EVALUATING THE INTEGRATION AND EDUCATIONAL IMPACT OF PRO TOOLS TECHNOLOGY IN DIGITAL MUSIC PRODUCTION CURRICULA: A CASE OF B UNIVERSITY IN HU BEI PROVINCE, CHINA

SIKAI WANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
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ABSTRACT

This study investigated the integration and educational impact of Pro Tools technology in digital music production curricula at B University in Hubei Province, China. The purpose of this study is 1) to examine the impact of the Pro Tools technology on students' digital music production education; 2) to investigate how Pro Tools technology enhances students' learning achievements in digital music production education;3) to study whether using Pro Tools in digital music production courses demonstrates greater student self-efficacy in digital music production education. This study adopted the quantitative research method. There were 322 valid questionnaires. The student's learning achievements and self-efficacy tests in digital music production education consist of pre-test and post-test items. This study focuses on Class 1 (33 students) and Class 2 (35 students) of the 2023 intake in the Music Production major at B University in Hubei Province, China. It compares the impact of integrating Pro Tools technology into teaching (experimental group) with that of traditional teaching methods (control group) on students' achievement and self-efficacy. This study finds that 1) Pro Tools technology positively impacts students' digital music production education; 2) The Pro Tools technology enhances students' learning achievements in digital music production education;3) Students using Pro Tools in digital music production courses demonstrate greater student self-efficacy in digital music production education. This research contributes to understanding technology integration in music education and provides practical recommendations for institutions implementing digital audio workstations in their curricula. The findings affect curriculum design, instructor professional development, and student engagement strategies in digital music production education.

Keywords: Pro Tools, Digital Music Production, Educational Impact, Curricula

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SiKai WANG

CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER I

INTRODUCTION

1.1 Background and Rationale

In the rapidly evolving landscape of digital music production, Pro Tools has emerged as an industry-standard software, revolutionizing the way music is created, recorded, and produced. As a comprehensive digital audio workstation (DAW), Pro Tools offers a wide array of tools and features for various aspects of music production, from recording and editing to mixing and mastering. The software's prominence in professional studios worldwide has made it an essential skill for aspiring music producers and audio engineers (Yin, 2024).

In China, the music industry has been experiencing significant growth, with a rising demand for skilled professionals in digital music production. This trend has led to an increased focus on music technology education in Chinese universities. B University in Hubei Province, recognizing the importance of staying current with industry standards, has integrated Pro Tools into its digital music production curriculum (Aminah et al., 2020).

The integration of Pro Tools in educational settings, however, presents both opportunities and challenges. While it offers students hands-on experience with professional-grade software, it also requires a significant investment in equipment, licensing, and instructor training (Yang, 2024). Moreover, the rapid pace of software updates and the complexity of Pro Tools' features necessitate continuous adaptation of teaching methodologies and curriculum design.

This research aims to investigate the integration of Pro Tools technology in digital music production education at B University and assess its impact on various aspects of the educational process and outcomes (Chuang, 2021). By examining factors such as integration level, instructor proficiency, and student engagement, this study seeks to offer new perspectives on the effectiveness of Pro Tools as an educational tool in a Chinese university (Resch & Schrittesser, 2023).

The findings of this research will not only benefit B University in refining its approach to digital music production education but also contribute to the broader understanding of technology integration in music education. As more institutions in China and globally consider incorporating industry-standard software into their curricula, this study will offer valuable perspectives on the challenges, best practices, and potential outcomes of such initiatives.

1.2 Research Questions

These research questions are designed to comprehensively explore the various aspects of Pro Tools integration in digital music production education at B University. They address the key variables identified in the research framework, including integration levels, instructor proficiency, student engagement, learning outcomes, and overall program effectiveness. With that, the research questions are formulated as follows:

1. How does Pro Tools technology impact students' digital music production education?

2. How does Pro Tools technology enhance students' learning achievements in digital music production education?

3. Do students using Pro Tools technology in digital music production courses demonstrate higher self-efficacy in digital music production education?

1.3 Research Hypotheses

Hypothesis 1: Pro Tools technology positively impacts students' digital music production education.

Hypothesis 2: The Pro Tools technology enhances students' learning

achievements in digital music production education.

Hypothesis 3: Students using Pro Tools in digital music production courses demonstrate greater student self-efficacy in digital music production education.

1.4 Research Objectives

1.4.1 To examine the impact of the Pro Tools technology on students' digital music production education.

1.4.2 To investigate how Pro Tools technology enhances students' learning achievements in digital music production education.

1.4.3 To study whether using Pro Tools in digital music production courses demonstrates greater student self-efficacy in digital music production education.

1.5 Scope of the Research

1.5.1 Scope of the Research Study

The research is confined to B University in Hubei Province, China. While the findings may have implications for other institutions, the study does not aim to generalize its results to all universities or regions. The unique cultural, economic, and educational context of Hubei Province and B University was considered in the analysis and interpretation of results.

1.5.2 Content

This study focuses specifically on the integration and impact of Pro Tools technology in digital music production education. While other music production software may be used in the program, they are not the primary focus of this research. The study examined various aspects of Pro Tools integration, including curriculum design, teaching methodologies, student engagement, learning outcomes, and program effectiveness.

1.5.3 Research Method

The study adopted a quantitative methodology to provide a comprehensive understanding of the research problem. The research method used in this study is a survey questionnaire, specifically designed to evaluate the integration and impact of Pro Tools technology on digital music production education at B University, Hubei Province, China. The pre- and post-tests were administered to assess changes in student learning outcomes and self-efficacy resulting from Pro Tools integration. The combination of surveys and pre- and post-tests ensures that both numerical data and personal experiences are considered, enabling a robust analysis of the integration of Pro Tools technology into digital music production education.

1.5.4 Duration

The research was conducted over one academic year, allowing observation of Pro Tools integration across different courses and levels of study. This timeframe enabled data collection over two semesters but may not capture long-term trends or the full impact of curriculum changes implemented during the study period.

1.6 Research Framework

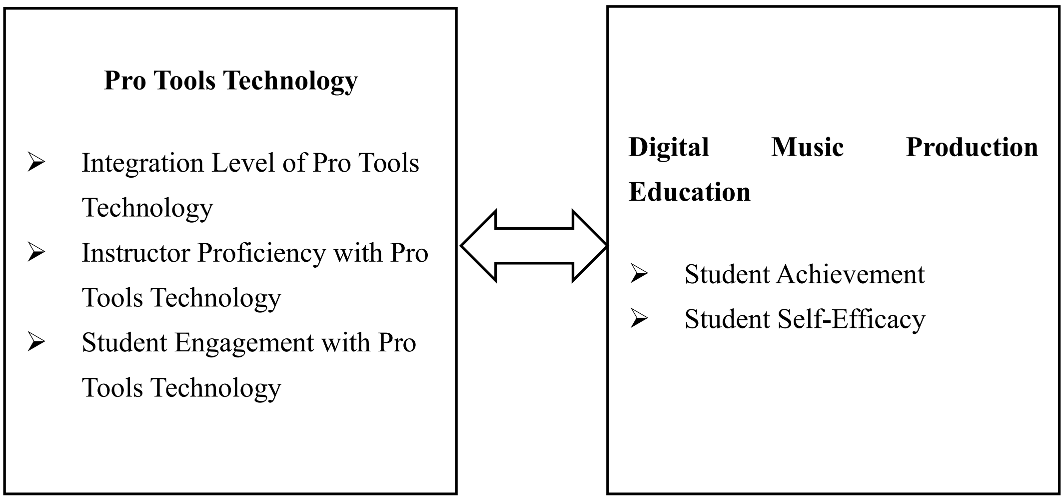

Figure 1.1 Research Framework

The research framework for this study is based on the following key variables:

Independent Variables:

- Integration Level of Pro Tools Technology
- Instructor Proficiency with Pro Tools Technology
- Student Engagement with Pro Tools Technology

Dependent Variable:

- Digital Music Production Education (student achievement and student self-efficacy)

This framework posits that the level of Pro Tools integration, instructor proficiency, and student engagement with the technology all influence the quality and outcomes of digital music production education at B University. The study examined how these independent variables interact and impact various aspects of the educational process and outcomes. The integration level of Pro Tools technology was assessed by reviewing its frequency of use in courses, the depth of its integration into the curriculum, and the variety of Pro Tools features used in teaching. Instructor proficiency was evaluated based on years of experience, certifications or training, and confidence in teaching Pro Tools. Student engagement was measured through time spent using Pro Tools outside of class, participation in related projects, and attitudes toward the software. The dependent variable, digital music production education, encompasses multiple facets, including student learning outcomes (student achievement) and overall program effectiveness (student self-efficacy). This framework allows for a comprehensive investigation of how Pro Tools technology is being integrated into the educational process at B University and its impact on various academic outcomes. It provides a structure for addressing the research questions and testing the hypotheses outlined in previous sections.

1.7 Definition of Key Terms

1.7.1 Pro Tools Technology

Pro Tools technology: A professional digital audio workstation used in music production, audio editing, mixing, film scoring, broadcasting, television, and other media audio processing. Pro Tools technology encompasses software and hardware, allowing users to record, edit, process, mix, and master high-quality audio.

Integration Level of Pro Tools Technology: The extent to which Pro Tools software is incorporated into the curriculum, teaching methods, and practical exercises in digital music production courses. This includes the frequency of use, the depth of integration into course content, and the variety of Pro Tools features used in teaching.

Instructor Proficiency with Pro Tools Technology: The level of expertise, experience, and comfort that instructors possess in using and teaching Pro Tools technology. This encompasses technical skills, pedagogical knowledge related to Pro Tools, and confidence in applying the software in educational settings.

1.7.2 Student Engagement with Pro Tools Technology

Student Engagement with Pro Tools Technology: The degree to which students actively participate in, interact with, and utilize Pro Tools technology in their learning process. This includes time spent using the software, involvement in Pro Tools-related projects, and attitudes toward its usage in their studies.

1.7.3 Digital Music Production Education

Digital Music Production Education: The process of teaching and learning the skills and knowledge required for creating, recording, editing, and producing music using digital technologies, with a specific focus on Pro Tools in this study.

Student Achievement: The measurable outcomes of students' performance in digital music production courses, including grades, scores on practical assessments, and demonstrated proficiency in using Pro Tools for music production tasks.

Student Self-Efficacy: Students' beliefs in their capability to successfully perform digital music production tasks using Pro Tools. This encompasses their confidence in operating the software, their ability to apply it to various music production scenarios, and their perceived ability to achieve desired outcomes.

CHAPTER II

LITERATURE REVIEW

2.1 Related Theories

2.1.1 Technological Pedagogical Content Knowledge (TPACK) Framework

In this sense, the Technological Pedagogical Content Knowledge (TPACK) appears as a valuable framework for understanding the integration of technology in educational settings, particularly in digital music production education. And with all of the above, it turns out that TPACK is actually an extension (a critical one) of Shulman's original work on Pedagogical Content Knowledge (PCK) (Alrwaished et al., 2020). For this study, the study could use a TPACK framework to examine Pro Tools technology in terms of its level of integration (TC), how proficient our instructors are with teaching engineering principles and tools like Pro Tools best coupled together (GP), and how effectively it works, so students want to know and understand this (SC).

The Technology, Pedagogy, and Content Knowledge (TPACK) framework suggests that meaningful integration of technology in teaching and learning through tech reflective practice begins with the unique knowledge base at interaction points between three primary forms: knowledge for teaching disciplines and technological disciplines (Aminah et al., 2020). In practical terms, this means that for an instructor teaching music production on Pro Tools as a software tool, they should have to know deeply about their field of study (CK alone), in addition to the best ways of helping students learn those contents and why they work well (PK alone), with technological development being used just considering it under all contexts related right above. Hence, the depth of integration available in Pro Tools technology depends on how well-trained and able teachers are to use this comprehensive approach.

The first way in which the integration level of Pro Tools technology into digital music production education is influenced is the extent to which it has been integrated into the curriculum and teaching practices. This aligns with the TPACK framework's emphasis on technological knowledge. Having this level of mastery over Pro Tools means that the instructors can incorporate it seamlessly into their instruction, thereby enabling students not only to learn how to use the tool but also to understand its roles, proposed projects, and how they fit within music production (Archambault et al., 2022). The last 5-10 years have seen significant improvements in integrating digital technology into education, resulting in an environment where technology supports and enhances pedagogical goals.

Second, having the skills as an instructor to use Pro Tools technology is essential in reaching high TPACK levels. Instructors with strong technological pedagogical knowledge (TPK) in Pro Tools can be effective at using it to teach, assess student learning, and provide feedback. They can identify technology problems and adapt their teaching style to accommodate diverse learning styles (Costa et al., 2020). According to the TPACK framework, teachers who understand and can efficiently use Pro Tools create a more engaging learning experience that is both interactive for students in the room and online. Instructors can augment this engagement by employing best practices in the classroom with Pro Tools.

The TPACK framework (as an independent variable) exhibits a strong correlation with student engagement, another dependent variable. This framework focuses on creating an active learning atmosphere that is engaging and supportive, with teaching as the medium for technology. Students will be best able to dig deeper into the material and build their skills when working with both a user-friendly version of Pro Tools and instructors who can navigate it effectively (Borodo et al., 2022). Cognitive and emotional engagement in the learning process allows students to interact with Pro Tools in a proper instructional context.

2.1.2 Social Cognitive Theory

Albert Bandura's Social Cognitive Theory (SCT) offers a theoretical model for understanding student success and the development of self-efficacy in digital music production education. As explained earlier, SCT suggests that learning occurs in a social context, where individuals are influenced by interactions among their environment, behavior, and others (Chuang, 2021). These ideas about observational learning, self-efficacy, and reciprocal determinism parallel those of SCT, as seen in a study of digital music production education at B University.

The basic premise of SCT is that people learn by observing others who serve as role models, particularly when the behavior they exhibit is rewarded. During digital music production education, Pro Tools is the technology that teachers use as a model for students to reference and learn from (Yang, 2024). The proficiency of their instructor with Pro Tools influences the students' ability to observe and learn effectively. Professors who show a high level of competence and confidence with technology persistently use it to model effective practice while also creating an environment that encourages students to imitate them.

Self-efficacy is a central construct in SCT and refers to a person's belief in their ability to succeed at a specific task or challenge (Han, 2021). An important issue in digital music production education is understanding the significance of student self-efficacy for learning and achievement. Students who believe they can achieve higher levels of competence in Pro Tools are likely to engage more actively and persist through the challenges of digital music production. According to the SCT, self-efficacy can be influenced by personal success experiences (direct mastery) and vicarious experiences (observing others perform), as well as by verbal persuasion from others and emotional states.

Both the integration level of Pro Tools technology and instructor proficiency influence student self-efficacy. A highly developed Pro Tools system built into the infrastructure of a recording program can give students ample opportunities to practice this tech and thus increase self-efficacy (Barton & Dexter, 2020). In addition, because the instructors know how to navigate Pro Tools competently and confidently, they can offer more thorough direction to their students, giving them greater confidence in themselves as well. Greater self-efficacy leads to higher levels of student achievement, as students undertake more difficult projects, experiment with ways of working and aim for quality in their work.

Reciprocal determinism, a core component of SCT, is referenced repeatedly throughout the MSC model and denotes an ongoing bidirectional relationship among personal factors (ex. self-efficacy) (Vorster De Wet, 2020), environmental forces (e.g., classroom environment, access to Pro Tools technology), and behaviors or performance outputs in composing music individually/with peers, respectively set against one another as indicators for student engagement & persistence efforts. For instance, in the context of digital music production education, the university's facilities, anchored in Pro Tools technology, play a crucial role by shaping students' beliefs and actions. For example, a digital music lab that is adequately stocked with Pro Tools can facilitate new and innovative experimentation in sound manipulation. Success in this setting increases students' sense of self-efficacy, leading to more engaged, persistent behavior, solidifying learning and achievement.

This research combines Social Cognitive Theory (SCT) and the Technological Pedagogical Content Knowledge (TPACK) framework to understand better how Pro Tools is used in digital music production classes and how it affects teaching effectiveness (Barton & Dexter, 2020). The TPACK framework requires teachers to integrate content, pedagogical, and technological knowledge (Aminah et al., 2020). When using Pro Tools to teach music production, teachers must have a thorough understanding of core content, such as audio editing, mixing, and mastering, which constitutes their content knowledge (CK). At the same time, teachers need to master effective methods for conveying this content (pedagogical knowledge, PK), such as step-by-step demonstrations, immediate feedback, and guidance in independent exploration (Archambault et al., 2022). Teachers must also be proficient in the technical functions of Pro Tools (technological knowledge, TK), including multi-track recording, MIDI editing, and plugins. These three elements enable teachers to design course content that meets educational objectives and fully leverages Pro Tools' capabilities. Beyond demonstrating the operation of Pro Tools, teachers should employ reflective practices to help students understand how these techniques are applied in music production (Borodo et al., 2022). For example, teachers can use case studies and project-based learning to guide students in using Pro Tools to complete the entire process, from creative concept to finished product. The teacher's instructional strategies encompass not only technical demonstrations but also interaction and feedback, fostering students' understanding and application of technology and enhancing their creativity and problem-solving abilities.

Social Cognitive Theory offers a framework for understanding the learning process (Chuang, 2021). SCT emphasizes that learning occurs through observation, imitation, and social interaction. In learning music production with Pro Tools, students not only learn technical operations through the teacher's demonstrations but also improve their skills and self-efficacy through collaboration, discussion, and peer feedback. For instance, students might observe how the teacher performs complex audio editing in Pro Tools and then attempt to replicate that process in their projects. Through ongoing practice and teacher feedback, students can gradually master these skills and build confidence in their abilities as they complete tasks. SCT also highlights the influence of the environment on learning (Yang, 2024). In a technology-rich learning environment, students can better combine theoretical knowledge with Pro Tools for hands-on work and experience music production. This environment not only enhances students' technical skills but also, through continuous practice and reflection, helps them develop a deeper understanding of music production. By combining the TPACK and SCT theories, the research can analyze the methods of integrating Pro Tools technology into digital music production courses and its specific impact on teaching outcomes (Han, 2021). This integration not only helps teachers design and implement instructional activities more effectively but also enhances students' technical skills and self-efficacy in practice, thereby significantly improving their learning experience and achievements.

2.2 Pro Tool Technology

Pro-Tool is intrinsically empathic because it fosters better communication between machines, sensors, and control systems, resulting in a higher level of integration that is essential for new-age manufacturing processes (Baqays, 2020).

One of the most notable features of Pro Tools technology is its versatile integration of hardware and software. This includes support for a full range of devices, including programmable logic controllers (PLCs), human-machine interfaces, and various sensors. Pro Tool, in contrast, enables these elements to communicate effectively and ensures that all components of a production system work together properly (Sanchez et al., 2020). This also reduces the need for manual effort, decreases the probability of errors, and increases overall productivity (Han, 2021).

2.2.1 Integration Level of Pro Tools Technology

Pro Tool offers extensive integration capabilities with hardware and software systems in industrial settings. Designing for various industrial protocols and standards makes it compatible with multiple software platforms used in manufacturing. It is compatible with other software applications for process control, data analysis and production management (Bueno et al., 2020). As a result, Pro Tool enables all software tools to collaborate and share their data efficiently, allowing managers to make more informed decisions that ensure the entire operation runs smoothly. Pro Tool also features a key integration capability that enables communication with higher-level enterprise systems. Production systems in most industrial environments must interact with enterprise resource planning (ERP) and supply chain management systems, among other business applications. Pro Tool technology enables such collaboration by providing interfaces that will allow data exchange from the shop floor to the enterprise level (Enrique et al., 2022). These capabilities offer integration with the production floor, enabling agile, real-time responses that help leaders make better decisions about their business by accessing information where it is created.

Moreover, Pro Tool incorporates the potential convergence of new technologies such as IoT (Internet of Things) and AI, which could be integrated to run operations within a room. The evolution of IoT devices and AI algorithms will require integration with existing systems to enhance adaptability as industrial automation continues to strengthen. Forward-compatible and designed to facilitate the addition of new technologies when they arrive, Pro Tool is built for the future (Li et al., 2020). Adopting this forward-focused integration strategy will enable manufacturers to innovate and maintain a competitive advantage in a rapidly changing environment.

The Pro Tool technology has the level of integration you would expect from an interface and experience perspective as well. The products are designed to be easy to use, providing operators and engineers alike with a user-friendly set of tools for controlling and overseeing complex systems without extensive training. Pro Tool offers intuitive HMI tools for control centers or similar environments, enabling operators to view and act on a variety of process parameters (Raudaskoski, 2022). In addition to ease of use, this built-in simplification leads to more than increased productivity; it also significantly reduces operational errors, further aiding a safer, more reliable production facility.

2.2.2 Instructor Proficiency with Pro Tool Technology

Effective education and subsequent implementation require the instructor to be proficient in Pro Tool technology within industrial settings. Industrial automation and production procedures have become significantly more sophisticated, increasing the demand for experienced trainers who can effectively convey information about Pro Tool technologies (Loukatos et al., 2022). In addition to their technical knowledge, these instructors must also know how to translate complex ideas into a format that can be learnt and applied by people of all types.

Before anything else, instructors must possess an in-depth understanding of Pro Tool functionality and use cases. This includes experience with the technological capabilities in connecting hardware and software systems, managing HMIs (Human-Machine Interfaces), and integrating communication between production line components. Teaching Tools and Techniques: Instructors will need to know the pieces of Pro Tool, how it interfaces with other devices (sensors or control systems), and its specific technical details (that support automation processes) so that they can communicate as effectively as possible (Sung et al., 2021). This means not only can instructors answer technical questions and troubleshoot issues, but they also provide learners with hands-on demonstrations.

In addition to technical expertise, instructors must be well-versed in the pedagogical challenges of teaching Pro Tools technology. This includes developing and delivering tailored training content for different groups with diverse characteristics. Instructors need to use the right teaching styles that appeal to all learners — whether they are engineers, technicians, or operators! The list continues with hands-on practice problems, interactive videos, and applications that allow you to gain practical experience or problem-solving experience in real time. A successful teacher must also monitor learners' progress and provide feedback that encourages improvement (Carless, 2022).

Also, the instructor's proficiency with Pro Tools indicates they are always informed about the latest developments and updates in this field. Pro Tools technology is constantly being updated with new features and capabilities. Teachers need to be lifelong learners and stay up to date on what works best (Bell, 2020). That could mean taking part in higher-level training, industry-related conferences, or joining industrial automation and tech networks. Staying up to date ensures instructors offer students the most relevant and robust training available.

The same goes for the instructor's proficiency in troubleshooting and problem-solving, if any. Any complex system is prone to issues, and Pro Tool technology falls into the same category in terms of quick thinking and problem-solving (Nagahi et al., 2021). At times, instructors will need to navigate technical problems and guide learners through a troubleshooting process; they must also be able to adjust their training strategies in response to challenges. This flexibility is critical to keeping the training session moving and helping learners reach their goals, no matter what obstacles they encounter.

2.2.3 Student Engagement with Pro Tool Technology

A key factor in the successful adoption and use of this advanced industrial automation tool is student engagement with Pro Tool technology. Facilitating active learning is essential to help students in an educational or training setting understand and simulate the intricate behaviors of Pro Tool in real-world use cases (Srivatanakul & Annansingh, 2022). They do this by creating high-quality learning resources, making the experience fun through an interactive teaching style, and fostering curiosity to learn and experiment.

A crucial element in student engagement with Pro Tool technology was the inclusion of practical learning experiences. As a complex platform that combines multiple industrial systems, Pro Tool can be too much for students to handle if they only learn it in theory. The gap between theory and practice can be bridged by having the instructor integrate practical sessions that allow students to directly interact with technology (Resch & Schrittesser, 2023). This may include simulations where students can test out the various functions of Pro Tools, and problem-solving and realize how instantly their actions make an impact. These experiential learning opportunities are significant for enhancing comprehension and keeping students engaged.

Using interactive teaching methods with Pro Tools technology significantly enhances student engagement and improves learning outcomes. Traditional lecture-based methods may be inadequate for dealing with complex automation systems. Instructors should instead use a mix of teaching strategies that promote active learning. For example, group projects that require teamwork to solve problems and case studies based on real-life industry scenarios (Zawilinski et al., 2020) can be effective. These are just a few examples, but such methods not only enrich the learning process and make it more dynamic; they also improve students' critical thinking and teamwork skills: key skills in an area as challenging as industrial automation.

Another way to increase student engagement with Pro Tool is to use technology-enhanced learning tools. When you combine media such as videos, simulations, or digital twins, learning becomes more accessible and engaging. The tool enables students to draw and create various program outputs and helps them learn complex abstract concepts, providing easily accessible feedback (Kanika et al., 2020). Additionally, elements of gamification, such as challenges and quizzes, along with progression, can drive students to engage with the content and take full responsibility for their learning path.

Our working spaces provide a supportive learning environment that engages students with the Pro Tool. Instructors will be able to better serve the various needs and learning speeds of your students, with additional help easily included where needed. This type of assistance can take the form of individual coaching, setting up student-run study groups, or running online forums where students can discuss problems and success stories. It is a way to maintain engagement at higher levels while avoiding frustration and disengagement by ensuring the class provides support and value to all students (Skilling et al., 2021).

2.3 Digital Music Production Education

In the information age, the need for digital music production education has emerged, as the creation and manipulation techniques used to produce sound for media applications have evolved rapidly. In modern music production, software instruments and DAWs are considered the primary focus of technology. The invention of Digital Audio Workstations (DAWs) and a paradigm shift in VST Plugins have changed how people create, produce, and distribute music (Douglas, 2024). As such, digital music production is nowadays taught not only as the playing of an instrument and the understanding of how to put a track together musically, but also as the learning of every detail to enable you to produce professional-quality music within a topical, commodifying, innovative, and ecological ecosystem.

Using a DAW (Digital Audio Workstation). A key focus in digital music production is teaching students how to access and use different DAWs. This software forms the primary backbone of music creation, with applications for recording vocals and instruments and stringing them together through an editing or mixing process to ensure everything is synced and in tune. Ableton Live, Logic Pro and FL Studio are the most popular DAWs among music producers, so aspiring music producers must know how to use them effectively (D'Errico, 2021). The objective of the course is to teach students how to create tracks, arrange songs, apply effects, automate their sets, and export their tracks. These skills are essential for producing music that meets industry standards.

Along with how to use DAW, digital music production education can also train you in many technical skills. Sound Design introduces students to the creation of their sound sources through synthesis, sampling and processing. Learning to use tools such as oscillators, filters and modulators effectively helps students design unique audio components that distinguish their sound from everyone else’s (Sickmen-Fox, 2023). Courses will also often explore mixing and mastering, training students to set levels properly, shape frequencies with an equalization processor & create dynamics for the final product using a compressor (Abbas et al.). These technical skills are essential for making music that sounds good across a wide range of playback systems and maintains professionalism and client satisfaction.

The ethos of creativity and artistic expression in digital music production is crucial. Education is as important as technical skills. To be a successful producer, it is more about what you can do with those tools that makes people hire and listen to your music. Case studies, space for developing new forms of writing, and other programs—both within educational institutions—highlight the value Osterweil placed on finding your voice and learning to write across a range of genres (Miranda et al., 2021). Students have the freedom to experiment with various production techniques and learn from a wide variety of musical genres. Fostering creativity, these curricula instill the individual voice necessary to compete in an increasingly saturated music market.

Skills related to collaboration and communication are essential for those continuing their digital music production education.

Music Industry: In the professional world, record producer duties include collaborating with an artist to find a suitable pre-production and production schedule for their music. In an academic setting, students will undertake various projects as part of group coursework, such as creating original songs or remixes and producing music for visual media (Ng et al., 2022). These situations help students learn to communicate their ideas and to disagree creatively with others while remaining productive and working together as a team. With music being driven mainly by collaboration in every sense of the word, finding your place within these dynamics and how to handle them is essential for the road.

2.3.1 Student Achievement in Digital Music Production

Student achievement in digital music production education has become increasingly important as technology continues to reshape the music industry. The integration of digital audio workstations (DAWs) such as Pro Tools into music education curricula has significantly changed how student achievement is measured and understood in this field.

Research by Kardos (2012) suggests that the use of music technology can make sound and music worlds more accessible to student composers, potentially leading to improved achievement outcomes. This accessibility factor is crucial in understanding how technology integration affects student performance. Building on this, Bell (2018) argues that the proliferation of DAWs has democratized music production, enabling students to achieve higher production quality than ever before.

However, the relationship between technology integration and student achievement is not straightforward. A study by Herbst and Muehlausen (2015) found that while technology can enhance students' capabilities, it also requires a shift in pedagogical approaches to realize its potential to improve student achievement fully. They emphasize the importance of balancing technical skill development with creative expression to foster comprehensive student achievement in music production.

In the context of higher education, Yang (2024) conducted a study on teaching electroacoustic music in digital environments. The findings indicate that students achieved higher levels of compositional sophistication when working with advanced DAWs, but this was contingent on proper instruction and scaffolding. This study points out the importance of effective pedagogy in translating technological capabilities into tangible student achievements.

Assessing student achievement in digital music production presents distinctive challenges. Harrison (2020) proposes that traditional methods of assessing music performance may not fully capture the nuances of achievement in digital production contexts. He advocates for assessment strategies that consider both technical proficiency and creative innovation, reflecting the dual nature of achievement in this field.

Empirical evidence from Ng et al. (2022) demonstrates that engaging students in creative music-making with digital tools can lead to significant improvements in both technical skills and musical understanding. Their study, which involved online flipped classroom strategies, showed that students achieved higher scores in production tasks and demonstrated more sophisticated musical thinking when actively engaged with music production software.

However, Dobbs (2017) cautions against an over-reliance on technology, arguing that foundational musical skills remain crucial for student achievement in digital production. He suggests that the most successful students are those who can effectively blend traditional musical knowledge with technological proficiency.

As the field continues to evolve, new paradigms of student achievement are emerging. D'Errico (2021) explores how the design of music software itself influences student learning and achievement. He argues that the interface and workflow of DAWs like Pro Tools shape not only what students can achieve but also how they conceptualize the music production process itself.

In conclusion, the literature suggests that student achievement in digital music production education is a multifaceted concept, influenced by factors such as technology integration, pedagogical approaches, assessment methods, and the balance between technical and creative skills. As technology continues to advance, ongoing research will be crucial to understanding and optimizing student achievement in this dynamic field.

2.3.2 Student Self-Efficacy in Digital Music Production

Student self-efficacy, a concept rooted in Bandura's (1997) social cognitive theory, plays a crucial role in digital music production education. In the context of music technology, self-efficacy refers to students' beliefs in their ability to use digital tools effectively for music creation and production. This concept has gained increasing attention as music education has become more technologically oriented.

Research by Waldron (2017) suggests that integrating networked technologies into music learning can significantly enhance students' self-efficacy. The study found that students who engaged in online music communities and collaborative digital projects reported higher levels of confidence in their music production abilities. This finding highlights the potential of technology to foster self-efficacy through peer learning and social validation.

However, the relationship between technology use and self-efficacy is not always straightforward. Bell (2020) conducted a study examining the relationship between self-efficacy and music teachers' ability to use technology in the classroom. The results indicated that while technology can enhance self-efficacy, there is also a threshold effect where too much unfamiliar technology can overwhelm students and temporarily decrease their self-efficacy.

In the context of digital audio workstations (DAWs), Yin (2024) found that students' self-efficacy in using Pro Tools was significantly influenced by the quality of instruction and the level of hands-on experience. Students who received structured, step-by-step guidance in using the software reported higher self-efficacy than those who were left to explore it independently. This illustrates the value of a pedagogical approach to fostering self-efficacy with complex music production tools.

The concept of technological pedagogical content knowledge (TPACK) has also been linked to student self-efficacy in digital music production. A study by Bauer (2013) found that instructors with high levels of TPACK were more effective in boosting student self-efficacy in music technology courses. This suggests that teacher competence plays a crucial role in developing student confidence with music production software.

Interestingly, Chuang (2021) applied constructivist learning theory to examine self-efficacy in music technology education for adults. The study found that project-based learning approaches, where students worked on real-world music production tasks, led to significant increases in self-efficacy. This highlights the importance of authentic learning experiences in building student confidence with music production tools.

Researchers have also explored gender differences in self-efficacy within music technology education. A study by Armstrong (2011) found that female students initially reported lower self-efficacy in music technology courses compared to male students. Still, this gap narrowed significantly with targeted interventions and supportive learning environments. This research points out the need for inclusive pedagogical strategies to ensure equitable development of self-efficacy across all student demographics.

The longitudinal development of self-efficacy in music production has been examined by Tobias (2015), who found that students' self-efficacy tends to follow a U-shaped curve over the course of their education. Initially, high levels of confidence often dip as students encounter the complexities of professional-grade software, only to rise again as they gain mastery. This pattern indicates that students require sustained support and encouragement throughout the learning process.

In conclusion, student self-efficacy in digital music production education is a complex construct influenced by factors such as technology integration, instructional quality, hands-on experience, and individual differences. As music education continues to evolve with technological advancements, fostering student self-efficacy remains a crucial goal for educators in this field.

2.4 The Relationship Between Pro Tools Technology and Digital Music Production Education

The integration of Pro Tools technology into digital music production education has shown promising results in enhancing student learning outcomes, skill development, engagement, and overall curriculum effectiveness. Research indicates that Pro Tools can make sound and music creation more accessible to students, potentially leading to improved achievement in composition and production tasks (Kardos, 2012; Bell, 2018). The software's professional-grade capabilities allow students to develop industry-relevant skills, better preparing them for careers in music production (D'Errico, 2021). Studies have found that engaging with Pro Tools can increase student motivation and self-efficacy in music technology courses (Chuang, 2021; Yin, 2024). However, the educational efficacy of Pro Tools is contingent on factors such as proper integration into the curriculum, instructor proficiency, and pedagogical approaches that balance technical skill development with creative expression (Herbst & Muehlausen, 2015; Yang, 2024). When effectively implemented, Pro Tools can serve as a powerful teaching tool that enhances the overall quality and relevance of digital music production education, fostering both technical competence and artistic innovation among students.

The relationship between Pro Tools technology and digital music production education is evident in skill development and teaching effectiveness, while also profoundly influencing educational models and learners' mindsets. As the industry standard for Digital Audio Workstations (DAWs), Pro Tools is an educational tool that integrates technology and art. It plays multiple roles in the teaching process: it serves as a platform for content delivery and a vehicle for developing students' creativity and collaboration skills (Kardos, 2012; Bell, 2018).

The widespread application of Pro Tools has facilitated the transition of music production education from traditional teaching models to more modern, practice-oriented ones. Compared to previous teaching methods that relied on physical equipment, Pro Tools offers a virtual production environment, enabling students to learn music technology at a lower cost and with greater flexibility (Chuang, 2021). This shift removes the constraints of hardware equipment, particularly for institutions with limited resources, lowering the educational barrier while granting students greater creative freedom. In such a teaching environment, students can deepen their understanding of complex concepts, such as audio editing, mixing techniques, and sound processing, through hands-on practice (Yin, 2024).

Pro Tools introduces standardized industry practices into music production education. By learning to operate this software, students become familiar with the entire process from recording to post-production and understand the industry's core requirements (Zawilinski et al., 2020). This experience prepares students to integrate into the music industry, making them competitive upon graduation. Pro Tools makes it easier for educational institutions to collaborate with the industry to design coursework that better aligns with employment needs. The version updates and feature expansions of Pro Tools keep pace with technological advancements, allowing teachers to continuously improve their teaching methods by incorporating the latest industry practices into the classroom, thereby keeping the curriculum current (Resch & Schrittesser, 2023).

The use of Pro Tools in teaching also promotes interdisciplinary integration. Digital music production involves technology, programming, and media design. In Pro Tools for sound design or scoring, students need to understand and apply knowledge of video editing, interactive technology, and even artificial intelligence (Srivatanakul & Annansingh, 2022). This interdisciplinary learning expands students' knowledge systems and cultivates their ability to solve complex problems, enabling them to better adapt to diverse career demands. The collaboration features of Pro Tools hold value in digital music production education. Collaboration is an integral part of the music production process. Through Pro Tools' cloud collaboration features, students can share projects in real time, exchange ideas, and collaborate on creations (Bell, 2020). This experience fosters teamwork skills while also providing students with valuable experience in facing collaboration challenges in actual professional environments.

The educational significance of Pro Tools also lies in its ability to stimulate students' creativity. Despite its complex and professional functions, the software's interface design and configuration options provide users with sufficient flexibility. This flexibility allows students to unleash their imagination and innovation within technical constraints. Through Pro Tools, students learn to follow technical rules while exploring new artistic expressions by breaking them (Nagahi et al., 2021). This balance is crucial for cultivating talent in proficiency and creativity. Pro Tools technology is a tool in digital music production education and is a driving force for changing educational methods and cultivating comprehensive talent (Carless, 2022). It tightly integrates technology and art, theory and practice, and individuals and teams, giving music production education greater depth.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design

3.1.1 Questionnaires

The study adopted a quantitative methodology to provide a comprehensive understanding of the research problem. The study used a survey to investigate the relationships among the integration level of Pro Tools technology, instructor proficiency with Pro Tools, student engagement with the technology, and student achievement and self-efficacy in digital music production education.

The survey instrument developed for this study includes Likert-scale items designed to assess perceptions of Pro Tools integration, instructor proficiency, and student engagement. The quantitative data were analyzed using descriptive statistics to characterize the sample and inferential methods, such as regression analyses, to test the proposed hypotheses and interpret relationships among the measured variables. This quantitative approach provides statistical evidence of the impact of Pro Tools integration and enriches the analysis, ensuring a well-rounded understanding of the technology's role in digital music education.

The participants in this study comprised students and instructors involved in digital music production courses at B University in Hubei Province, China. The student sample consisted of 278 individuals randomly selected from the approximately 1,000 students enrolled in these courses. These students represented various levels of study within the digital music production program. The instructor sample included 44 faculty members, also randomly selected, from 50 instructors who teach digital music production courses at the university. The instructors have varying levels of experience in both teaching and professional music production. Both student and instructor participants represented diverse backgrounds in age, gender, and prior experience with music technology. This sample size and composition were determined using Krejcie and Morgan's (1970) table to ensure statistical validity and representativeness of the broader population at B University. All participants are familiar with digital audio workstations, particularly Pro Tools, in an educational setting, making them well-suited to offer opinions about the integration and impact of this technology in their learning and teaching experiences.

3.1.2 Lesson Plan and Test

This study evaluated the impact of Pro Tools technology on students' achievement and self-efficacy in digital music production education through a lesson plan and testing (Ng et al., 2022). A comparative analysis identified the educational value of Pro Tools technology by combining pre- and post-tests. Before the study's commencement, pre-tests are conducted to assess students' achievement and self-efficacy at the starting point of the course. The assessment of achievement included measurements of students' competencies in digital music production. This test part was implemented through task completion, scoring criteria, and performance-based evaluations. Simultaneously, a survey on students' self-efficacy was conducted to assess their confidence in digital music production and their perceptions of their ability to complete tasks. The results of the pre-tests served as a benchmark for subsequent analysis of teaching effectiveness, providing a reference for comparing changes in students' abilities at different stages.

During the experimental phase, students engaged in teaching activities using Pro Tools and received systematic training in digital music production. The design of the teaching content emphasizes the core functions of Pro Tools in digital audio processing and output, with project-based learning employed to master the technical essentials. This stage ensured that students grasp the tool's use and integrate it into practical projects, thereby enhancing their application skills.

Upon completion of the teaching experiment, post-tests were conducted. The assessment methods for the post-tests remained consistent with those of the pre-tests to ensure data comparability and scientific rigor. The researcher paid special attention to students' progress in digital music production skills and software applications by measuring their achievement at the end of the course. At the same time, students' self-efficacy was resurveyed to examine changes after the course and to analyze whether the teaching process effectively boosted students' confidence in their task performance and cognitive abilities.

Through a comparative analysis of pre-test and post-test data, the analysis integrated quantitative research with students' personal experiences to ensure the scientific validity and practicality of the research conclusions.

3.2 Samples and Sample Size

3.2.1 Population

This study focused on students and teachers involved in digital music production courses at a private B university in Hubei province, China. This applies not only to students studying digital music production at the university but also to the teachers who teach these subjects. Enrollment records show there are nearly 1,000 students and about 50 instructors. Pro Tools novices were targeted because they represent people who can easily reach out to use Pro Tools in educational settings and align with the target users regarding our project requirements and deployment needs (Li et al., 2020). This research was intended to provide a holistic view of how Pro Tools technology has been introduced and the outcomes it has for student learning, so that all students are suitable for this study.

A study was conducted to evaluate the effectiveness of Pro Tools technology in music production, with the population comprising Class 1 and Class 2 students from the 2023 intake of the Music Production major at University B in Hubei Province, China. Class 1 has 33 students, while Class 2 has 35. The two classes were divided into an experimental and a control group. Specifically, Class 1 of the 2023 intake in the Music Production major adopted an integrated teaching approach using Pro Tools, whereas Class 2 continued with traditional teaching methods.

3.2.2 Samples

The research used the Krejcie and Morgan (1970) tables to determine a sample size based on the population value. A sample size of 278 is large enough to be representative of a population with n = 1000 students. If there are 50 instructors, the optimal sample size is 44 instructors. That is, the final sample for this study was N = 278 students and 44 instructors. In the context of data collection, this sample size strikes a balance between practicality and validity; it is an appropriate size to ensure reliability and generalizability. The Krejcie and Morgan table was used to determine the sample size based on statistical criteria, ensuring accuracy, reducing the risk of increased sampling error, and establishing confidence in the conclusions. Table 3.1 illustrates this.

Table 3.1 Population and Samples

No	Faculty	Population		Samples	
		Students	**Teachers**	**Students**	**Teachers**
1	Faculty of Music Production	199	10	56	9
2	Faculty of Audio Engineering	151	8	42	7
3	Faculty of Composition and Arrangement	249	12	70	11
4	Faculty of Performing Arts	121	6	33	5
5	Faculty of Music Education	178	8	50	7
6	Faculty of Music, Culture and Communication	102	6	28	5
Total		1000	50	278	44

The test on digital music production utilizes students from Class 1 and Class 2 of the 2023 intake in Music Production at University B in Hubei Province, China, as the research sample. Class 1 comprised 15 male and 18 female students, while Class 2 comprised 15 male and 20 female students. As shown in Table 3.2.

Table 3.2 Test Samples

Class	Class 1		Class 2	
Gender	Male	Female	Male	Female
Sample	15	18	15	20
Total	33		35	

3.2.3 Sampling Methods

This research employed simple random sampling to choose participants. This method was determined to be the optimal choice because it gives every individual in a population an equal opportunity to be included in the sample, minimizing selection bias and ensuring that the sample fairly represents the external population. Using the University Course Enrollment as the student sample, a complete listing of every student enrolled in digital music production classes was obtained from each university's registration office. A total of 278 students were selected from this list using a random number generator. Similarly, a list of all instructors teaching digital music production courses was compiled for the instructor sample, and 44 instructors were randomly selected from this pool using identical methods. By doing so, the sample was—one can hope—representative in a way that mirrors diversity in demographic characteristics (age group, nationality), level of experience, and other relevant criteria, which all go to strengthen both study conclusions under scrutiny.

3.3 Data Collection

Online platforms can reach diverse populations across many geographic areas, which might be impossible to reach in person. Given how digital music production is practiced nowadays, teaching via data collection on online platforms makes sense, as both students and teachers are familiar with and ready to use its tools. The online survey was created and delivered to the chosen students and educators in this sample. The survey was conducted online, using an established platform (e.g., Qualtrics or SurveyMonkey) to distribute the survey and manage data collection easily. The researcher measured all main variables in the study with multiple sections of a single survey.

3.3.1 Questionnaire Data Collection

Participants were to be queried on based demographic information, e.g., age, gender, and level/years of teaching (for instructors). The survey included items that measure the integration level of Pro Tools technology, including how often it is used in courses and how deeply it is integrated into coursework. Self-reported measures of confidence and competence with Pro Tools were used to evaluate instructor proficiency with the technology and perceived effectiveness in teaching with it. Student engagement with Pro Tools technology was quantified using items assessing the frequency of use, perceived ease of use, and whether they found it motivating/engaging. The following steps outline the methodology for data collection:

Step 1: Preparation:

Obtain approval from B University's ethics committee or relevant authorities. Prepare the online survey platform (e.g., Qualtrics or SurveyMonkey). Create the survey questionnaire based on the research variables.

Step 2: Sample Selection:

Obtain a complete list of students enrolled in digital music production classes from the university's registration office. Use a random number generator to select 278 students from this list. Obtain a list of all instructors teaching digital music production courses. Randomly choose 44 instructors from this pool.

Step 3: Survey Distribution:

Send invitation emails to the selected 278 students and 44 instructors, containing a link to the online survey. Include information about the study's purpose, confidentiality, and voluntary participation.

Step 4: Survey Administration:

Allow participants a specified time frame (e.g., two weeks) to complete the survey. Send reminder emails to those who have not yet responded after one week.

Step 5: Quantitative Data Collection:

Collect responses from the online survey platform. The survey included sections measuring: a. integration level of Pro Tools technology, b. instructor proficiency with Pro Tools technology c. student engagement with Pro Tools technology d. digital music production education outcomes (student achievement and self-efficacy).

Step 6: Data Verification:

Check the collected data for completeness and accuracy. Follow up with participants if any responses are unclear or missing.

Step 7: Data Storage:

Securely store all collected data to ensure participant confidentiality. Back up the data in a secure, password-protected location.

Step 8: Preliminary Analysis:

Conduct initial data screening to identify any anomalies or patterns. Prepare the data for in-depth analysis. By following these steps, you'll ensure a comprehensive and systematic data collection process that captures both quantitative and qualitative data, providing a rich dataset for your research on the integration and impact of Pro Tools technology in digital music production education at B University.

3.3.2 Test Data Collection

Step 1: Pre-test

The pre-test was conducted on students' education in digital music production. The aim is to understand the students' achievements and student self-efficacy in digital music production education before exposure to different teaching methods, providing a baseline for subsequent comparative analysis.

Step 2: Implementation of Different Teaching

Class 1 of the 2023 intake in the Music Production major adopted an integrated teaching approach using Pro Tools. Meanwhile, Class 2 continued with traditional teaching methods.

Step 3: Post-test

After the teaching experiment concludes, a post-test is conducted to reassess students' education in digital music production. The post-test used the same assessment methods as the pre-test to determine whether there had been significant changes in the effectiveness of digital music production education. By comparing the pre-test and post-test results, this study analyzed the different impacts.

Step 4: Analysis and Comparison

A comparative analysis of the data collected before and after the experiment was conducted. The research results determine the impact of an integrated teaching approach using Pro Tools technology on students' achievement and self-efficacy in music production.

3.4 Research Instrument

Part 1: For Answering Research Question 1

Questionnaire

A questionnaire survey is a research method that utilizes controlled scales to investigate issues and obtain reliable information. The process involves developing the final questionnaire, distributing it via online links, and collecting the responses. The questionnaire comprises four main sections:

Section One: This section collects basic personal information to categorize respondents into different subgroups for stratified sampling and analysis. Questions in this part include gender, age, and grade. Understanding these demographic variables helps analyze the sample's diversity. Section Two: This section evaluates digital music production education at B University in Hubei Province, China. The designed questions aim to assess the Pro Tools technology. The questions are designed to utilize a five-point Likert scale to measure knowledge mastery, skill application, and attitudes and behaviors.

The respondents were required to use a five-point Likert scale to rate their level of agreement with the statements: 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly Agree. The interpretation of the mean values was elaborated on in a separate section. Arithmetic means were utilized to analyze the responses, yielding continuous numbers with decimal points. The interpretation of these mean values is as follows:

The mean value of 1 but less than 1.5 indicates "Strongly Disagree".

The mean value of 1.5 but less than 2.5 falls under the "Disagree" category.

The mean value of 2.5 but less than 3.5 represents a "Neutral" stance.

The mean value of 3.5 but less than 4.5 signifies "Agree".

A mean value of 4.5 or higher indicates the "Strongly Agree" level.

To maximize response rate, the questionnaire includes an explanation of the study's nature and purpose. Respondents were informed that their contributions are essential and valuable. It is estimated that completing the questionnaire took approximately 15-20 minutes.

Part 2: For Answering Research Question 2

Lesson Plan: Pro Tools Integration in Digital Music Production

Pro Tools is a professional Digital Audio Workstation (DAW) developed by Avid Technology, extensively utilized in music production, audio editing, mixing, film scoring, radio, television, and other media audio processing fields. It is recognized as the industry standard in audio production and is favored by musicians, producers, mixing engineers, and film sound designers. Pro Tools offers powerful features that efficiently handle audio tracks and complex audio projects, supporting multiple formats and high-resolution audio sampling.

The technical architecture of Pro Tools comprises both software and hardware components. On the software side, Pro Tools provides a multifunctional interface that supports various audio processing tasks, including recording, editing, mixing, and mastering, complemented by robust audio processing plugins that enable precise control over audio quality. It supports traditional audio editing functions and includes advanced features such as MIDI editing, audio synthesis, dynamic processing, and time-stretching, enabling creative audio production. In terms of hardware, Pro Tools offers dedicated audio interfaces and control surfaces that seamlessly integrate with professional audio hardware equipment, further enhancing the accuracy and stability of audio processing.

Pro Tools is essential for education, particularly in digital music production courses, where it is widely used. It plays a role in course content and is integrated into syllabi, teaching methods, and practical exercises. Many institutions' digital music production programs require students to be familiar with Pro Tools and even use it as the standard tool for course assessments. Teachers utilize Pro Tools in instruction to help students master the core skills of professional audio production, ranging from basic audio recording to advanced audio processing and mixing. As Pro Tools technology continues to advance, teaching content is constantly updated to meet the needs of industry development.

Teachers' professional knowledge and experience are crucial to students' learning. Teachers need to be familiar with the Pro Tools interface and its functions and possess a deep understanding of how to apply it in teaching. Proficient teachers can help students efficiently grasp software operation techniques while guiding students in creation and technology, cultivating their innovative thinking and problem-solving abilities. Teachers' confidence and technical proficiency impact students' learning experience, influencing their interest and in-depth understanding of audio production. Pro Tools is a professional tool in the music and audio production industry and has become the core of many audio-related courses. With the continuous development of technology, the importance of Pro Tools in audio education and actual creation only continued to increase.

Duration: Students enrolled in the Digital Music Production Course. The course consists of four 90-minute sessions.

Objectives:

Students grasped fundamental music theories, including rhythm, harmony, pitch, and musical structure.

Students understood the modern music production process and its core steps.

Students applied the acquired knowledge to analyze musical works and create simple musical passages.

Session 1: Fundamentals of Music Theory (Pitch, Rhythm, Harmony)

Objective: Students understand the components of music and grasp foundational concepts.

Introductory Activity (10 minutes)

Play a classic pop music snippet (e.g., a simple melody in C major).

Ask students: What main elements can you hear in this music? (Guide students to focus on pitch, rhythm, harmony, etc.).

Core Instruction (40 minutes)

Pitch: Introduce musical scales (C major, natural minor) and the relationship between whole steps.

Rhythm: Explain time signatures (e.g., 4/4 time) and demonstrate basic rhythmic patterns.

Harmony: Teach triads, seventh chords, and their functions (tonic, dominant, subdominant).

Classroom Exercise (30 minutes)

Students mark pitch names and rhythmic values on the provided sheet music (in numerical or staff notation).

Simple chord accompaniment exercises for melodies (the teacher provides examples).

Summary and Q&A (10 minutes)

Summarize the core content of pitch, rhythm, and harmony.

Students ask questions, and unclear points are documented.

Session 2: Musical Structure and Appreciative Analysis

Objective: Students understand the structure of music and learn to analyze musical works.

Introductory Activity (10 minutes)

Play a pop music snippet (e.g., "Shape of You").

Ask: Can you identify the different sections of this song?

Core Instruction (40 minutes)

Introduce common pop music structures (verse-chorus-bridge-chorus).

Explain emotional expression and dynamic variations in music (crescendo, decrescendo, dynamic markings, etc.).

Classroom Activity (30 minutes)

Students analyze a pop song in groups, annotate its structural sections, and describe emotional changes.

Groups present their discussion.

Summary (10 minutes)

Summarize the core elements of musical structure and their role in composition.

Session 3: Music Production Process and Technical Understanding

Objective: Students understand the basic production process from composition to completion of a musical work.

Introductory Activity (10 minutes)

Ask: What steps are needed to produce a complete musical work?

Briefly review students' answers and introduce the session's topic.

Core Instruction (40 minutes)

Introduce the four main stages of music production: composition, recording, mixing, and mastering.

Briefly describe recording equipment, track management, and basic mixing techniques (e.g., equalizer, reverberation).

Classroom Activity (30 minutes)

Demonstrate a simple recording and mixing process to the students, which may include a demonstration video.

Students complete a paper-based analysis of the mixing exercise, following the instructions.

Summary and Discussion (10 minutes)

The teacher provides answers to students' questions as they review the results of classroom activities.

Session 4: Comprehensive Review and Assessment

Objective: Consolidate knowledge and assess learning outcomes through testing.

Review Activity (20 minutes)

Recap core knowledge points from the previous three sessions.

Students can ask questions freely, and the teacher provides answers.

Formal Assessment (60 minutes)

Music Knowledge Test:

The test consists of 20 multiple-choice questions, worth 40 points, designed to assess students' understanding of basic music knowledge and production processes.

Feedback and Summary (10 minutes)

The teacher briefly comments on the test results and provides targeted improvement suggestions.

Encourage students to put the knowledge they have learnt into practice.

Teaching Methods and Resources

Teaching Methods:

The teaching methods utilize heuristic instruction, supplemented by practical examples.

The teaching methods also include group discussion and interactive analysis.

The exercises are task-driven and incorporate musical snippets.

Teaching Resources:

Multimedia music materials (pop music snippets, classic works).

The resources include numerical notation, chord diagrams, and basic sheet music analysis exercises.

Student Achievement Test

This test aims to evaluate students' achievement in digital music production education comprehensively. The student achievement test aims to evaluate students' mastery of core knowledge in music theory, structure, and production processes within the digital music production course.

Test Content and Scope

The content of this test is divided into the following sections:

Music Fundamentals (50%)

This section covers pitch, rhythm, harmony, scales, chords, and musical notation. This section examines students' basic understanding of core musical elements, ensuring they can accurately identify and apply related knowledge.

Music Structure and Appreciation (25%)

Students learned about common musical forms, such as the verse-chorus structure in pop music, and developed their ability to perceive and describe musical emotional expression and dynamic changes.

Music Production Process (25%)

Primarily assesses students' understanding of the music creation process (such as recording, mixing, and mastering), including the functions and application scenarios of basic technical terms (such as ‘equalizer’, ‘metronome’, and ‘reverberation’).

Test Administration

Time: The recommended test duration is 30 minutes to ensure students have sufficient time to complete the questions.

Format: This can be administered as a paper-based test or an online quiz.

Scoring Criteria: Each correct answer is worth 2 points; incorrect or unanswered questions receive no points. The score is 40, and the scoring results evaluate students' theoretical knowledge and the effectiveness of classroom instruction.

Analysis of the score distribution can provide feedback on students' overall learning effectiveness and guide instructional adjustments to target weak areas. Additionally, combining students' classroom performance with other evaluation indicators can provide a more holistic reflection of their learning progress.

Part 3: For Answering Research Question 3

The student self-efficacy test in digital music production learning aims to assess students' confidence in their abilities and their self-evaluation of task completion in learning digital music production. Self-efficacy reflects students' beliefs in their capacity to solve problems, accomplish tasks, and achieve success in their musical endeavors. Through this test, teachers can gain insights into students' psychological states and confidence levels throughout the learning process. Furthermore, teachers can analyze the impact of teaching methods on students' learning attitudes and self-perception. The data obtained serves as a basis for further refining teaching approaches and strategies for providing psychological support to students.

Test Content and Scope

This test comprises 20 items, primarily examining the following three dimensions:

Confidence in Task Completion

Measures students' level of confidence when completing musical learning tasks such as reading musical notation, analyzing musical structures, or composing musical passages. It assesses students' acceptance of complex functions in music learning and their confidence in solving problems.

Psychological Adaptability During Learning

Examines students' coping strategies when faced with challenges or failures. It also evaluates their satisfaction with learning efficiency, progress rate, and achievements.

Expectations of Achievement and Goal Setting

It gauges students' expectations regarding their ability to meet learning goals, such as understanding music theory or producing a complete musical composition. It tests their enthusiasm for future learning challenges and their sources of motivation.

Test Format and Design

Item Type: 20 items using a three-point Likert scale (1=Disagree, 2=Neutral, 3=Agree).

Scoring: Each item is worth 3 points, with a total possible score of 60. Student self-efficacy levels were analyzed by score range.

Test Administration

Duration: Approximately 15 minutes.

Format: Online questionnaire or paper-based test, ensuring anonymity to encourage honest responses from students.

Precautions: Before the test, explain its purpose (to aid in improving teaching) to students to alleviate psychological burdens.

Test Functions

Diagnostic: Helps teachers understand students' psychological states and learning confidence, identifying those who require support.

Interceptive: By analyzing students' self-efficacy scores, teaching strategies can be developed to enhance learning outcomes.

Evaluative: Combining pre-test and post-test data, it analyzes the impact of teaching interventions on students' confidence and learning attitudes, optimizing curriculum design.

3.5 Content Validity and Reliability

3.5.1 Validity

Validity refers to the extent to which a measurement tool or method accurately measures its intended content. Factor analysis is commonly used to examine the construct validity of scales. Initially, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity can be employed to determine whether the data are suitable for factor analysis. According to Kaiser, H., a KMO value above 0.90 indicates that the scale is highly suitable for factor analysis; between 0.8 and 0.9, it is suitable; between 0.7 and 0.8, it is marginally suitable; between 0.6 and 0.7, it can still be considered marginally suitable, albeit with caution; between 0.5 and 0.6, factor analysis is not recommended; and below 0.5, factor analysis is deemed highly unsuitable. Additionally, factor analysis can proceed when the p-value of Bartlett's test of sphericity is less than or equal to the significance level. This study designed its questionnaire based on relevant literature, ensuring it possesses high content validity. This study utilized factor analysis to assess structural validity. To determine the underlying structure of the collected data, we specifically conducted exploratory factor analysis.

The methodology of this study prioritized ensuring the content validity and reliability of the survey instrument. Content validity indicates that the survey items fully represent all aspects of a construct. This goal is accomplished through an exhaustive literature review on digital music production education, arts technology integration, and, particularly, the implementation of Pro Tools in academia, which leads to the development of a survey questionnaire. The researcher solicited expert feedback on survey items from instructors and experts in digital music production, educational technology, and audio engineering within the context of popular/commercial music genres operating in their online domains. Experts rate the pertinence of items to construct representation and clarity, or the lack of term definitions. All items that are ambiguous or redundant receive amendments, so they are not included in a later version of the survey. This test determines the final form of our remaining variables. On the other hand, reliability is the degree to which your survey results remain consistent over time.

Ratings were as follows:

A rating of +1 indicates that it is "consistent with the definition".

A rating of 0 indicates that it is "uncertain whether it aligns with the definition".

A rating of -1 indicates that it is "not consistent with the definition".

The Index of Objective Consistency (IOC) was calculated. A content consistency index of 0.5 or greater is deemed suitable for research. The IOC analysis result was 1.00.

3.5.2 Reliability

A pilot study was conducted with a small group of students and teachers from the same population (not included in the primary survey) to assess the instrument's reliability. During a pilot study, data were analyzed using Cronbach’s alpha to assess the reliability of each survey section. We expected anything above 0.70 to indicate internal consistency among the survey items and that they ultimately measure what we believe they do. The pilot study results revealed that all survey sections have satisfactory reliability, with Cronbach's alpha ranging from 0.75 to 0.95. These results suggested that the survey instrument is both valid and reliable, which adds to our confidence in the secure, robust data for analysis in the main study. The research team reviewed the survey one last time, and any final changes were made prior to full deployment to ensure greater validity and reliability.

3.6 Data Analysis

The researcher employed inferential statistics to test the hypotheses formulated for this study and to infer relationships between variables. The primary methods of inferential statistics utilized in this study include regression analysis, correlation analysis, and Analysis of Variance (ANOVA). These methods were applied to data collected through the questionnaire, standardized test, and lesson plan implementation.

For the questionnaire data, correlation analysis was used to assess the strength and direction of relationships between the independent variables (integration level of Pro Tools Technology, instructor proficiency, and student engagement) and the dependent variables (student achievement and self-efficacy). The researcher calculated a Pearson correlation coefficient for each pair of variables, reflecting how closely they are related. A positive correlation indicates that as one variable increases, the other tends to grow as well, whereas a negative correlation suggests an inverse relationship. The strength of these correlations was evaluated based on the proximity of the coefficient to +1 or -1.

Regression analysis was employed to investigate the explanatory power of the independent variables on the dependent variables. The researcher constructed multiple regression models to predict student achievement and self-efficacy, integrating Pro Tools technology, instructor proficiency, and student engagement. The resulting slope coefficients were used to examine relationships between the dependent and independent variables. At the same time, the R-squared value indicated the proportion of variance in the dependent variable explained by the independent variables. F-tests were used to assess the significance of the regression models, and t-tests were used to evaluate the significance of individual predictors. The researcher excluded invalid responses, such as those with significant missing data or those that displayed a pattern of random answers. Next, the questionnaire responses were numerically coded for ease of analysis (e.g., Male = 1, Female = 2; Likert scale responses ranging from 1 to 5).

3.6.1 Descriptive Statistics

Descriptive statistics were used to summarize the data's fundamental characteristics. Frequency distributions were calculated for categorical variables (such as gender, grade, and major). For variables, the central tendency (mean) and variability (standard deviation) were calculated.

3.6.2 Inferential Statistics

Inferential statistics were employed to analyze the data, testing hypotheses at the 0.05 significance level. This analysis aimed to examine the relationships or interactions between the dependent variable and several independent variables.

Descriptive statistics summarized the fundamental characteristics of the data. For categorical variables such as gender, grade, and specialty, frequency distributions were calculated to showcase the number of samples within each category, providing insights into the sample. For continuous variables such as age, measures of central tendency (e.g., mean, median, and mode) and variability (e.g., standard deviation and range) were computed to describe the distribution and dispersion of the data. This statistical information offered a comprehensive overview of the data, enabling researchers to identify fundamental trends and characteristics and laying a foundation for further analysis.

Inferential statistics were employed to analyze the data and test research hypotheses at the 0.05 significance level. By extrapolating from sample data to infer characteristics, inferential statistics examines the relationships or interactions between dependent variables (e.g., academic achievement) and independent variables (e.g., gender, grade, teaching methodology), assessing the influence and significance of these variables. The t-tests assessed whether the independent variables had a statistically significant impact on the dependent variables, shedding light on the roles and interrelationships among different factors in student achievement.

By combining descriptive and inferential statistics, researchers can systematically analyze and interpret the effects of Pro Tools technology on students' digital music production education, thereby validating research hypotheses and drawing scientific conclusions. This process not only unveiled the potential effectiveness of educational strategies but also provided empirical evidence for further educational interventions and policy-making.

CHAPTER IV

ANALYSIS RESULT

Based on the research content presented in Chapters 1 to 3, this chapter validates the hypotheses through data collection and analysis. The SPSS software is utilized to test various research hypotheses, employing descriptive statistical analysis (frequency, percentage, mean, and standard deviation) and independent-sample T-tests to analyze the sample distribution of students from B University in Hubei Province, China, and the differences before and after implementing Pro Tools technology in digital music production. Data were collected and analyzed using questionnaires, learning plans, and tests. The questionnaire covered basic student information and students' evaluations of their achievement and self-efficacy with Pro Tools technology in digital music instruction. A total of 322 questionnaires were collected, including 278 from students and 44 from teachers. Tests were conducted to evaluate students' achievement and self-efficacy in using Pro Tools technology. Students were nurtured through learning plans, and pre-test and post-test data were collected to analyze the differences. To evaluate the effectiveness of Pro Tools technology in music production, Class 1 and Class 2 of the 2023 intake in the Music Production major at B University in Hubei Province, China, were selected as the study population. Class 1 had 33 students, while Class 2 had 35. Classes 1 and 2 of the 2023 intake in the Music Production major were divided into an experimental group and a control group. Class 1 of the 2023 intake adopted an integrated teaching approach with Pro Tools technology, while Class 2 continued with traditional teaching methods.

4.1 To Examine the Impact of the Pro Tools Technology on Students' Digital Music Production Education

Overview of the descriptive characteristics of the participants in the study. Regarding gender distribution, the sample includes 176 males (54.7%) and 146 females (45.3%), indicating a relatively balanced distribution, with a slight majority of males. For age distribution, the participants (86.0%) fall within the 18-25 age group, making it the dominant demographic in the study. Smaller proportions are observed in other age groups, including 26-35 (4.0%), 36-45 (6.5%), and above 45 (3.1%), while only 0.3% of participants are under 18. This suggests that the study primarily targets young adults, which is typical for educational or training environments. Regarding familiarity with Pro Tools technology, all 322 participants (100.0%) reported familiarity, with none reporting unfamiliarity. This uniformity ensures that the participants share a consistent baseline understanding of the technology, making them suitable for the study's focus on Pro Tools-related educational outcomes. The data highlights a predominantly young and Pro Tools-aware participant, with a balanced gender distribution. These characteristics provide a strong foundation for examining the research questions related to Pro Tools and its impact on digital music education.

Table 4.1 Descriptive Characteristics

Items	Options	Frequency	Percent
Gender	Male	176	54.7
	Female	146	45.3
Age	Under 18	1	0.3
	18-25	277	86.0
	26-35	13	4.0
	36-45	21	6.5
	Above 45	10	3.1
Do you know Pro Tools technology?	Yes	322	100.0
	No	0	0
Total		322	100

Table 4.2 Average, Standard Deviation, and Interpretation of the Impact of the Pro Tools Technology on Students' Digital Music Production Education

	Questions	Average	Std. Deviation	Interpretation
Integration Level of Pro Tools Technology	Pro Tools is seamlessly integrated into our university's digital music production curriculum.	3.69	.866	Agree
	The use of Pro Tools technology is encouraged in all relevant courses.	3.66	.989	Agree
	Students have access to Pro Tools for practice outside of scheduled class time.	3.61	1.033	Agree
	Pro Tools is consistently used across courses in the music production program.	3.51	1.071	Agree
	The curriculum is updated regularly to incorporate new features of Pro Tools.	3.62	.998	Agree
	Pro Tools integration has improved the overall quality of music production education.	3.68	.913	Agree
	The university provides adequate resources to support the integration of Pro Tools technology.	3.54	1.133	Agree
	There is a clear strategy for integrating Pro Tools into the music production program.	3.51	1.092	Agree
Instructor Proficiency with Pro Tools Technology	Instructors are proficient in using Pro Tools for teaching digital music production.	3.41	1.147	Neutral
	Instructors receive regular training on the latest features of Pro Tools.	3.67	.984	Agree
	Instructors can troubleshoot and assist students with Pro Tools-related issues.	3.60	.906	Agree

	Questions	Average	Std. Deviation	Interpretation
	Instructors' proficiency positively impacts student learning outcomes.	3.57	1.078	Agree
	Instructors use Pro Tools effectively to demonstrate music production techniques.	3.41	1.100	Neutral
	Instructors regularly incorporate Pro Tools into their lesson plans.	3.48	1.114	Neutral
	Students feel confident in their instructors' knowledge of Pro Tools technology.	3.57	1.072	Agree
	The university provides adequate support for instructors to improve their Pro Tools skills.	3.51	.971	Agree
Student Engagement with Pro Tools Technology	Students actively engage with Pro Tools technology during class.	3.59	1.093	Agree
	Pro Tools technology makes the learning process more interesting for students.	3.47	1.100	Neutral
	Students use Pro Tools outside of class to enhance their learning.	3.48	1.097	Neutral
	The availability of Pro Tools increases student participation in digital music production.	3.50	1.063	Agree
	Students feel motivated to learn more about digital music production because of Pro Tools.	3.50	.941	Agree
	Pro Tools technology fosters collaboration among students in the music production program.	3.64	1.106	Agree
	The use of Pro Tools has improved student	3.52	1.091	Agree

	Questions	Average	Std. Deviation	Interpretation
	engagement in music production classes.			
	Students are confident in using Pro Tools technology for their assignments and projects.	3.54	1.047	Agree
Digital Music Production Education	Pro Tools technology has enhanced my understanding of digital music production.	3.55	1.070	Agree
	My achievements in digital music production have improved due to the use of Pro Tools.	3.69	.866	Agree
	I feel more confident in my music production skills after using Pro Tools.	3.66	.989	Agree
	Pro Tools technology has contributed to my success in digital music production courses.	3.61	1.033	Agree
	Using Pro Tools has prepared me well for a career in digital music production.	3.51	1.071	Agree
	I believe that Pro Tools technology is essential for my academic success in music production.	3.62	.998	Agree
	My self-efficacy in digital music production has increased due to my experience with Pro Tools.	3.68	.913	Agree
	Pro Tools technology has significantly impacted my overall achievement.	3.54	1.133	Agree

The insights were provided to inform understanding of what it looks like to integrate new technology, such as Pro Tools, into a university's digital music production program, its impact on the classroom, and the responses of professors and students within the curriculum. Overall, the results indicate that Pro Tools is generally well integrated into the program and has a positive impact on education outcomes, with some areas showing room for improvement.

From a curriculum-integration perspective, respondents agreed that Pro Tools plays a role in music production. The highest-rated item (with a mean score of 3.69) was that the Pro Tools integration has improved the overall quality of music production education. Respondents similarly emphasized that the curriculum is updated frequently to include new Pro Tools features (average = 3.62), followed by students knowing the software outside class (average = 3.61). These results indicate that the university prioritizes keeping its technology-based music production curriculum up to date and allows students the space to hone their practice. On the other hand, the consistency with Pro Tools used in courses was rated noticeably lower (average = 3.51), indicating that Pro Tools was used consistently across all courses.

Additionally, instructors perceived the university as supportive and Pro Tools skills as positive. The instructor's high (average = 3.67) response regarding training on regular Pro Tools features indicates an institutional effort to keep staff informed of technological developments. There is a modest gap in autopilot levels between students' Pro Tools prowess (average = 3.41) and their ability to demonstrate it successfully (average = 3.41). Expectations for instructors' capacity to troubleshoot problems and integrate Pro Tools into lesson plans rated only moderately well (3.60 and 3.48 means, respectively), indicating departments should continue emphasizing instructional skills so that instructors can deliver consistently and effectively.

It addressed some perceptions of Pro Tools' impact on students' learning and engagement. The technology makes learning exciting (average = 3.47) and encourages collaboration with students (average = 3.64). Students felt comfortable using Pro Tools for assignments and projects (average = 3.54), and they thought that the technology enhanced their understanding of digital music production (average = 3.55). These results highlight the power of Pro Tools to improve technical skills in collaborative, interactive learning environments. However, students reported moderate scores on their motivation to learn more about music production as a result of working in a Pro Tools environment (average = 3.50) and the degree to which they feel it has influenced their achievement (average = 3.54), indicating that while Pro Tools is a tool, the transformative application could be strengthened.

Response indicates a workable agreement among students on the positive impact of Pro Tools on their self-efficacy (average = 3.68) and career preparation (mean = 3.51). Students felt that their skills, learning and achievements in producing music improved after using Pro Tools (average = 3.69). However, somewhat lower ratings in preparing students for their careers suggest a disconnect between what students are learning in the classroom and what the industry expects.

The evidence indicates that Pro Tools is a highly regarded and valuable part of the university's digital music production program. These effects provide additional insight into its ability to support student learning, engagement, self-efficacy, and overall academic quality. While those are important, there are further opportunities for optimizing the impact of (or, in some cases, the context in which) the tool itself, and they are as follows: (1) competing with gaps in instructor proficiency, (2) varying use in different courses, and (3) alignment of learning outcomes, career preparation and delivery format.

4.1.1 The Integration Level of Pro Tools Technology Positively Impacts Digital Music Production Education

Table 4.3 Regression Analysis of Integration Levels of Specialized Tool Technologies

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.947	.416		2.275	.024
	Integration Level of Pro Tools Technology	.968	.014	.967	68.123	.000

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		

a. Dependent Variable: Digital Music Production Education (Student Achievement and Student Self-Efficacy)

The regression analysis revealed a strong, significant correlation between Pro Tools technology integration and students' achievement and self-efficacy in digital music production. The model demonstrates how impactful Pro Tools' coupling is in shaping students' attitudes and confidence in seeking knowledge in digital music production.

Given this linear regression analysis, the unstandardized coefficient (B = 0.968) indicates that adding a unit to the Pro Tools technology integration level is associated with an increase of 0.968 units in the outcome variable, which includes student achievement and self-efficacy in digital music production education. These significant coefficients suggest that implementing Pro Tools has a near one-to-one positive effect on students' educational outcomes. Moreover, the low standard error (Std. Error = 0.014) for this coefficient indicates high precision, further supporting the credibility of the results.

The standardized coefficient (Beta = 0.967) illustrates the practical importance of Pro Tools integration. A Beta value close to 1 indicates that the degree of Pro Tools integration almost perfectly predicts variations in student achievement and self-efficacy compared to other possible factors. The value of this standardized coefficient is so high that it can be interpreted as explaining technology’s role as a key element in the broader context of digital music production education. The extent to which Pro Tools is integrated into the curriculum and the overall learning environment profoundly impacts student performance and confidence.

The t-value (t = 68.123) is again extremely large, confirming that the observed difference in student outcomes due to Pro Tools integration is not by mere chance and is statistically significant. This elevated t-value corresponds to the low p-value (Sig. = 0.000), which is much lower than the conventional significance threshold of 0.05. The p-value is near zero, confirming that the relationship they observed in Pro Tools is significant and cannot be attributed to sampling error.

The constant term (B = 0.947) estimates the level of student achievement and self-efficacy in digital music production education when the level of Pro Tools integration is 0. The constant is statistically significant (p = 0.024); however, it is small in magnitude compared to the Pro Tools integration coefficient, highlighting the relative value of technology and its effective application to maximize foundational inputs to educational outcomes. It means that, although other variables could affect student outcomes, the Pro Tools integration is the major contributor here.

The regression analysis contributes to the existing body of research by demonstrating a significant predictive relationship between the level of integration of Pro Tools technology and academic outcomes, as measured by student self-reports of achievement and student self-efficacy in studies focused on digital music production instruction. The addition of technology contributes to this: coefficients are large and highly significant, and education technology is positively affecting educational quality. Such sites have reiterated the critical need for a growing commitment to Pro Tools programming and the intelligent application of that technology in the development of all digital music production programs. Strengthening integration efforts is necessary to equip students, both physically and emotionally, for music production.

4.1.2 The Instructor's Proficiency with Pro Tools Technology Positively Impacts Digital Music Production Education

Table 4.4 Regression Analysis of Instructor's Proficiency with Pro Tools Technology

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	8.166	.930		8.777	.000

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Instructor Proficiency with Pro Tools Technology	.734	.032	.785	22.673	.000

a. Dependent Variable: Digital Music Production Education (Student Achievement and Student Self-Efficacy)

Moreover, regression modelling shows the extent to which instructor familiarity with Pro Tools technology affected student achievement and perceived ability to learn digital music production. The results showed that students' experiences and educational outcomes overlapped with instructors' familiarity with Pro Tools.

The unstandardized coefficient (B = 0.734), for example, indicates that for every 1-unit increase in instructors' proficiency with Pro Tools, there is a 0.734 increase in the dependent variable (including student achievement and self-efficacy). This excellent coefficient indicates that instructors need to ensure their students are proficient in using Pro Tools, which significantly aids our learning process. This means that the better teachers master this technology, the better they can increase their pupils' self-confidence and academic abilities in music production.

The standardized coefficient (Beta = 0.785) validates the strength of the relationship. In other words, instructor performance accounts for much of the variation in student results compared to other factors — a Beta of 0.785. This indicates that proficiency in using Pro Tools is not merely an addition to their teaching methods, but rather a significant factor influencing students' success and confidence in that area of learning. When students have teachers who understand, model, and advocate for the leading music production technology, it provides a significant advantage.

The t-value (= 22.673) is exceptionally high, indicating that instructor quality and student outcomes are strongly associated and that this relationship is unlikely to be due to chance. If T is very high (which correlates with the very low p

(Sig. = 0.000)), then they can determine that the effect of instructors' skills on student success and student self-efficacy is highly statistically significant. The findings suggest that instructor proficiency has a significant, unidirectional effect on course facilitation, underscoring its importance when delivering Pro Tools course content.

In this case, the constant (B = 8.166) signifies the degree of students' achievement and self-efficacy at the lowest point of the instructor's performance. The level of significance of the constant (p = 0.000) indicates that, even in the complete absence of excellent teaching, there was still a degree of success and confidence in students that can only be attributed to self-determination or independent access to Pro Tools. But the fairly sizable influence of instructor fluency suggests that it significantly amplifies these baseline outcomes.

The regression analyses indicate that the level of instructor familiarity with Pro Tools technology is a significant, if not the most vital, factor in choosing the landscape of digital music production education. Overall, the findings indicated that as instructors became more proficient and confident with Pro Tools, students also achieved higher levels of proficiency and self-efficacy. This can further cement the importance of integrating Pro Tools into education by providing professional development, offering X training, and ensuring that the integration is conducive to a useful course for instructors. Therefore, educational organizations can enhance the value of their digital music production courses by improving their quality and help students develop stronger preparedness for their upcoming academic paths and careers.

4.1.3 Student Engagement with Pro Tools Technology Positively Impacts Digital Music Production Education

Table 4.5 Regression Analysis of Student Engagement with Pro Tools Technology

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.655	.958		9.038	.000

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Student Engagement with Pro Tools Technology	.716	.033	.769	21.512	.000

a. Dependent Variable: Digital Music Production Education (Student Achievement and Student Self-Efficacy)

The regression analysis reveals a statistically significant correlation between student engagement with Pro Tools technology and both student achievement and student engagement in digital music production. The unstandardized coefficient (B = 0.716) indicates that a one-unit increase in student engagement with Pro Tools is associated with a 0.716-unit increase in the dependent variable, which serves as a synthetic measure of student achievement and self-efficacy. The results show that the more actively students engage with Pro Tools technology, the better they learn, study, and achieve higher goals, as well as build confidence in music production.

This means that the standardized coefficient Beta = 0.769 in the regression model indicates a strong relationship that accounts for most of the variance in student achievement and self-efficacy, according to Pro Tools. The Beta was so high; engagement with Pro Tools technology directly correlates with educational outcomes: the more active the Pro Tools user, the higher the confidence levels and performance in the music production context.

Notably, the high t-value (t = 21.512) indicates the strength of the link between engagement and student outcomes. In addition, the extremely low p-value (sig. = 0.000) indicates that this effect is statistically significant and not due to chance. Such a finding provides compelling evidence that product engagement with the Pro Tools environment has a statistically significant and positive impact on both outcomes — achievement and self-efficacy — and this impact is consistent across cohorts (students using Pro Tools).

Additionally, the constant term (B = 8.655) shows the level of achievement and self-confidence students have without using Pro Tools. While this baseline is statistically significant (p = 0.000), the strong effect of student engagement suggests that frequent use of Pro Tools significantly boosts test scores. Other successful learning methods exist, but regularly using this technology greatly improves both performance and educational experiences.

Pro Tools technology positively impacts students' education in digital music production. The analysis shows that students' engagement with Pro Tools is the most critical factor in improving educational outcomes in digital music production. Research shows that students who actively engage with technology are more successful, achieving a higher sense of self-efficacy, making a strong case for creating opportunities for engagement within the curriculum. Inferred that appropriate institutional initiatives will play a role in achieving the most from the interaction of Pro Tools and students, facilitating superior learning outcomes and meeting the requirements of the post-production environment.

4.2 To Investigate How Pro Tools Technology Enhances Students' Learning Achievements in Digital Music Production Education

This study focuses on students in Class 1 and Class 2 of the 2023 Music Production major. Students in Classes 1 and 2 received exposure to Pro Tools technology and traditional teaching methods during their music production education. Classes 1 and 2 of the 2023 Music Production major were divided into an experimental group and a control group. Tests were conducted twice, once before the study began (pre-test) and once after it ended (post-test). The pre-test assessed students' digital music production performance before receiving different teaching methods, while the post-test evaluated changes in their performance after using Pro Tools. The test content was aligned with the course syllabus: Pro Tools operations, audio recording and editing techniques, MIDI sequencing, mixing and signal processing, and project management within the Pro Tools environment.

This study focuses on Class 1 (33 students) and Class 2 (35 students) from the 2023 intake in the Music Production major at B University in Hubei Province, China. It compares the impact of integrating Pro Tools technology into teaching (experimental group) versus traditional teaching methods (control group) on students' achievements, to investigate the effectiveness of modern technology in digital music production education.

The integration of Pro Tools technology into teaching is more effective than traditional teaching methods at improving students' achievement.

(1) Test the variance of class integrating Pro Tools technology, equal variance of class traditional teaching methods (before learning)

$\delta^2_{Pro\ Tools\ technology}$: variance of integrating Pro Tools technology

$\delta^2_{traditional}$: variance of class traditional teaching methods

H_0 : $\delta^2_{Pro\ Tools\ technology} = \delta^2_{traditional}$: Pro Tools technology-integrated teaching has no significant impact on students' achievement compared to traditional teaching methods.

H_1 : $\delta^2_{Pro\ Tools\ technology} \neq \delta^2_{traditional}$ Pro Tools technology-integrated teaching significantly outperforms traditional teaching methods in enhancing students' achievement.

Table 4.6 Comparison of Variance Between Class Integrating Pro Tools Technology and Class Using Traditional Teaching Methods (Before Learning)

Class	**df**	**Mean**	**Variance**	**F**
Integrating Pro Tools Technology	32	22.06	4.24	1.24
Traditional Teaching Methods	34	22.18	5.25	

$$F_{0.025,32,34} = 1.995$$

$$F_{0.975,32,34} = 0.497$$

$$F_{0.975,32,34} = 0.497 < F_{compute} = 1.24 < F_{0.025,32,34} = 1.995$$

Accept null hypotheses. It means the test variance for classes integrating Pro Tools technology is equal to that for classes using traditional teaching methods. So, after learning, the t-test equals variance.

(2) Test the average achievement of integrating Pro Tools technology and the achievements of students at B University in Hubei Province.

$\mu^2_{Pro\ Tools\ technology}$: average the achievement of integrating Pro Tools technology

$\mu^2_{traditional\ teaching\ methods}$: average the achievement of traditional teaching methods

H_0 : $\mu^2_{Pro\ Tools\ technology} = \mu^2_{traditional\ teaching\ methods}$ There is no significant difference in students' achievement between Pro Tools technology-integrated teaching and traditional teaching methods, indicating that the two groups' mean post-test scores are equal.

H_1 : $\mu^2_{Pro\ Tools\ technology} > \mu^2_{traditional\ teaching\ methods}$: Pro Tools technology-integrated teaching in students' achievement is significantly superior to traditional teaching methods, indicating that the mean value of the post-test scores for the experimental group is higher than that of the control group.

Table 4.7 Comparison Average Achievement of Integrating Pro Tools Technology and Traditional Teaching Methods

Class	**Mean**	**Variance**	**df**	**t**
Integrating Pro Tools Technology	38.06	1.47	66	7.37
Traditional Teaching Methods	31.65	24.13		

$$t_{0.05,66} = 1.997$$

$$t_{compute} = 7.37 > t_{0.05,66} = 1.997$$

The result showed that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the experimental group's post-test mean is substantially higher than the control group's.

The Pro Tools technology enhances students' learning achievements in digital music production education. There are no significant differences in the mean values and variances of the pre-test data between the two groups, indicating that the experimental and control groups have similar initial levels. The post-test data show that Pro Tools technology-integrated teaching significantly improves students' achievement, with the experimental group's mean post-test score higher than that of the control group. Therefore, the conclusion is that integrating Pro Tools technology in teaching can significantly enhance students' learning outcomes compared to traditional teaching methods.

4.3 To Study Whether Using Pro Tools in Digital Music Production Courses Demonstrates Greater Student Self-Efficacy in Digital Music Production Education

The subjects of this study are students from Class 1 and Class 2 of the 2023 Music Production Major. Students in both classes were exposed to two methodologies in music production education: Pro Tools technology and traditional teaching methods. The pre-test assessed students' self-efficacy in digital music production before receiving different teaching methods, while the post-test evaluated changes in their self-efficacy after using Pro Tools. Before teaching with Pro Tools, self-efficacy tests were administered to students in Class 1 and Class 2 of the 2023 Music Production Major, yielding 68 tests in total. An independent-sample t-test was performed on the scores of students from both classes.

The self-efficacy of integrating Pro Tools technology into teaching is superior to that of traditional teaching methods in improving students' self-efficacy.

(1) Test the variance of class integrating Pro Tools technology equals the variance of class using traditional teaching methods (before learning)

$\delta^2_{Pro\ Tools\ technology}$: variance of integrating Pro Tools technology

$\delta^2_{traditional}$: variance of class traditional teaching methods

$H_0 : \delta^2_{Pro\ Tools\ technology} = \delta^2_{traditional}$: Pro Tools technology-integrated teaching does not significantly affect students' self-efficacy when compared to traditional teaching methods.

$H_1 : \delta^2_{Pro\ Tools\ technology} \neq \delta^2_{traditional}$ Pro Tools technology-integrated teaching significantly outperforms traditional teaching methods in enhancing students' self-efficacy.

Table 4.8 Comparison of Variance Between Class Integrating Pro Tools Technology and Class Using Traditional Teaching Methods (Before Learning)

Class	**df**	**Mean**	**Variance**	**F**
Integrating Pro Tools Technology	32	32.55	8.506	1.71
Traditional Teaching Methods	34	32.49	14.551	

$$F_{0.025,32,34} = 1.995$$

$$F_{0.975,32,34} = 0.497$$

$$F_{0.975,32,34} = 0.497 < F_{compute} = 1.71 < F_{0.025,32,34} = 1.995$$

Accept null hypotheses. It means the test variance for the class integrating Pro Tools technology equals that of the class using traditional teaching methods. So, after learning, the t-test for equal variance.

(2) Test the average achievement of integrating Pro Tools technology and the self-efficacy of students at B University in Hubei Province.

$\mu^2_{Pro\ Tools\ technology}$: average the self-efficacy of integrating Pro Tools technology

$\mu^2_{traditional\ teaching\ methods}$: average the self-efficacy of traditional teaching methods

H_0 : $\mu^2_{Pro\ Tools\ technology} = \mu^2_{traditional\ teaching\ methods}$: There is no significant difference in students' self-efficacy between Pro Tools technology-integrated teaching and traditional teaching methods, meaning that the mean values of the post-test scores for the two groups are equal.

H_1 : $\mu^2_{Pro\ Tools\ technology} > \mu^2_{traditional\ teaching\ methods}$: Pro Tools technology-integrated teaching in students' self-efficacy is significantly superior to traditional teaching methods, indicating that the mean value of the post-test scores for the experimental group is higher than that of the control group.

Table 4.9 Comparison Average Self-Efficacy of Integrating Pro Tools Technology and Traditional Teaching Methods

Class	**Mean**	**Variance**	**df**	**t**
Integrating Pro Tools Technology	57.73	2.83	66	2.75
Traditional Teaching Methods	50.57	60.958		

$$t_{0.05,66} = 1.997$$

$$t_{compute} = 2.75 > t_{0.05,66} = 1.997$$

The result showed that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the experimental group's post-test mean is substantially higher than the control group's.

Students using Pro Tools in digital music production courses demonstrate greater self-efficacy in digital music education. The mean values and variances of the pre-test data for both groups showed no significant differences, indicating that the initial levels of the experimental group and control group were similar. The post-test data revealed that Pro Tools technology in teaching significantly enhanced students' self-efficacy, with the experimental group scoring higher on average than the control group. Therefore, the conclusion is that integrating Pro Tools technology into teaching can significantly improve students' self-efficacy compared to traditional teaching methods.

CHAPTER V

CONCLUSION AND DISCUSSION

5.1 Conclusion

Part 1: For Answering Research Question 1

Data was collected from 322 participants (278 students and 44 instructors) through surveys and analyzed using descriptive and inferential statistics. The integration level of Pro Tools technology positively impacts digital music production education. Results revealed a strong positive correlation between Pro Tools integration and digital music production education ($\beta = 0.967$, $p < .001$), with each unit increase in integration corresponding to a 0.968-unit rise in digital music production education. Instructor proficiency with Pro Tools technology emerged as a crucial factor ($\beta = 0.785$, $p < .001$), demonstrating that teacher competency significantly influences digital music production education. Student engagement with Pro Tools had a substantial positive effect on digital music production education ($\beta = 0.769$, $p < .001$).

Part 2: For Answering Research Question 2

The $F_{0.975,32,34} = 0.497 < F_{compute} = 1.24 < F_{0.025,32,34} = 1.995$ showed that the test of variance for the class integrating Pro Tools technology equals the variance of the class using traditional teaching methods. Thus, after learning, the t-test equals variance. The $t_{compute} = 7.37 > t_{0.05,66} = 1.997$ showed that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the experimental group's post-test mean is significantly higher than the control group's. The conclusion is that integrated technology in Pro Tools can significantly enhance students' learning outcomes compared to traditional teaching methods.

Part 3: For Answering Research Question 3

The $F_{0.975,32,34} = 0.497 < F_{compute} = 1.71 < F_{0.025,32,34} = 1.995$

indicates that the test variance for the class integrating Pro Tools technology equals that of the class using traditional teaching methods. Therefore, after learning, the t-test equals the variance. The $t_{compute} = 2.75 > t_{0.05,66} = 1.997$ showed that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the mean post-test score of the experimental group is significantly higher than that of the control group. The conclusion is that integrating Pro Tools technology into teaching can significantly improve students' self-efficacy compared to traditional teaching methods.

5.2 Discussion

Part 1: To Answer Research Question No. 1

The integration of Pro Tools technology in digital music production education has demonstrated significant advantages. The study's conclusions align with those of Yang (2024), Harrison (2020), and Dobbs (2017). As an industry-standard software, Pro Tools provides students with a platform that closely mirrors real-world working environments. Using this tool equips students with basic classroom operations. Pro Tools technology endows students with core skills essential for entering the industry. In teaching, Pro Tools' intuitive interface and comprehensive functionality greatly enhance teaching efficiency. Students can engage directly in processes such as recording, editing, and mixing, thereby fostering their interest and improving learning outcomes. The integration of this technology has transformed teaching methodologies. Traditional teaching relied more on theory and static presentations, whereas the application of Pro Tools supports dynamic and interactive teaching methods (Chuang, 2021). Teachers can demonstrate complex audio production processes, allowing students to observe in real time and perform operations, thereby cultivating their ability to solve practical problems (Bell, 2020). More importantly, this integration also fosters creativity.

The various plugins and sound-processing tools in Pro Tools offer students abundant creative possibilities, enabling them to explore diverse sound effects and musical styles and thereby enhance their innovative capabilities. However, integrating Pro Tools technology also poses some challenges. Teachers need to possess high technical proficiency to effectively use the tool and address issues encountered by students during their learning process (Miranda et al., 2021). The cost of hardware equipment and software licenses poses some challenges for schools. Nevertheless, integrating Pro Tools into music production education brings immense value by bridging the gap between theory and practice, thereby enhancing students' learning outcomes and professional competitiveness.

Teachers' proficiency with Pro Tools technology has a significant positive impact on digital music production education. This proficiency directly determines the quality and efficiency of teaching and profoundly influences students' learning experiences and outcomes. Teachers' mastery of Pro Tools technology ensures the professionalism and practicality of the teaching content. Pro Tools encompasses complex functions such as recording, editing, mixing, and mastering (Resch & Schrittesser, 2023). When teachers are proficient in these techniques, they demonstrate professional workflows to students, explain the principles of key operations, and provide technical guidance. This in-depth explanation helps students grasp the technical essentials while preparing them for future industry entry. Teachers' skilled operations enhance the interactivity and dynamics of teaching. A proficient teacher can flexibly adjust teaching content according to classroom needs, provide technical optimization suggestions for students' work, and even resolve unexpected issues. This teaching approach captures students' attention and enhances their interest in learning and practical abilities through real-life case studies.

Teachers' proficiency directly affects students' trust and confidence in the technology. When teachers can proficiently use Pro Tools and demonstrate their professional skills in the classroom, students are more willing to embrace and learn this technology, recognizing its practical value. This sense of trust inspires students to explore Pro Tools technology, enhancing their learning outcomes and innovation capabilities. Teachers' inadequate proficiency in Pro Tools can affect the coherence and effectiveness of teaching. Unskilled operations lead to students' unclear understanding of software functions, reducing their learning efficiency. Teachers need to invest time and effort to enhance their technical skills before teaching to ensure they are competent for their teaching tasks. Teachers' proficiency in Pro Tools technology is the foundation of digital music production education and a guarantee of enhanced student learning experiences. By improving teachers' professional capabilities, integrating theory and practice can be achieved, helping students master the core skills of digital music production and laying a solid foundation for their future career development.

Student engagement with Pro Tools technology in digital music production education has a notable positive impact (Han, 2021). Pro Tools offers extensive functionality and operational experience, enabling students to deeply engage with various aspects of digital music production, thereby effectively promoting skill development and comprehensive ability development. Active student participation enhances the practicality and enjoyment of learning. In traditional teaching, students passively receive knowledge, but through hands-on operation with Pro Tools, they can transform theoretical knowledge into practical skills. This hands-on experience helps consolidate classroom content and allows students to intuitively understand core concepts of music production by experimenting with different operations and functions.

Student engagement offers crucial opportunities to foster creativity. Pro Tools boasts a wealth of plugins and tools that students can utilize to freely experiment with different musical styles and sound design, thereby expanding their creative boundaries. Through participation in project production or team collaboration, students can also gain experience in the creative process and learn how to strike a balance between technology and art. This practice holds far-reaching significance for cultivating students' personalized expression and innovation capabilities. The study's conclusions align with those of Yang (2024) and Harrison (2020).

Student involvement with Pro Tools also enhances their professional adaptability. Pro Tools is used in music and film production. Mastering this technology during their studies sharpens students' technical skills and familiarizes them with industry processes, laying a solid foundation for future employment. Student engagement with Pro Tools technology has a significant positive impact on digital music production education. This engagement elevates students' technical abilities and creativity while preparing them for industry integration, providing robust support for their future career development (Nagahi et al., 2021). In teaching practice, students should be encouraged to engage as much as possible, and appropriate guidance and resource support should be provided to help them overcome challenges in the learning process, thereby achieving more efficient learning outcomes.

Part 2: To Answer Research Question No. 2

In digital music production education, Pro Tools technology significantly enhances students' performance compared to traditional teaching methods, improving practical skills, theoretical understanding, and creativity. This viewpoint is consistent with the research by Resch & Schrittesser (2023) and Sickmen-Fox (2023). Pro Tools technology provides students with a learning environment, whereas traditional teaching methods often emphasize theoretical instruction or simulated operations, lacking a connection with real-world workflows. In traditional classrooms, students learn about recording, editing, and mixing through demonstrations or theoretical lectures, but opportunities for hands-on practice are limited (Miranda et al., 2021). The introduction of Pro Tools technology enables students to personally operate recording equipment, edit audio tracks, and apply effects plugins, directly participating in the complete music production process. This practical learning deepens students' understanding of knowledge and enhances their operational skills, leading to better performance in assignments and exams (Barton & Dexter, 2020).

Pro Tools offers extensive features that enhance students' creativity and the quality of their work. Pro Tools' multi-track recording, virtual instruments, plugin effects, and automation features enable students to complete more complex projects professionally, especially when compared to the paper-and-pencil exercises or simple music editing software used in traditional teaching. Pro Tools' real-time feedback and efficient workflow support enhanced learning efficiency. In traditional education, students rely on teachers' corrections and feedback. Pro Tools helps students hear the effects of adjustments in real time, enabling them to make improvements. The study's conclusions align with those of Yang (2024) and Harrison (2020).

Compared to traditional teaching methods, the Pro Tools technology in digital music production education significantly improves students' performance. By combining industry-standard tools with a practice-oriented teaching model, students grasp theoretical knowledge and demonstrate their skills and creativity through high-quality practical work. This teaching approach stimulates students' interest in learning and lays a solid foundation for their future development.

Part 3: To Answer Research Question No. 3

In digital music production courses, students using Pro Tools software demonstrate higher self-efficacy in music composition and production. This phenomenon can be attributed to the professional tools, practice-oriented learning environment, and immediate feedback mechanisms provided by Pro Tools, which significantly enhance students' technical skills and self-confidence (Miranda et al., 2021). As an industry-standard digital audio workstation, Pro Tools boasts powerful functionalities and a comprehensive toolset, catering to the creative needs of both beginners and professionals. For students, using software aligned with real-world industry practices reinforces their trust in their abilities. The tools help students realize they are using the same technologies as those used by practitioners in the music industry, thereby enhancing their recognition of their music composition and production capabilities. The study's conclusions align with those of Yang (2024), Harrison (2020), and Chuang (2021).

Pro Tools emphasizes practice and operation, enabling students to progress through hands-on learning. In teaching scenarios without Pro Tools, students rely on theoretical understanding, which, while providing foundational knowledge, lacks connection to actual working scenarios. In contrast, Pro Tools provides a functional production environment, allowing students to experience the entire recording, editing, mixing, and mastering process within the course. This direct practical experience enables students to see the fruits of their efforts, enhancing their confidence and motivation. Students using Pro Tools exhibit higher self-efficacy in digital music production courses, primarily because of the software's professionalism, practice-oriented approach, and instant feedback. This viewpoint is consistent with the research by Barton & Dexter (2020), Loukatos et al. (2022), and Sung et al. (2021). However, to fully leverage its advantages, reasonable guidance and support must be provided in teaching to enable students to overcome challenges in the learning process and maximize their skills and confidence. This enhanced self-efficacy manifests academically and lays a solid foundation for students' future careers in music.

5.3 Implementation for Practice

To integrate Pro Tools technology into digital music production courses at University B in Hubei Province, systematic strategies are needed in instructional design, teacher and student capacity building, resource guarantees, and teaching evaluation to optimize teaching effectiveness and enhance students' learning outcomes.

In instructional design, a practice-oriented curriculum system should be constructed with a focus. Courses should be stratified according to students' technical proficiency, progressing from basic operations to advanced creation. At this stage, teachers can guide students to familiarize themselves with the interface and functions of Pro Tools; at the intermediate stage, students can engage in specific production processes such as recording, editing, and mixing; while at the advanced stage, project-driven learning can be carried out around original music or complex sound design. By structuring the curriculum into multiple practical projects, such as the recording and mixing of complete songs, students can enhance their operational skills and creative abilities while solving real-world problems. At the same time, the evaluation system needs to be optimized with diversified assessment methods that assess students' technical mastery, emphasize their innovative capabilities and practical achievements, and incorporate evaluations of the learning process to motivate students to reflect and improve.

Teachers' technical proficiency is crucial to the success of curriculum integration. To ensure teaching quality, teachers should be regularly scheduled to participate in Pro Tools official certification courses or related skills training to master software operations and stay up to date with the latest industry trends. Additionally, teaching workshops should be provided to help them design more interactive and practical course plans, such as how to use Pro Tools for real-time demonstrations or simulate actual production scenarios. Establishing a teaching resource library to share teaching cases, materials, and operation guides with teachers can reduce their preparation pressure while enhancing course consistency and quality.

In terms of student support, to help students smoothly adapt to Pro Tools' complex functions, introductory training courses or step-by-step instructional videos can be set up to help beginners get started quickly. A technical support team composed of experienced teachers can help students face issues during their learning process. Furthermore, stimulating students' learning motivation is equally important. By hosting intra-school digital music production competitions or showcases, students can be motivated to invest more time in creation while feeling a sense of accomplishment and value in their learning outcomes.

Resource guarantees are the foundational conditions for curriculum integration. The school should construct a high-end digital music lab equipped with sufficient Pro Tools licenses, audio interfaces, monitoring equipment, and other professional-grade hardware. At the same time, the school can provide students with educational versions of Pro Tools licenses to support their practice on personal computers, thereby significantly enhancing their practical abilities through extracurricular learning. Establishing an online learning platform to upload tutorials, materials, and practice tasks can provide students with round-the-clock learning support, further improving the accessibility of course resources.

Continuous improvement in teaching effectiveness requires systematic evaluation and research. By regularly administering questionnaires, conducting interviews, and analyzing learning outcomes, the school can assess students' mastery of Pro Tools technology and the curriculum's actual impact on their creative abilities. Collaborating with local music production companies or film and television production agencies to introduce real-world industry projects into teaching or arrange student internships can provide the curriculum with more practically oriented adjustment directions. On the other hand, during open classes and showcase events, invite industry experts and internal and external reviewers to evaluate course outcomes and provide feedback and suggestions for further refining teaching.

For policy and funding support, the school should integrate Pro Tools technology into its teaching reform plans and seek special funding for software licenses, equipment updates, and teacher training. Additionally, policies can elevate digital music production courses, making them distinctive and increasing their impact both within and beyond the university. These measures will provide robust safeguards for University B in Hubei Province to integrate Pro Tools technology and enhance the quality of teaching in digital music production courses.

5.4. Recommendations for Future Research

This study validates the positive impact of Pro Tools technology in digital music production courses, yet future research can further deepen and broaden the exploration in related fields. Future studies should expand the research scope to include students from more schools, majors, and cultural backgrounds to verify the universality and stability of the results. The varying degrees of technology acceptance across different teaching environments and student backgrounds may influence research outcomes, offering abundant directions for cross-regional or cross-cultural research. Future research should incorporate more qualitative methods, such as interviews and observations, to better understand students' specific experiences and challenges with Pro Tools technology. The research will help reveal the underlying mechanisms of technology integration in teaching and further optimize instructional design to meet students' individual needs. Future research should also explore the potential impact of Pro Tools technology on related abilities, such as students' creativity, teamwork skills, and problem-solving. These abilities are crucial in digital music production. By expanding the research indicators, we can more comprehensively assess the educational value of Pro Tools technology. As new technologies such as artificial intelligence and virtual reality continue to develop, future research should investigate whether integrating Pro Tools into digital music production is effective. The research will provide empirical evidence for the iterative development and upgrading of educational technologies, while promoting further innovation and growth in digital music production education.

5.5. Limitations of the Study

Although this study validates the educational impact of Pro Tools technology in digital music production courses, some deficiencies require further improvement and exploration. The sample size in this study is relatively small and homogeneous, comprising two classes of music production majors from Grade 2023 at University B in Hubei Province, China. This homogeneity may restrict the generalizability of the research results. This study primarily relies on quantitative data (such as questionnaires and test scores) to assess the educational effectiveness of Pro Tools technology. This study lacks in-depth observation and qualitative analysis of students' learning processes. The study duration is relatively short, confined to a single course cycle, and fails to evaluate the sustained impact of Pro Tools technology on students' long-term learning outcomes. For instance, whether students' self-efficacy and academic performance will be maintained or even further improved after the course ends remains a question worthy of in-depth research. This study did not thoroughly consider potential confounding variables, such as teachers' instructional styles, students' familiarity with technology, or extracurricular learning resources.

These factors may influence the interpretation of the research results, leading to an overestimation or underestimation of the educational effectiveness of Pro Tools technology. Therefore, future research should further systematically control these variables to ensure the accuracy and reliability of the results.

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APPENDICES

Questionnaire

Dear Sir/Madam,

Thank you for your participation in this questionnaire survey. The survey will be conducted anonymously, and your relevant information will be kept confidential. Thank you again for your cooperation.

Part I

1. Gender
A. Male B. Female

2. Age
A. Under 18
B. 18-25
C. 26-35
D. 36-45
E. Above 45

3. Do you know Pro Tools technology?
A. Yes
B. No

Part II

Please judge the extent of your agreement with the following statement, choose the most appropriate option, and mark the corresponding number "√". The questionnaire used a Likert scale, ranging from 1 to 5, in which 1 indicates ‘strongly disagree’, 2 indicates ‘disagree’, 3 indicates ‘neutral’, 4 indicates ‘agree’, and 5 indicates ‘strongly agree’.

Integration Level of Pro Tools Technology (Smith & Taylor, 2022)

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Pro Tools is seamlessly integrated into our university's digital music					

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	production curriculum.					
2	The use of Pro Tools technology is encouraged in all relevant courses.					
3	Students have access to Pro Tools for practice outside of scheduled class time.					
4	Pro Tools is consistently used across courses in the music production program.					
5	The curriculum is updated regularly to incorporate new features of Pro Tools.					
6	Pro Tools integration has improved the overall quality of music production education.					
7	The university provides adequate resources to support the integration of Pro Tools technology.					
8	There is a clear strategy for integrating Pro Tools into the music production program.					

Instructor Proficiency with Pro Tools Technology (Johnson & Lee, 2023)

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Instructors are proficient in using Pro Tools for teaching digital music production.					
2	Instructors receive regular training on the latest features of Pro Tools.					
3	Instructors can troubleshoot and assist students with Pro Tools-related issues.					
4	Instructors' proficiency positively impacts student learning outcomes.					
5	Instructors use Pro Tools					

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	effectively to demonstrate music production techniques.					
6	Instructors regularly incorporate Pro Tools into their lesson plans.					
7	Students feel confident in their instructors' knowledge of Pro Tools technology.					
8	The university provides adequate support for instructors to improve their Pro Tools skills.					

Student Engagement with Pro Tools Technology (Brown & Thompson, 2022)

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Students actively engage with Pro Tools technology during class.					
2	Pro Tools technology makes the learning process more interesting for students.					
3	Students use Pro Tools outside of class to enhance their learning.					
4	The availability of Pro Tools increases student participation in digital music production.					
5	Students feel motivated to learn more about digital music production because of Pro Tools.					
6	Pro Tools technology fosters collaboration among students in the music production program.					
7	The use of Pro Tools has improved student engagement					

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	in music production classes.					
8	Students are confident in using Pro Tools technology for their assignments and projects.					

Digital Music Production Education (Student Achievement and Student Self-Efficacy) (Wilson & Campbell, 2023)

Q#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Pro Tools technology has enhanced my understanding of digital music production.					
2	My achievements in digital music production have improved due to the use of Pro Tools.					
3	I feel more confident in my music production skills after using Pro Tools.					
4	Pro Tools technology has contributed to my success in digital music production courses.					
5	Using Pro Tools has prepared me well for a career in digital music production.					
6	I believe that Pro Tools technology is essential for my academic success in music production.					
7	My self-efficacy in digital music production has increased due to my experience with Pro Tools.					
8	Pro Tools technology has significantly impacted my overall academic performance.					

Lesson Plan: Pro Tools Integration in Digital Music Production

Duration: Students enrolled in the Digital Music Production Course. Total of 4 sessions (each session is 90 minutes)

Objectives:

Students will grasp fundamental music theories, including rhythm, harmony, pitch, and musical structure.

Students will understand the modern music production process and its core steps.

Students will apply the acquired knowledge to analyze musical works and create simple musical passages.

Session 1: Fundamentals of Music Theory (Pitch, Rhythm, Harmony)

Objective: Students understand the components of music and grasp foundational concepts.

Introductory Activity (10 minutes)

Play a classic pop music snippet (e.g., a simple melody in C major).

Ask students: What main elements can you hear in this music? (Guide students to focus on pitch, rhythm, harmony, etc.).

Core Instruction (40 minutes)

Pitch: Introduce musical scales (C major, natural minor) and the relationship between whole steps.

Rhythm: Explain time signatures (e.g., 4/4 time) and demonstrate basic rhythmic patterns.

Harmony: Teach triads, seventh chords, and their functions (tonic, dominant, subdominant).

Classroom Exercise (30 minutes)

Students mark pitch names and rhythmic values on the provided sheet music (in numerical or staff notation).

Simple chord accompaniment exercises for melodies (the teacher provides examples).

Summary and Q&A (10 minutes)

Summarize the core content of pitch, rhythm, and harmony.

Students ask questions, and unclear points are documented.

Session 2: Musical Structure and Appreciative Analysis

Objective: Students understand the structure of music and learn to analyze musical works.

Introductory Activity (10 minutes)

Play a pop music snippet (e.g., "Shape of You").

Ask: Can you identify the different sections of this song?

Core Instruction (40 minutes)

Introduce common pop music structures (verse-chorus-bridge-chorus).

Explain emotional expression and dynamic variations in music (crescendo, decrescendo, dynamic markings, etc.).

Classroom Activity (30 minutes)

Students analyze a pop song in groups, annotate its structural sections, and describe emotional changes.

Groups present their discussion.

Summary (10 minutes)

Summarize the core elements of musical structure and their role in composition.

Session 3: Music Production Process and Technical Understanding

Objective: Students understand the basic production process from composition to completion of a musical work.

Introductory Activity (10 minutes)

Ask: What steps are needed to produce a complete musical work?

Briefly review students' answers and introduce the session's topic.

Core Instruction (40 minutes)

Introduce the four main stages of music production: composition, recording, mixing, and mastering.

Briefly describe recording equipment, track management, and basic mixing techniques (e.g., equalizer, reverberation).

Classroom Activity (30 minutes)

Show students a simple recording and mixing process (can include a demonstration video).

Students complete a paper-based analysis of the mixing exercise, following the instructions.

Summary and Discussion (10 minutes)

The teacher answers as they review classroom results.

Session 4: Comprehensive Review and Assessment

Objective: Consolidate knowledge and assess learning outcomes through testing.

Review Activity (20 minutes)

Recap core knowledge points from the previous three sessions.

Students can ask questions freely, and the teacher provides answers.

Formal Assessment (60 minutes)

Music Knowledge Test:

Includes 20 multiple-choice questions (total score of 40 points) to evaluate students' grasp of basic music knowledge and production processes.

Feedback and Summary (10 minutes)

The teacher briefly comments on the test results and provides targeted improvement suggestions.

Encourage students to apply the knowledge they have learnt in practice.

Teaching Methods and Resources

Teaching Methods:

Heuristic instruction (with practical examples).

Group discussion and interactive analysis.

Task-driven exercises (using musical snippets).

Teaching Resources:

Multimedia music materials (pop music snippets, classic works).

Provision of numerical notation, chord diagrams, and basic sheet music analysis exercises.

Student Achievement Test

This test aims to evaluate students' achievement in digital music production education comprehensively. The student achievement test aims to evaluate students' mastery of core knowledge in music theory, structure, and production processes within the digital music production course.

Part I: Basic Music Theory (10 questions, total 20 points)

1. What are the elements of music?
   A. Pitch, rhythm, dynamics, timbre
   B. Rhythm, speed, imagery, structure
   C. Dynamics, timbre, harmony, lyrics
   D. Rhythm, pitch, story, chord

2. In the C major scale, what is the fifth note?
   A. C
   B. G
   C. F
   D. D

3. Which chord belongs to a minor chord?
   A. Cmaj
   B. Am
   C. G7
   D. Fdim

4. What does the time signature 4/4 mean?
   A. Four beats per bar, each beat worth an eighth note
   B. Four beats per bar, each beat worth a quarter note
   C. Eight beats per bar, each beat worth an eighth note
   D. Two beats per bar, each beat worth a quarter note

5. In musical notation, what does the sharp (#) symbol indicate?
   A. Raise the pitch by a half-step
   B. Lower the pitch by a half-step
   C. Play the note as is
   D. Pause on the note

6. In orchestral music, which instrument group does the violin belong to?
   A. Woodwind instruments
   B. Brass instruments
   C. String instruments
   D. Percussion instruments

7. What does "harmony" primarily refer to in music?
   A. The combination of two melodies
   B. The repetition of the same melody
   C. Notes of different pitches played simultaneously
   D. Contrast in rhythm

8. What is the relationship between a whole tone and a half tone?
   A. One whole tone equals two half tones
   B. One whole tone equals four half tones
   C. One whole tone equals three half tones
   D. One whole tone equals one half tone

9. Which term indicates "getting louder"?
   A. Crescendo
   B. Diminuendo
   C. Staccato
   D. Legato

10. What is the structure of modern pop music?
   A. Introduction-Verse-Chorus-Coda
   B. Verse-Chorus-Bridge-Chorus
   C. Theme-Variation-Coda
   D. Overture-Development-Exposition–Recapitulation

Part II: Music Structure and Appreciation (5 questions, total 10 points)

11. What is the function of a metronome when recording music?
   A. To ensure consistent volume
   B. To provide a rhythmic reference
   C. To enhance sound quality
   D. To record dynamic range

12. What is the purpose of the equalizer (EQ) commonly used in mixing?
   A. To adjust the frequency balance
   B. To control volume
   C. To add echo effects
   D. To change the speed of sound

13. Which audio format is a lossless compression format?
    A. MP3
    B. WAV
    C. FLAC
    D. AAC

14. What are the typical steps involved in a complete music production process?
    A. Composition-Recording-Mixing-Mastering
    B. Recording-Editing-Exporting
    C. Lyric Writing-Performance-Distribution
    D. Arrangement-Performance-Archiving

15. What types of tracks are found in modern pop music?
    A. Vocals, instruments, percussion, effects
    B. Vocals, background sounds, storytelling, dialogue
    C. Instruments, score, ambient sounds, dialogue
    D. Melody, structure, lyrics, harmony

Part III: Music Production Process (5 questions, total 10 points)

16. In music analysis, which characteristic describes "melody"?
    A. The length, intensity, and timbre of sounds
    B. The continuity and emotional expression of notes
    C. The simultaneous occurrence of different frequency notes
    D. Changes in rhythm and speed

17. What is the purpose of mastering?
    A. To enhance sound quality and adapt to different playback devices
    B. To edit the structure of sound
    C. To combine multiple tracks into one
    D. To add special effects

18. What is the main difference between "stereo" and "mono"?
    A. The volume of sound
    B. Whether the sound contains left and right channel information
    C. The quality of audio
    D. The duration of audio

19. What is the primary role of arrangement in music creation?
    A. To adjust melody and lyrics
    B. To design the playing style and instrumentation of the instruments
    C. To fix audio errors
    D. To export the final work

20. In pop music, what is the function of the chorus?

A. To connect different sections
B. To express the core theme and climax of the song
C. To provide rhythmic support
D. To extend the duration of the song

Student Self-Efficacy Test

No	Test	1	2	3
1	I can complete audio editing tasks independently.			
2	I have full confidence in my Pro Tools operation skills.			
3	I can effectively utilize virtual instruments to complete compositions.			
4	I am adept at selecting appropriate sound effects and plugins.			
5	Even when faced with complex production tasks, I am confident I can complete them.			
6	I can quickly resolve issues encountered in Pro Tools.			
7	I can manage multiple audio tracks and keep the project organized.			
8	I can adjust audio effect parameters to meet requirements.			
9	I believe I can produce high-quality works using Pro Tools.			
10	I can independently plan and implement a complete music production project.			
11	I can accurately identify issues in audio and effectively make improvements.			
12	Even when encountering new features or plugins, I can quickly learn how to use them.			
13	I am confident about pursuing a career in digital music production.			
14	I can independently create innovative musical works.			
15	I am proficient at managing project timelines and workflows.			
16	Even under time constraints, I can complete music tasks.			
17	Through multiple attempts, I can find a production method that suits me.			
18	I believe my skills meet the industry's demands.			
19	I am proficient in Pro Tools and can operate it for collaborative team projects.			
20	In music creation, I can integrate and apply the knowledge and skills I have acquired.			