ISSN (print): *2588-5731*

Research Paper

Design and Production of Music Educational Assistant and its Effectiveness on the Cognitive and Skill Learning of Music Students in Comparison with Face-to-Face Training

Saeid Pourroostaei Ardakani[1]*,. Rashed mohammadyan*[2]

Received Date: 15/08/2023 Accepted Date: 17/06/2023

Pp: 188-203

Abstract

This study aims to design and develop an online teaching system (Nuance) for learning musical instruments compared to face-to-face training. The system performance was tested and analyzed to study the impact of the proposed system on cognitive and skill learning for a Persian music instrument named Setar. This study employed a "quasi-experimental post-test research with two control groups," with 900 Setar elementary students in Sanandaj city participating between 2021 and 2022. Sampling method was used to form two homogeneous groups, including the control group and the experimental group, so there were 15 learners in each group. The experimental group used an online instructional system, while the control group trained face-to-face. For data analysis, independent t-tests were used to compare their means and to assess the normality of variables and homogeneity of variance between groups, using Shapiro-Wilk and Levan tests. The results showed a significant difference between the groups and supported that the proposed system has better cognitive and skill learning performance than face-to-face training. Standard online training, organized by instructional design and based on the principles of music education, can be far more effective than conventional methods of music education (P 0.05). This study implicate the potential for well-designed online music education courses based on principles of music education to improve student outcomes compared to traditional face-to-face instruction. With proper structure and support, online learning offers a promising path forward for addressing challenges in the field of music education.

***Keywords*:** Cognitive learning, Face-to-face training, Music educational assistant, Music, Skill learning

Introduction

Today's music education requires new methods that can be taught to the learner in less time and in more depth (Taghizadeh & Hasani, 2019). As our daily lives are constantly changing with the digital world, using technology to create new ways of learning is an essential need (Reaves, 2019). These technologies are provided to students through software, hardware, and various training courses. Technology, such as mobile phones, desktops, laptops, and tablets, plays a significant role in combining technology and music education. Creating an interactive and user-friendly environment, the possibility of repeating content as many times as desired, and reducing training costs are other reasons for using software and hardware in teaching and learning (Gherheș, Stoian, Fărcașiu, & Stanici, 2021; Fick & Bulgren, 2021; Liu & Liang, 2021). However, several researchers have identified the following reasons for the inefficient or limited use of technology in music

[1]- Assistant Professor in Computer Science, University of Nottingham Saeid.ardakani@nottingham.edu.cn
[2] - PhD. Candidate in Educational Technology, Allameh Tabatabai University . r.mohammadian@atu.ac.ir

classes: (A) a lack of understanding of music technology applications and their cost-effectiveness; (B) a lack of conceptual frameworks to guide the integration of technology in music education; (C) a lack of sufficient studies to investigate the short- and long-term effects of technology integration in music learning; and (D) a lack of significant studies that provide advanced strategies, ideas, and principles for guiding teachers in how to teach music with technology (Bauer, 2020; Mrozi).

This study aims to provide and implement a solution to address the limitations and problems related to face-to-face music education. Additionally, it plugs fundamental gaps in e-learning. Issues in this area can be summarized as follows:

1. Limited communication time between trainer and trainee in class.
2. Most of the student practices are outside of the classroom. Where the instructor has no supervision in the face-to-face training method.
3. several tricky and complex skills should be learned with the teacher's help in the practice procedure.
4. Wrong playing and styling of the instrument and not receiving feedback in the rehearsal process.
5. Deprived areas do not have access to music education classes.
6. The prevalence of the COVID-19 pandemic and unresponsiveness to face-to-face music education classes.
7. Lack of a standardized program for music e-learning.
8. Lack of basic and reliable software in the field of music education.
9. Lack of credible research in the field.

In response to the above gaps and problems, the solution proposed in this study is to use standard training, organized by instructional design and based on music education principles, in the form of a web-based training course (Nuance Music Assistant). Therefore, the primary aim of this study was to design and produce a music education assistant and to determine its impact on music students' cognition and skill learning compared to common face-to-face training methods.

The designed course is called "Nuance" for short. Nuance is a web-based music learning course. The article is organized in such a way that, in the next section, after identifying the goals, the theoretical background, design, materials and methods, results, discussion, and conclusions are presented.

Based on the previous description, three objectives can be considered for this study:

1. Design and production of a music education assistant (Nuance)
2. Determining the effectiveness of Nuance on cognitive learning and skill learning of beginner music students.
3. The effects of Nuance and face-to-face music training were compared.

The following questions should be answered in this field: 1. has music e-learning been able to overcome the problems of face-to-face education?

2. Has music e-learning had any impact on student learning?
3. Does the current e-learning have enough quality to be an excellent alternative to face-to-face training?
4. Does music e-learning follow the principles of learning?
5. Are standards such as SCORM and instructional design principles considered in this training?

Literature Review

Harnessing the potential of new technologies to improve student learning efficiency and achievement has long been considered (National Research Council, 2000; Pople, 1992). Amongst these, e-learning can be considered one of the best strategies for teaching and learning (Encarnacion, Galang, & Hallar, 2021). "E-learning" is defined by Choudhury and Pattnaik as "the transfer of knowledge and skills, in a periodic content with appropriate design and credibility, provided through electronic media such as the Internet, Web 4.0, intranets, and subnets" (Choudhury & Pattnaik, 2020). Teachers and students have considered E-learning an effective tool to increase the efficiency of education and develop knowledge acquisition skills through transfer learning (Zhao, Wang, Zhou & Li, 2020).

An e-learning system can be web-based, computer-based, or digital (Obeng & Coleman, 2020). On the other hand, technology-driven, delivery-system-oriented, communication-oriented, and educational paradigms have been proposed as the main types of e-learning elements (Arkorful & Abaidoo, 2015). In this research, web-based e-learning has been used. As a techno-social system, the Web is the largest transformative information structure. The Web is the most prominent part of the internet and offers one of the most popular internet services. Advanced content, ease of use, availability, attractive design, valuable suggestions, use of analytical tools, and regular updates are essential factors in the success of an educational website (Obeng & Coleman, 2020). Some common web-based e-learning systems include WebBoard, Blackboard, Glow, Google Classroom, Code Academy, MOODLE, and Sakai.

A great deal of research has been done to identify, review, and evaluate the essential factors that affect the e-learning system, as well as the effectiveness of e-learning, to promote and maximize its benefits (Fathema, Shannon & Ross, 2015; Mtebe & Raphael, 2018; Means, Toyama, Murphy & Baki, 2013; Yuwono & Sujono, 2018; Choudhury & Pattnaik, 2020; Ulum, 2021; Yang et al., 2020; Encarnacion et al., 2021). A meta-analytic study by Means et al. (2013) found that students who were educated in both online and blended learning performed relatively better than those who received face-to-face training. Also, according to the meta-analytic research of Yuwono and Sujono (2018), the learning outcomes in the implementation of e-learning are more than normal and face-to-face learning. In the following, we will examine some of the findings mentioned in the implementation of e-learning.

Choudhury and Pattnaik (2020) reviewed articles published between 2000 and 2018 and identified important success factors in e-learning that relate to the various stakeholders in e-learning. Some important success factors are up-to-date technology, appropriate course, and class design, social presence, computer literacy, technology, program interoperability, course customization, interaction, ease of use and learner independence, stakeholder collaboration, and attention motivation. To increase this impact, the implementation of online education requires the support of teachers to provide educational materials so that they can adequately design learning opportunities and use various digital-based media, such as websites, software, and other tools to influence e-learning performance (Rolisca & Achadiyah, 2014). According to research conducted by Rahayu et al. (2017), using different types of software has been shown to increase the effectiveness and quality of e-learning. Implementing e-learning can affect students' ability to adapt to technological advances, as students use different educational resources on the Internet to access different types of information. This enables them to become accustomed to interrogative and active learning (Hart et al., 2019; Prestiadi, 2019).

When we want to look at the results in more detail in music education, we come across studies with similar results. However, no studies have been found that precisely assess the effectiveness of e-learning compared to other methods. Here, we review some similar research in the field of music and finally identify the differences between the present study and them.

Generally, the use of information technology can expand the boundaries of music learning in the classroom and create many new and exciting possibilities (Chung Ho, 2007). Numerous studies have examined the effects of technology on music education. For example, the use of virtual reality (Innocenti et al., 2019), using automated composing software (Huang, Nien & Yeh, 2015), the use of multimedia platforms (Cano & Sanchez-Iborra, 2015), the use of ICT in the Development of music practice skills (Chan, Jones, Scanlon & Joiner, 2006), setting up virtual participatory learning environments (McCarthy, Bligh, Jennings & Tangney, 2005), application of computer-based visual learning system (Ho, Lin, Chen & Tsai. b2013), use of multimodal, dual-channel, multimedia learning (DML) and game-based learning (Raziūnaitė et al., 2018), are technology-based research with positive impact in the field Music education. Among these, e-learning has a special place because it has a more theoretical background than other methods and can be used in more situations (Koutsoupidou,

b2014; Blake, 2018; Walls, 2008; Groulx & Hernly, 2010).

Music e-learning requires a focused approach when moving from face-to-face learning to an online environment. an approach that makes the best use of critical elements of instructional design, principles of educational technology, and the basics of music education and their proper integration (Johnson, 2020; Macrides & Angeli, 2018). On the other hand, when we examine the research, courses, and content produced for music e-learning, they have not applied the above principles in their designs and, therefore, lack the necessary credibility (Macrides & Angeli, 2018). Such a gap became even more apparent during the COVID-19 pandemic. According to research, during the COVID-19 pandemic, many face-to-face music classes were closed, and the remaining classes were forced to change their online teaching methods. In this shift, many problems arise, such as the lack of appropriate electronic content, the inability of teachers to use e-learning methods, and the lack of standard e-learning courses, resulting in decreased motivation and efficiency of students and educators (Daubney & Fautley, 2020; Garrido & Carnicer, 2021; Müller et al., 2021; Rosset, Baumann & Altenmüller, 2021). This led to a negative attitude toward e-music education (Garrido & Carnicer, 2021).

The last paragraph shows the difference between the present study and other work done in this field. This study seeks to validate the music e-learning course based on the latest findings in educational technology, instructional design, and the fundamentals of music education, design, and production. In the following, we will explain the course's design conditions.

Design

Changing the way of learning from one platform to another (switching from face-to-face to e-learning) requires changing the learning paradigm (Johnson, 2017). This paradigm shift includes changes in learning theories, educational design models, teaching methods, learning tools and technologies, and the use of educational technology sciences (Johnson, 2020). Below is a brief overview of the design phase of the Nuance course, from problem discovery to production and certification:

Problem-discovery

This step was explained in detail in the introduction.

Design framework

At this stage, the general design framework is determined, including the type of learners, content, media, tools, training strategies, evaluation, and design level. These items are needed to determine the design pattern (see Table 1).

It is essential to explain the instructional tools, the level of training, the learning theory, the training strategy, and the synchronous and asynchronous tools mentioned in the design framework table:

Table 1 - General design framework

Dimensions	Details		Description
Learners	**Gender**	Man and Woman	none
	Age	13 to 18 years	Adolescent age category
	Job	student	none
	Education	Ninth grade to twelfth grade	Non-musical field
Content	music theory Playing skills Instrumentation Music styles History of Music The connection of music with culture and geography		none
Media	Educational infographic	booklet-book-teacher-film-image-audio	none
Instrument	Setar		Setar is an Iranian percussion instrument.
Instructional tools	Computer - smartphone - laptop - tablet Synchronous tools - Asynchronous tools		none
Level of training	Beginner		It lasts about 9 months.
Learning theory	Complies with system patterns		none
Educational strategies	Organizing strategy	Content sequences from simple to complex	Bruner Spiral Curriculum
	Instructional strategy	e-learning Web based	none
	Training strategy	Student-centered Teacher-centered Subject-oriented	none
	Management strategy	Learning management system(LMS)	Communicate; Assessment ; View; Management; Organize; Planning; Archive; Recovery; Upload ; Download; share ; Publish; Announce
Evaluation	Input-Formative-Diagnostic-Summative		tracking;self-reflecting; peerreviewing; portfolio making; recording; grading; describing; refining
Design level	Micro and macro		none

The musical instrument taught in this course is the Setar, an Iranian stringed instrument. The reason for choosing Setar is that it is prevalent in Iran and is taught in all music schools and e-learning courses. It is also a standard instrument for training.

Music training levels are divided into beginner, intermediate, and advanced. Since passing each level requires a lot of time, money, and energy from the student and the instructor, only one level is considered for this research. The most appropriate level in this regard is the beginner level because students start with basic knowledge and skills and are all on the same level. This fact causes the interfering variable of students' prior knowledge and skills to be controlled. Thus the data and results of the elementary-level study will have the most validity and reliability. Basic training helps the researcher to provide peer-to-peer subjects for the experimental and control groups.

The supportive learning theory of this course is consistent with systemic patterns. Systems theory involves the sequential steps of identifying what needs to be learned, identifying educational strategies, and evaluating what needs to be learned. Some experts in this field suggest a constructivist approach to music education (Johnson, 2020). The constructivist approach to music education is student-centered and depends on the learner's activities, creativity, creation, and critical thinking. In this approach, the learner has an active role in learning and is suitable for situations where the learner already has the necessary knowledge and skills to master the learning process. Hence, the constructivist approach is appropriate for intermediate and advanced music education levels but cannot support the beginner level. At the beginner level, the student must learn the basic skills of playing and music theory, which is impossible without the instructor's direct intervention. Therefore, a systemic approach is the best choice for teaching the basic level of music because, in addition to the active role of the learner, it emphasizes the centrality of the role of the instructor and can transfer the basic skills and principles of music to the student.

The training approach can be student-centered, teacher-centered, or subject-centered. In a student-centered approach, students are responsible for the direction of learning and how learning develops. Student-centered learning activities focus on social collaboration and interactive activities (Jonassen, 1992; Moallem, 2003). A teacher-centered approach identifies teachers as responsible for developing course content. Teachers are a source of knowledge, positioning lectures as the primary means of training delivery (Carmody & Berge, 2005; Joyce & Weil, 2008). In a subject-centered approach, students and teachers interact with a subject and are motivated to learn more about it because of their interest in it (Johnson, 2020). Using a single approach in long-term courses can reduce each student's learning depth. By incorporating different teaching methods into a well-targeted curriculum, students experience the right learning environment to share expertise, personalize learning, step-by-step leadership of student scaffolding, and increase subject-specific responsibilities (Johnson, 2020). Therefore, in this course, all three training methods are used where appropriate, with the exception that the student-centered approach is less practical at the beginner stage

Synchronous activities in this course include interaction, listening, presentation; collaboration; conversation, and performance. Asynchronous activities include interacting; listening; browsing; answering; writing; recording; discussing, viewing, viewing infographics, taking exams, and archiving.

Select a design model

Now that the design framework and its details are specified, the design model can be selected with the help of this framework. After a review of the system models, the seven-step Reigeluth model was selected as the most suitable model for the current curriculum design. This model was developed by Santia Leshin, C. B., Pollock, J., and Reigeluth, C. M. in 1992. This model is one of the system models considered for micro and macro design. The difference between this model and other educational design models is that most models introduced by different experts are limited to a specific type of learning objective or a specific method of providing training. In contrast, the Reigeluth model includes various learning objectives, teaching methods, and content delivery systems and can thus be considered a combination of all known educational design models to date (Leshin et al., 1992). The reason for choosing this model is that it is designed at the micro and macro level, follows a system model and is also applicable to cognitive learning and skill learning.

Designing

After providing all the design prerequisites and specifying the seven-stage Reigeluth model, we can design and produce the entire course. The model levels are shown in Figure 1 below:

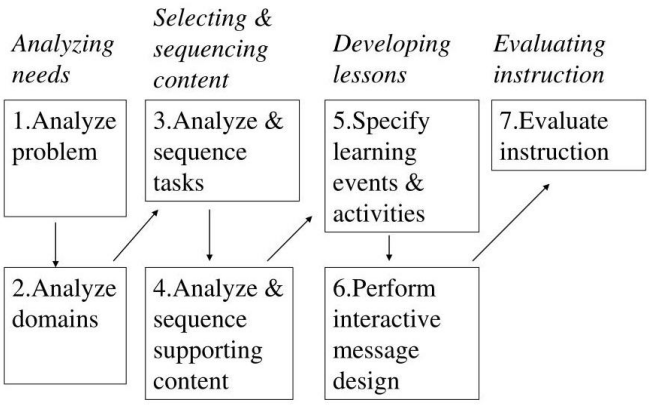

Figure 1- The model of Leshin, Pollack and Reigeluth

In addition to the design framework as well as the Reigeluth model, the following principles have been used in the production of the Nuance course:

- **SCORM Standard**: The word SCORM is a glossary of the words "shareable, content, object, reference, and model." The main emphasis of this standard is on the alignment of specifications and factors determined by other researchers, standardization of e-learning, and providing a uniform format for designing and implementing e-learning environments and educational content (Bai, 2017).
- **Mayer Principles**: Mayer (2009) Based on Atkinson-Schifferin's theory of media psychology and research in this field, he has presented seven principles for the production of instructional multimedia, which are: Multimedia, Spatial contiguity, Temporal contiguity, Coherence, Modality, Redundancy, and Personalization.
- **Principles of music education**: Theoretical knowledge, skill training, and practice are the main processes for learning music. Appropriate and standard combinations of these allow us to achieve ideal learning (Colwell & Richardson, 2002). In this course, we try to use the latest music education principles and foundations to provide the right mix of theoretical knowledge, skills training, and practice.
- **Multidimensional education:** Music students need a multi-dimensional education to grow in areas such as music theory, performance techniques, music history, Instrumentation, stylistics, music's connection to culture and geography, composition, and listening training (Jorgensen , 2008; Colwell & Richardson, 2002; Westerlund, Karlsen & Partti, 2020; Holdhus, Murphy & Espeland, 2021; Feldman & Contzius, 2015).

Method

This is applied research. The proposed method was evaluated using a quasi-experimental research method consisting of control and experimental groups and a post-test. Because all subjects' levels are the same before the research, there is no need to perform a pre-test. The hypotheses are stated below:

RH1. There is a significant difference between the means of face-to-face training and Nuance in the cognitive learning variable.

RH2. There is a significant difference between the means of face-to-face training and Nuance in the skill learning variable.

Participants and Sample

The participants of this study includes all Setar primary school students in Sanandaj City (Kurdistan Province of Iran) who were learning music in 2021-2022. The present study has two experimental and control groups.

1. experimental group: students who completed the Nuance course
2. Control group: students who have been trained with the face-to-face method.

The first step in the sampling was to find students interested in learning Setar through the Nuances course. Because the course took about nine months to train and was a relatively long-term research project, samples had to participate in the course voluntarily to prevent sample loss. Hence, a research participation form was distributed in high schools in Sanandaj to find volunteers. Among the volunteers, 30 were randomly selected to receive Nuance and face-to-face

training (15 people in each group, 8 males and 7 females). After the sample of the nuance group was determined, the control group was sampled using the nuance group-based sample matching method. The criteria of age, gender, and education matched

Instruments and Data Collection

Since no relevant studies were found to provide standard questionnaires and collection tools, researcher-made tools were used in this study. The three tools [3]used are as follows:

- Questionnaires to collect general and basic information on the subject
- A researcher-made test to assess cognitive learning
- Forms made by researchers for measuring skill learning

Table 4 lists the components measured in cognitive and skill learning.

Table 4 - components

Main variables		Components
Cognitive learning	Music theory	Instrumentation
	Music history	Principles of music practice
	Music styles	Prominent characters
Skill learning	Relax while playing	Consider harmony
	Sitting style	Ability to tune with the help of a tuner
	Right hand style	Tune the Setar by hearing the notes
	Left hand style	Use of harmonic techniques
	Using frets	Mastery of music composition
	clear playing	Consider the logic of beating
	Playing speed	Observe the logic of using frets
	Playing power	Mastery of Tremolo
	Adornment techniques	connections
	Musical mood	Playing style
	Rhythm stability	Mistakes

[3] - All questionnaires, tests, and forms have been designed with the cooperation of five experts in this field.

Content validity was used to determine the validity of the test. Content validity means that test content should include an accurate sample of course content and educational goals. Hence, the questions and the forms were designed based on the educational goals of the course and the intended content. In order to evaluate the reliability of the tests, Cronbach's alpha method was used, which in the cognitive test had a reliability of 0.91 and the skill, the test had a reliability of 0.88.

Data Analysis

The raw data from the assessments were analyzed using SPSS software version 25 and descriptive and inferential statistics. Considering that the main purpose of this study is to compare the mean scores of two variables of cognitive and skill learning between face-to-face and nuance groups, an independent t-test was used to compare their means and to evaluate the normality of variables and homogeneity of variance between groups, Shapiro-Wilk and Levan tests were used. The significance level for this study was 95%, with an alpha value less than or equal to 0.05.

Results

The mean and standard deviation of the study variables in each group are shown in Table 5.

Table 5 - Average grades of groups in post-test

Variables	Groups	Standard deviation ± mean	Mid
Cognitive learning	face-to-face	46.9 ± 7.3	49
	Nuance	60.9 ± 8.2	63
	Total	53.9 ± 10.4	52.5
Skill learning	face-to-face	370 ± 43.1	373
	Nuance	486 ± 63	490
	Total	428.4 ± 79.6	417.5

Normality Of Data Distribution

To use statistical tests, we must first ensure that the variables are normal. We use the Shapiro-Wilk test, which examines the assumption of normality. In this test, if the significance level (Sig) is more significant than 0.05, the data are normal(See Table 6).

Table 6 - Shapiro-Wilk test results for research variables

Variables	Groups	Shapiro-Wilk test	Degrees of freedom	Sig
Cognitive learning	face-to-face	0.960	15	0.691
	Nuance	0.941	15	0.39
	Total	0.971	30	0.566
Skill learning	face-to-face	0.953	15	0.57
	Nuance	0.927	15	0.244
	Total	0.956	30	0.247

Considering that the significance level (Sig) for assuming the normality should be greater than 0.05, it can be seen that the significance level for the variables of cognitive learning and skill learning is 0.566 and 0.247, which are more significant than 0.05, So these variables are normal. Also, the value of sig for their subgroups, face-to-face, and Nuance, is more than 0.05, and in all subgroups, the variables are normal.

Test of research hypotheses

In the descriptive statistics section, we observed a difference in the means of face-to-face and Nuance at the level of the cognitive learning variable. We noticed that the mean score of Nuance was higher than the face-to-face score descriptively and graphically. We use the independent hypothesis of the first hypothesis, which confirms the descriptive inferences. The table below shows Levene's Test to test the assumption of homogeneity of variances and the independent t-test for mean equality.

If the value of the significance level in the Leven test is more than 0.05, it means homogeneity of variances in the independent t-test. Also, if the significance value in the independent t-test is less than 0.05, there is a significant difference in the means of qualitative variables(See Table 7).

The findings of the independent t-test table clearly show that the significance level for Levene's Test in the cognitive learning variable is 0.330, which is greater than the standard error value of 0.05, so the assumption of homogeneity of variance is accepted, and the parametric t-test is valid. It also has a high level of significance in the t-test for the cognitive learning variable at the levels of face-to-face and Nuance, which is less than the standard error value, so reject the hypothesis of equality of means and the opposite hypothesis, which is related to the first hypothesis, and where differences express meaning in the mean of face-to-face and Nuance's cognitive learning.

With a similar argument, the second hypothesis can be confirmed. As can be seen in the table of findings, the significance level for skill learning is zero, so the mean hypothesis is rejected, and the hypothesis that there is a significant difference between face-to-face skill learning and Nuance is accepted.

The results of the first and second hypotheses are inferential arguments for the tables and graphs discussed in Descriptive Statistics. In the following, we will discuss the results obtained from the research hypotheses.

Table 7 - Levene's test and independent t-test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
				T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Cognitive Learning	Equal variances assumed	0.985	0.330	-4.959	28	0.000	-14.00000	2.82292	-19.78249	-8.21751
	Equal variances not assumed			-4.959	27.629	0.000	-14.00000	2.82292	-19.78600	-8.21400
Skill Learning	Equal variances assumed	3.403	0.076	-5.908	28	0.000	-116.53333	19.72442	-156.93697	-76.12969
	Equal variances not assumed			-5.908	24.749	0.000	-116.53333	19.72442	-157.17747	-75.88919

Discussion

Based on the analysis available in Table 9, assuming that RH1 was accepted, it was concluded that the Nuance education course significantly impacted cognitive learning in elementary school music students. Also, it affected cognitive learning much more than face-to-face training, a common way to learn music (see Chart 1).

The findings of this study are compatible with the previously mentioned research because they showed that e-learning designed based on learning standards and principles could perform better than other conventional methods (Johnson, 2020; Macrides & Angeli, 2018; Bauer, 2014; Mroziak & Bowman, 2016; Savage, 2007; Webster, 2007). Features that are considered in this course to affect cognitive learning and do not exist in other training include the use of the principles of learning and training, the principles of multimedia production, and the use of various contents such as images, audio, text, movies, infographics, motion graphics, using the Reigeluth educational design model, proper organization of multiple theoretical contents, providing Cognitive Tests, Providing Extensive and Rich Knowledge of Music History, Instrumentation, Music, and Geography, and composing and hearing training.

Based on the analysis results in Table 9, it is assumed that RH2 has been accepted, and it is concluded that the Nuance music education program significantly impacts elementary music students' skill learning. Furthermore, it had a much more significant impact on skill learning than face-to-face (see Chart 2).

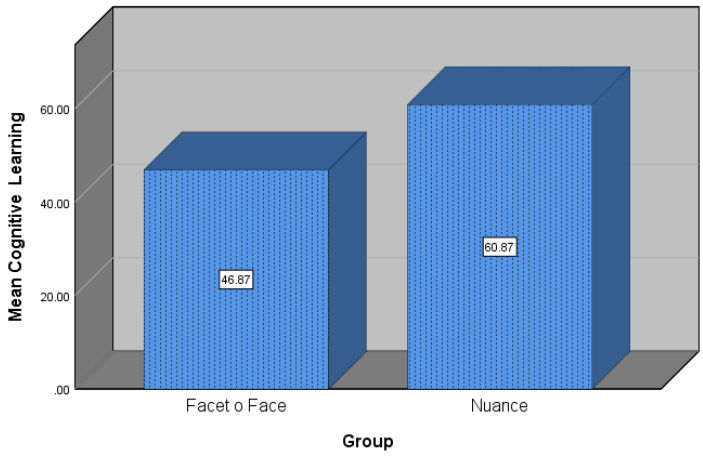

Figure 1 - Cognitive learning variable

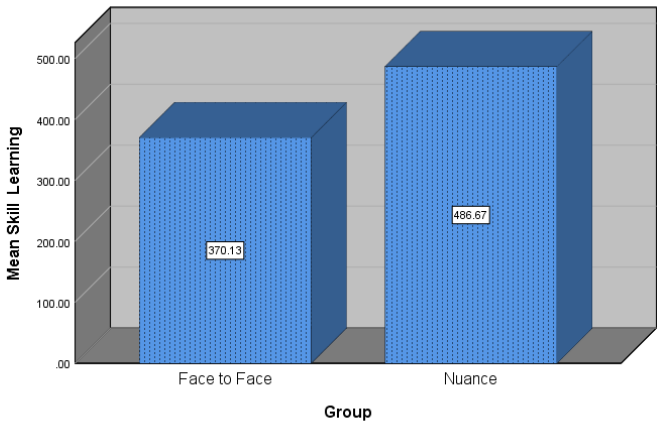

Figure 2 - Skill learning variable

In explaining and analyzing the results of this hypothesis, we can refer to specific and innovative methods of the Nuance course to improve skill learning. This course considers the following to improve students' playing skills, which does not exist in other methods:

- The principles of teaching and learning music,
- Using the Reigeluth Educational Design Model for Skills-Based Learning,
- Supervise the student's training by the trainer,
- Online support by the trainer
- Provide skill assignments and feedback by the trainer.
- Use the latest findings in music practice.

Conclusion

This study aims to teach Setar to the beginner level with the latest principles and fundamentals of music learning through structured lessons. This course has been constructed by music and educational science experts, educational technologists, and software engineers during the current research process. Theoretical knowledge, skill training, and practice are the main processes for learning music. Appropriate and standard combinations of these allow us to achieve ideal learning (Colwell & Richardson, 2002). This course, considering the same point and all the obstacles and problems of e-learning and face-to-face music education, as well as observing the principles of music learning in the context of technology, presented the Nuance course with the highest standards. As a result, the Nuance experimental group significantly differed from the control group in two main variables (cognitive learning and skill learning), with a more significant effect.

One of the problems we considered in this research was the problems that the students faced while practicing, and they did not have a teacher with them to help. While online courses like Nuance can somewhat solve this problem, they do not entirely solve it. The root cause of this problem is the lack of real-time feedback. When educational music software can provide real-time feedback during practice, students' mistakes will be minimized. A standard solution to such a problem could be intelligent voice recognition technology. This technology provides real-time feedback to students during practice and informs them of their strengths and weaknesses. This issue could be a suggestion for future work by researchers in this field.

In addition, another vital point in the research process is to consider the motivation of the students. Due to the long process of learning music, students' motivation to learn is expected to be reduced. According to recent research, gamification and game-based learning are important ways to keep learners actively engaged in the learning process (Rachels & Rockinson-Szapkiw, 2017; Jagušt et al., 2018; Hung et al., 2018). Therefore, the present researchers intend to conduct research in this field in the future.

These findings suggest a new path for the music education field. By continuing in this way and using energy and time efficiently, most problems in music education can be overcome, turning weaknesses into strengths. This path requires effort and scientific solid and structural support. Based on the findings, some Practical suggestions are mentioned below:

- Pay special attention to the students' training when not in class. The main reason for improving skills learning in this course is to consider a practice program for students outside the classroom.
- Pay particular attention to the difficulty leveling procedure for music education topics, especially the skills section.
- Similar designing courses for other musical instruments and styles.
- Producing quality and principled content in the field of music education.

References

Arkorful, V., & Abaidoo, N. (2015). The role of e-learning, advantages and disadvantages of its adoption in higher education. *International Journal of Instructional Technology and Distance Learning*, *12*(1), 29–42

Atlantis Pressei Hart, C. M., Berger, D., Jacob, B., Loeb, S., & Hill, M. (2019). Online learning, offline outcomes: Online course taking and high school student performance. *Aera Open*, *5*(1).

Bai, X. (2017). Promote Technology Self-efficacy via a SCORM-Based e-Learning Approach. *International Journal of Information and Education Technology*, *7*(8), 575–580.

Bauer, W. I. (2020). *Music learning today: Digital pedagogy for creating, performing, and responding to music*. Oxford University Press.

Blake, J. N. (2018). Distance learning music education. *Journal of Online Higher Education*, *2*(3), 1-23.

Calderón-Garrido, D., & Gustems-Carnicer, J. (2021). Adaptations of music education in primary and secondary school due to COVID-19: the experience in Spain. *Music Education Research*, *23*(2), 139-150.

Cano, M. D., & Sanchez-Iborra, R. (2015). On the use of a multimedia platform for music education with handicapped children: A case study. *Computers & Education*, *87*, 254–276.

Carmody, K. and Berge, Z. L. (2005). Elemental analysis of the online learning experience .International *Journal of Education and Development Using Information and Communication Technology*, *1*(3), 108–119.

Chan, L. M., Jones, A. C., Scanlon, E., & Joiner, R. (2006). The use of ICT to support the development of practical music skills through acquiring keyboard skills: a classroom based study. *Computers & Education*, *46*(4), 391–406.

Choudhury, S., & Pattnaik, S. (2020). Emerging themes in e-learning: A review from the stakeholders' perspective. *Computers & Education*, *144*, 103657.

Cloete, A. L. (2017). Technology and education: Challenges and opportunities. *HTS: Theological Studies*, *73*(3), 1-7.

Colwell, R., & Richardson, C. (Eds.). (2002). *The new handbook of research on music teaching and learning: A project of the Music Educators National Conference*. Oxford University Press.

Degli Innocenti, E., Geronazzo, M., Vescovi, D., Nordahl, R., Serafin, S., Ludovico, L. A., & Avanzini, F. (2019). Mobile virtual reality for musical genre learning in primary education. *Computers & Education*, *139*, 102-117.

Elcullada Encarnacion, R., Galang, A. A., & Hallar, B. J. (2021). The Impact and Effectiveness of E-Learning on Teaching and Learning. *International Journal of Computing Sciences Research*, *5*(1), 383–397.

Fathema, N., Shannon, D., & Ross, M. (2015). Expanding the technology acceptance model (TAM) to examine faculty use of learning management systems (LMSs) in higher education institutions. *Journal of Online Learning & Teaching*, *11*(2), 210-232

Feldman, E., Contzius, A., Lutch, M., Bugaj, K. K., & Battisti, F. L. (2020). *Instrumental music education: Teaching with the musical and practical in harmony*. Routledge.

Fick, J., & Bulgren, C. (2022). Developing 21st-Century Musicianship: Tablet- based Music Production in the General Music Classroom. *Journal of General Music Education*, *35*(2), 4-12.

Gherheș, V., F, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-Learning vs. Face- To-Face Learning: Analyzing Students' Preferences and Behaviors. *Sustainability*, *13*(8), 4381.

Groulx, T. J., & Hernly, P. (2010). Online master's degrees in music education: The growing pains of a tool to reach a larger community. *Update: Applications of research in music education*, *28*(2), 60-70.

Ho, T. K. L., Lin, H. S., Chen, C. K., & Tsai, J. L. (2013). Development of a computer-based visualised quantitative learning system for playing violin vibrato. *British Journal of Educational Technology*, *46*(1), 71–81.

Ho, W. C. (2007). Students? Experiences with and preferences for using information technology in music learning in Shanghai?s secondary schools. *British Journal of Educational Technology*, *38*(4), 699–714.

Holdhus, K., Murphy, R., & Espeland, M. I. (2021). *Music education as craft*. Springer International Publishing.

Huang, C. F., Nien, W. P., & Yeh, Y. S. (2015). Learning effectiveness of applying automated music composition software in the high grades of elementary school. *Computers & Education*, 83, 74–89.

Hung, C. Y., Sun, J. C. Y., & Liu, J. Y. (2018). Effects of flipped classrooms integrated with MOOCs and game-based learning on the learning motivation and outcomes of students from different backgrounds. *Interactive Learning Environments*, 27(8), 1028–1046.

Jagušt, T., Botički, I., & So, H. J. (2018). Examining competitive, collaborative and adaptive gamification in young learners' math learning. *Computers & Education*, *125*, 444–457.

Johnson, C. (2017). Teaching music online: Changing pedagogical approach when moving to the online environment. *London Review of Education*.

Johnson, C. (2020). A conceptual model for teaching music online. *International Journal on Innovations in Online Education*, *4*(2).

Jonassen, D. H. (1992). Evaluating Constructivistic Learning in Duffy. *TM & Jonassen, DH Construtivism and the Technology of Instruction-A Conversation. LEA Publishers*.

Jorgensen, E. R. (2008). *Transforming Music Education*: Indiana University Press.

Joyce, B. R. and Weil, M. (2008*). Models of teaching* (8th ed.). Pearson.

Koutsoupidou, T. (2014). Online distance learning and music training: benefits, drawbacks and challenges. Open Learning: *The Journal of Open, Distance and e-Learning*, *29*(3), 243–255.

Leshin, C. B., Pollock, J., & Reigeluth, C. M. (1992). *Instructional Design Strategies and Tactics*. Educational Technology Pubns.

Liu, J., & Liang, L. (2021, April). The Application of Computer Music Technology in Music Education. In *2021 IEEE Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC)* (pp. 791-793). IEEE.

Macrides, E., & Angeli, C. (2018). Domain-Specific Aspects of Technological Pedagogical Content Knowledge: Music Education and the Importance of Affect. *TechTrends*, *62*(2), 166–175.

Mayer, R. E. (2009). Multimedia Learning (2nd ed.). Cambridge University Press.

McCarthy, C., Bligh, J., Jennings, K., & Tangney, B. (2005). Virtual collaborative learning environments for music: networked drumsteps. Computers & Education, 44(2), 173–195.

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. Teachers College Record, 115(3), 1–47

Moallem, M. (2003). An interactive online course: A collaborative design model . Educational Technology: Research and Development, 51(4), 85–103

Mroziak, J., & Bowman, J. (2016). Music TPACK in higher education: Educating the educators. *Handbook of technological pedagogical content knowledge (TPACK) for educators*, 285-296.

Mtebe, J. S., & Raphael, C. (2018). Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania. *Australasian Journal of Educational Technology*, *34*(4), 4.

Müller, A. M., Goh, C., Lim, L. Z., & Gao, X. (2021). COVID-19 Emergency eLearning and Beyond: Experiences and Perspectives of University Educators. *Education Sciences*, *11*(1), 19.

Council, N. (2000). How people learn: Brain, mind, experience, and school: Expanded edition.

Pople, A. (1992). Computer music and computer-based musicology. *Computers & Education*, *19*(1–2), 173–182.

Prestiadi, D., Zulkarnain, W., & Sumarsono, R. B. (2019, December). Visionary leadership in total quality management: efforts to improve the quality of education in the industrial revolution 4.0. In *The 4th International Conference on Education and Management (COEMA 2019)* (pp. 202-206). Atlantis Press.

Rachels, J. R., & Rockinson-Szapkiw, A. J. (2017). The effects of a mobile gamification app on elementary students' Spanish achievement and self-efficacy. *Computer Assisted Language Learning*, *31*(1–2), 72–89.

Rahayu, F. S., Budiyanto, D., & Palyama, D. (2017). Analisis penerimaan e-learning menggunakan tech- nology acceptance model. *Jurnal Terapan Teknologi Informasi*, *1*(2), 87–98.

Raja, R., & Nagasubramani, P. C. (2018). Impact of modern technology in education. *Journal of Applied and Advanced Research*, S33–S35.

Raziūnaitė, P., Miliūnaitė, A., Maskeliūnas, R., Damaševičius, R., Sidekerskienė, T., & Narkevičienė, B. (2018). Designing an educational music game for digital game based learning: A Lithuanian case study. In *2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)* (pp. 0800-0805). IEEE.

Reaves, J. (2019). 21st-century skills and the fourth industrial revolution: a critical future role for online education. *International Journal on Innovations in Online Education*, *3*(1).

Rolisca, R. U. C., & Achadiyah, B. N. (2014). Pengembangan media evaluasi pembelajaran dalam bentuk online berbasis e-learning menggunakan software wondershare quiz creator dalam mata pelajaran akuntansi SMA Brawijaya Smart School (BSS). *Jurnal Pendidikan Akuntansi Indonesia*, *12*(2).

Rosset, M., Baumann, E., & Altenmüller, E. (2021). Studying Music during the Coronavirus Pandemic: Conditions of Studying and Health-Related Challenges. *Frontiers in Psychology*, 12.

Russell, J. A. (2018). *Statistics in Music Education Research* (Unabridged ed.). Oxford University Press.

Savage, J. (2007). Reconstructing Music Education through ICT. *Research in Education*, *78*(1), 65–77.

Taghizadeh, M., & Hasani Yourdshahi, Z. (2019). Integrating technology intoyoung learners' classes: language teachers' perceptions. *Computer Assisted Language Learning*, *33*(8), 982–1006.

Tan, A. G., Tsubonou, Y., Oie, M., & Mito, H. (2019). Creativity and music education: A state of art reflection. *Creativity in music education*, 3-16.

Ulum, H. (2022). The effects of online education on academic success: A meta-analysis study. *Education and Information Technologies*, *27*(1), 429-450.

Walls, K. C. (2008). Distance Learning in Graduate Music Teacher Education. *Journal of Music Teacher Education*, *18*(1), 55–66.

Webster, P. R. (2007). Computer-based technology and music teaching and learning: 2000–2005. In *International handbook of research in arts education* (pp. 1311-1330). Springer, Dordrecht.

Westerlund, H., Karlsen, S., & Partti, H. (2020). *Visions for intercultural music teacher education* (p. 219). Springer Nature.

Yaw Obeng, A., & Coleman, A. (2020). Evaluating the effects and outcome of technological innovation on a web-based e-learning system. *Cogent Education*, *7*(1), 1836729.

Yuwono, K. T., & Sujono, H. D. (2018). The Effectiveness of E-Learning: A Meta-Analysis. *Journal of Physics: Conference Series*, *1140*, 012024.

Zhao, Y., Wang, N., Li, Y., Zhou, R., & Li, S. (2020). Do cultural differences affect users' e- learning adoption? A meta- analysis. *British Journal of Educational Technology*, *52*(1), 20–41.