake in their work at present. In terms of the educational literature, the definition of innovation in behaviour usually refers to teachers' practice of generating new ideas, methods or approaches in teaching and learning for improvement. In addition to the creative act itself, the whole process of innovative behaviour is taken to include experiment, improvement and institutionalisation of new practices.

Recent reviews and empirical research indicate that teachers' innovative Behaviour is influenced by both individual and environmental factors. Messmann and Mulder (2021), among others, believe that at the individual level, Teachers' beliefs, attitudes and motivation are key factors driving their desire to participate in innovative Activities (Thurlings et al., 2022). In terms of the context, if there is no organisational support, professional development

opportunities, or accessible resources available at the organisational level, it will be difficult for teachers to carry out innovative actions continually in their daily teaching work.

Among the body of research that has identified technology as a key driver for teachers' innovative behaviour. If teachers feel that digital technology helps solve teaching problems and is easy to use, they will be more willing to explore new ways of Teaching and restructure their own practice. In recent years, a large number of policy-oriented and empirical studies have shown that positive technology perception can help teachers engage in innovative activities by reducing perceived risk and enhancing their sense of professional value (OECD, 2023).

### **2.3 Linking Technology Adoption and Innovative Behavior**

Research on the impact of teachers' use of technology on creativity began in the field of education during this period. According to recent research, teachers' attitudes towards the application of technology in education, especially perceived usefulness, have a positive impact on their change-oriented educational behaviour, such as pedagogical innovation and teaching reform (Messmann & Mulder, 2021; OECD, 2023). In addition, perceived ease of use can also help drive the popularity of this process through word-of-mouth or other means after an individual uses it smoothly.

In addition, based on the research on organisational learning and learning-oriented school cultures, it can be inferred that institutional conditions may affect the innovative results that individual teachers perceive technology as having. Recently, some studies have shown that collaborative practice, knowledge-sharing mechanism and reflective professional community are conducive to the dissemination and maintenance of innovation in educational organisations (Pinheiro 2024; Otoo 2024). In doctoral-level research, the organisational learning process is generally regarded as a path from technological belief to innovative behaviour through mediating or moderating factors.

Empirical evidence also indicates that the extent to which the aforementioned relationships hold in different subjects may vary. Teachers who are engaged in particular professions, such as vocational education and art education, may need to meet different teaching requirements when using this technology, thereby affecting the assessment and use of this technology. Recently, research indicates that subject-specific teaching scenarios are more conducive to shaping teachers' technological perceptions and innovation patterns, and therefore, other groups of professionals need to be included in related explorations (Zhao & Frank, 2023).

### **2.4 Theoretical Framework**

Based on the above literature, this study is based on a combined theoretical framework of the technology acceptance model (David, 1989) and teacher innovative behaviour theory (Scott & Bruce, 1994), while also considering other aspects of organisational learning in education.

First, Technology Acceptance Theory, including the TAM and its current applications, provides an established framework to help explain teachers' cognitive appraisals of technology. Under this context, in the concept of perceived usefulness and perceived ease of use as central belief dimensions influencing teachers' participation in digital technologies (Scherer et al., 2021; Teo et al., 2021). These constructs are teachers' judgments on the instrumental value and practicality of technology in connection with their professional roles.

Second, theories of innovative behaviour in education conceptualise innovation as a professional process that includes the generation, adoption and implementation of new ideas and practices. Recently, some studies have pointed out that teachers' innovative behaviour is

closely related to their individual beliefs, professional agency and the perceived value of change-oriented practices (Messmann & Mulder, 2021; Thurlings et al., 2022). Therefore, in this sense, teachers' technology-related beliefs are the antecedents to innovative behaviour.

Organisational Learning Theory is a new perspective on how peoples' Beliefs And Professional Behaviour Are Influenced By Institutions. Several scholars have pointed out in this section that, through cooperative learning, knowledge-sharing and reflection on practice, new impetus has been provided for educational reform (Pinheiro, 2024; Otoo, 2024). To this end, a combination of these views suggests that the application of technology and innovative behaviour are embedded within a broader organisational learning environment in educational institutions.

## 2.5 Conceptual Framework

Based on the above theory, the concept framework of this study suggests that there is a direct relationship between the perception of technology by orchestral teachers and their innovative behaviour. Specifically, perceived usefulness and perceived ease of use are conceptualised as independent variables that influence teachers' engagement in innovative professional practices.

Innovative behaviour refers to the behavioural outcomes that reflect teachers' involvement in the generation, acceptance and application of new ideas and methods supported by digital technology. Following the empirical research and theoretical foundations of teachers' innovation in recent times, it is recognised that their own belief system and professional judgment are crucial for propelling or hindering acts of creativity (Messmann & Mulder, 2021; Thurlings et al., 2022).

Under this conceptualisation, teachers' technology-related beliefs are considered as proximal antecedents that influence innovation-related actions in the professional practice of orchestral education and other special educational fields. This framework provides a special analytical tool for exploring the connection between technology application and innovation practices of Orchestral Teachers.

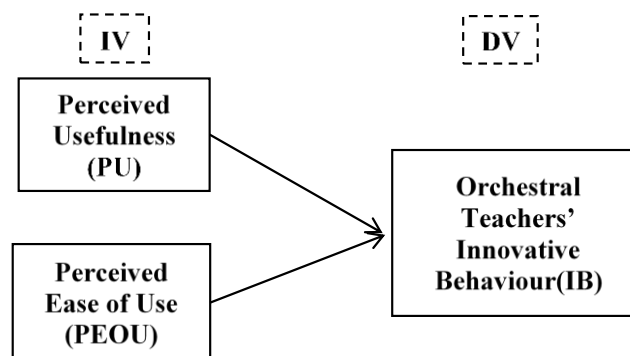


Figure 2: Conceptual Framework

## 3. Methodological Approach

### 3.1 Conceptual Research Design

A conceptual research design is employed in this study to develop a theoretical explanation for the technology adoption behaviour of teachers in the field of Orchestral Performance and its relationship with innovative professional behaviour. In terms of conceptual research, the synthesis and integration of existing theoretical and empirical studies at home and abroad are

carried out to build an analytical framework that advances academic progress, proposes a proposition rooted in theory.

This study does not intend to examine the relationships through primary empirical data collection. In other words, the application of traditional theory in explaining technology-assisted innovation in orchestral education is discussed. Furthermore, this method can also be applied to other new research directions at the forefront of theoretical construction that have not yet been fully explored, so as to carry out subsequent empirical research work.

### **3.2 Literature Synthesis Strategy**

The conceptual framework of this study was built by systematically integrating existing scholarly works on the application of technology, teachers' innovative behaviours and organisational learning in education. When selecting literature for the review, peer-reviewed journal articles, review studies, and international policy reports published between 2021 and 2026 have been prioritised to ensure theoretical relevance and timeliness.

Through academic retrieval, relevant literature was classified into the primary theoretical categories of three main fields.

- i. Technology acceptance research examining cognitive determinants of technology adoption, particularly perceived usefulness and perceived ease of use.
- ii. Teacher innovative behaviour research focusing on professional processes involving the development and implementation of innovation-oriented practices.
- iii. Organizational learning perspectives addressing institutional and professional contexts that support innovation in education.

By using the Thematic Analysis Method to identify relationships between topics in different fields. Systematic synthesis of recurring theoretical patterns and construct relationships in the literature to form an integrated analytical perspective.

### **3.3 Conceptual Framework Development**

The construction of the theoretical framework was carried out using the method of integrating theories. Constructs based on technology acceptance research were first used to identify the core belief-based determinants that influence teachers' use of digital technology. Perceived usefulness and perceived ease of use were chosen as the core constructs because they have strong and consistent theoretical and empirical support in current research on educational technology.

Subsequently, theoretical views on teachers' innovative behaviour were referred to, and innovation was seen as a professional outcome produced under the influence of teachers' beliefs, professional judgment and willingness to adopt change-oriented practices. Based on these views, some grounds were established to connect the beliefs about technology with innovative teaching behaviours.

Organisational learning literature was referred to in order to provide an organisational context for professional innovation. Based on the literature, the general interpretive framework of technology adoption and innovative behaviour in orchestral education was established.

Through this integrative analysis process, this study has proposed a conceptual model that connects the perceptions of orchestral teachers towards technology adoption with innovative professional behaviour.

### 3.4 Proposition Development

Based on the theoretical synthesis, this study advances two conceptual propositions:

i. Proposition 1:

The stronger the perception of music teachers to apply digital technology, and their sense of innovation in teaching patterns, the more highly they recognise that this is true.

ii. Proposition 2:

Orchestral teachers' feelings of ease in using digital technology have a positive correlation with their innovative behaviour in teaching.

Figure 2 shows the theoretical relationship diagram of the propositions constructed in this paper. These propositions provide theoretical references for future empirical studies on technology-supported innovation in orchestral education.

### 4. Discussion

Based on this framework, this study aims to explain the mechanism of how orchestral teachers' technology application promotes innovation in their own professional development. By combining the views of TAM, the literature on teacher innovative behaviour and organisational learning research, this paper provides a theoretical basis for explaining why teachers' perceptions of digital technology may affect innovation-oriented teaching practices in orchestral education.

According to the concept analysis, it can be determined that PU plays a central motivating role in promoting the related professional behaviour of innovation (Zhu et al., 2025). If teachers find that digital technology helps improve their teaching effectiveness, rehearsals manage and enhances their own professional development, they are more willing to engage in the development and practice of new things. This view increases the current perception of TAM, that is, while paying attention to cognitive evaluations of technology value, more generalised professional behaviour also exists (Sobhanmanesh et al., 2023).

In addition, through the application of PEOU, there will be more innovative teacher behaviour that combines digital technology and teaching. Technologies that are relatively easy for people to understand and accept may help reduce cognitive and operational burdens, thus promoting the practice application of new teaching methods. This interpretation is consistent with the current literature that highlights the enabling role of usability in supporting teachers' willingness to participate in innovation-oriented professional activities (Al-Mahdy & Elwakil, 2026).

By focusing on orchestral teachers, this study expands the existing theoretical exploration of technology application to specialised music education fields. Orchestral teaching is a form of collaborative rehearsal process, performance-oriented teaching method and interactive state of the entire class that requires teachers to meet different professional requirements. Based on the above framework, it can be known that when applying this technology in such environments, it is not only about technological integration but also closely linked to teachers' professional beliefs and innovation practices (Abedi, 2024).

#### 4.1 Theoretical Implications

This study makes contributions to the existing body of literature in several areas. First, TAM is applied to the field of Orchestral Education, which has received little theoretical attention in research on technology adoption. By placing PU and PEOU in the context of music education, this study shows that the technology acceptance constructs still apply to explaining professional behaviour of specialised teachers.

Second, this study adds to the research on teachers' innovative practice by connecting their beliefs about technology to their innovative professional behaviour. Existing literature tends to explore innovation as a result of organisational or contextual factors (Pinto et al., 2023), while this study focuses on the role of individuals' cognitive appraisals as the underlying antecedents of innovation.

Thirdly, this paper incorporates an organisational learning perspective to offer a more extensive theoretical framework for technology adoption and innovation in professional education. In this case, there is a three-tier structure linking individuals' beliefs and institutions through learning over time.

#### **4.2 Practical Implications**

Based on the above problems, this study has put forward some improvement directions for educational practice. First, professional development programs for promoting technology integration in orchestral education need to highlight the educational and practical value of digital technology (Sharma, 2024). Improve teachers' PU to enhance their motivation to participate in innovative practices.

Second, educational institutions need to ensure that the Digital technology tools selected for use in Orchestral teaching are easy to operate and have good Accessibility. Technologies that are easy to use are more likely to stimulate users' desire for exploration and continue to be used over the long term in their professional roles.

Third, the institutional support structure that promotes collaborative learning and the sharing of professional knowledge may also help to drive technology-supported innovation by orchestral teachers. If it creates a situation conducive to such learning, there will be more chances for technology application and innovative practice linkage.

#### **4.3 Future Research Directions**

The conceptual framework presented in this study offers a theoretical basis for subsequent empirical research into technology-enabled innovation in orchestral education. In the future, empirical studies can be conducted to test the above propositions using a combination of quantitative, qualitative or mixed-method research approaches.

Further research may also examine the impact of context and organisations on the relationship between technology adoption and innovative behaviour. Various music education environments can also provide some reference for further expansion in the direction that professional situations affect technology application.

### **5. Conclusion**

Based on this, a model explaining the reasons for teachers to use technology in their work and innovative behaviour was constructed. Based on the Technology Acceptance Model (TAM), relevant literature on teachers' innovation and organisational learning is summarised to propose

that perceived usefulness and perceived ease of use serve as core antecedents of teachers' innovation-oriented teaching practices. By extending the current theoretical research on the application of technology to add music education scenarios, and stressing teachers' professional beliefs as an essential factor influencing innovation (Zhang et al., 2021). Beyond the theoretical significance, this framework offers an exploratory path for the development of orchestra education under the background of technological transformation and changes in the education system. By prompting interdisciplinary integration among technology, pedagogy and profession, this concept model provides some references for promoting the sustainable innovation of music education and supporting the continuous development of high-quality orchestra teaching.

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### **Conflict of Interest Statement**

The authors declare that there is no conflict of interest regarding the publication of this study.

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