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Original Article

Design and Evaluation of ' Music Educational Assistant ': a Web-Based Assistant for Enhanced Music Cognitive and Skill Learning During COVID-19

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Abstract

Learning musical instruments has been rapidly popular during the past decades. However, it is faced with COVID-19 pandemic restrictions and lockdowns, which limit face-to-face music lectures. This research aims to design and develop an online instructional system named Nuance for learning musical instruments. The system performance is tested and analyzed to study the impact of the proposed system on cognitive and practical learning skills for a Persian musical instrument named Setar. This study uses a "quasi-experimental research" method for a population of 900 Setar elementary students in Sanandaj city during the 2021-2022 academic year. A convenience sampling method is used to form two homogenous groups, including control and experimental, each with 15 learners. The experimental group uses the Nuance system, while the control group receives online videos. The Shapiro-Wilk test is used to test the data normality, while one-way ANOVA and Tukey post hoc tests are used to analyze data and study the performance of the proposed system. The results show a significant difference between both the groups and support that the proposed system has a better performance for cognitive and practical music learning skills than the standard online system ($P < 0.05$).

Keywords

COVID-19, Music Learning, Online Instructional System, Setar.

Introduction

The landscape of music education, like many other fields, has been significantly altered by the ongoing COVID-19 pandemic. With the closure of schools in 180 countries, more than 85% of students worldwide could not attend in-person classes since April 2020 (World Bank, 2020). This abrupt shift from traditional face-to-face teaching and learning (T&L) to remote education poses profound challenges, particularly in fields that heavily depend on direct interaction between instructors and students. One such area is music education.

The unique nature of music education involves a combination of cognitive understanding and skill-based learning that traditionally benefits from face-to-face interaction. This interaction allows for immediate feedback from instructors, a critical component in learning to play a musical instrument (Kaschub & Smith, 2014). The loss of this direct feedback in a remote learning context significantly increases the likelihood of unsuccessful instrument playing, a problem that becomes more pronounced when trainer-trainee interaction is minimized (Kaschub & Smith, 2014).

Research conducted during the pandemic has corroborated these challenges. Studies have reported a decrease in music practice hours due to factors such as negative emotions, lack of motivation, and reduced interaction with teachers (Biasutti et al., 2021; Daubney & Fautley, 2020; Müller et al., 2021; Rosset et al., 2021). These unprecedented circumstances necessitate the exploration of alternative methods to traditional music education, with a particular emphasis on leveraging technology.

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Advancements in technology provide potential solutions to these challenges. The integration of technology in music education through various software, hardware, and training courses has been shown to offer significant benefits, such as creating interactive and user-friendly environments and reducing training costs (Gherheș et al., 2021; Fick & Bulgren, 2021; Liu & Liang, 2021). However, this integration has not been without its challenges. These include a lack of understanding about music technology applications, insufficient frameworks to guide the integration and evaluation of technology in music education, and a dearth of studies examining the long-term effects of this integration (Bauer, 2020; Mroziak & Bowman, 2016; Savage, 2007; Webster, 2007).

These challenges bring us to the following research questions: Can music e-learning overcome the problems of face-to-face education? How does it impact student learning? Does current e-learning offer a viable alternative to traditional teaching? Does it comply with learning principles and standards like Scorm and instructional design principles?

Motivation

Motivated by these challenges and questions, this study aims to address the limitations of face-to-face music education and improve the gaps in e-learning. We propose a web-based training course that uses standard, organized training based on the basics of music education: the 'Nuance Music assistant'. This research's primary goal is to design, implement, and evaluate this music educational assistant and determine its effects on the cognitive and skillful learning of music students compared to common online learning methods. The designed course is called '*Nuance*' for short. **Nuance is a web-based music learning course.** For the common online learning method, **the Khonyagar** site was selected as the control group, a music education site in Iran with a high reputation.

Goals

according to the previous description, three goals can be considered for this research:

A. Design and produce music educational assistant(Nuance)

B. Compare the effectiveness of Nuance on cognitive learning with music e-learning(Khonyagar)

C. Compare the effectiveness of Nuance on skill learning with music e-learning(Khonyagar)

According to the explained goals, one Research question and two hypotheses are derived from goals:

RQ1. What elements and components are used in the design and production of music educational assistant?

RH1. There is a significant difference between the means of Khonyagar and Nuance in the cognitive learning variable.

RH2. There is a significant difference between the means of Khonyagar and Nuance in the skill learning variable.

Theoretical background

Utilizing the potential of new technologies to increase student learning productivity and achievement has long been considered (National Research Council, 2000; Pople, 1992). Among these, e-learning can be considered one of the best strategies for teaching and learning (Encarnacion, R. E., Galang, A. D., & Haller, B. A, 2021). *E-learning* is defined by Choudhury & Pattnaik as "the transfer of knowledge and skills, in a periodically 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 (Yang Zhao et al., 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 suggestion, use of analytical tools and regular updates are essential factors in the success of an educational website (Obeng & Coleman, 2020). Some standard web-based e-learning systems include WebBoard, Blackboard, Glow, Google classroom, Code Academy, MOODLE and Sakai.

A considerable amount of research has been done to identify, review and evaluate the critical factors that affect the e-learning system, as well as the effectiveness of e-learning, in order to promote and maximize its benefits (Fathema et al., 2015; Mtebe & Raphael, 2018; Means et al., 2013; Yuwono & Sujono, b2018; Choudhury & Pattnaik, 2020; Ulum, 2021; yang Zhao 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 overall learning outcomes in implementing e-learning are more than average and face-to-face learning. In the following, we will examine several findings that have mentioned some points in implementing e-learning.

Choudhury and Pattnaik (2020) reviewed articles published between 2000 and 2018 and identified essential success factors in e-learning that relate to the various stakeholders of e-learning. These critical success factors are up-to-date technology, appropriate course and class design, social presence, computer literacy, technology and 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 above results in more detail in music education, we come across studies with similar results. However, no research has been found that evaluates the effects 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), the use of automated composing software (Huang et al., 2015), the use of multimedia platforms (Cano & Sanchez-Iborra, 2015), the use of ICT in Development of music practice skills (Chan et al., 2006), setting up virtual participatory learning environments (McCarthy et al., 2005), application of computer-based visual learning system (Kwei-Liang Ho et al., b2013), use of multimodal, dual-channel, multimedia learning (DML) and video game-based learning (Raziunaite 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 the 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 Quaid-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, 1202; Müller et al., 2021; Rosset et al., 2021). This led to a negative attitude towards e-music education (Garrido & Carnicer, 2021).

The last paragraph shows the difference between the present study and other work done in this field. This research has tried to validate the music e-learning course based on the latest findings of educational technology, instructional design and the basics of music education, design, production and accreditation. 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 theory, educational design pattern, teaching approach, learning tools and technologies and the use of educational technology science (Johnson, 2020). The following is a brief overview of the design process. In Table 1, the general design framework is determined, including the type of learners, content, media, tools, training strategies, evaluation, and design level. These items are necessary to determine the design pattern (See Table 1).

Table 1. General design framework

Dimensions	Details		Description
Learners	**Gender**	Man and Woman	
	Age	13 to 18 years	Adolescent age category
	Job	student	
	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		
Media	Educational booklet-book-teacher-film-image-audio infographic		
Instrument	Setar		Setar is an Iranian percussion instrument.

Instructional tools	Computer - smartphone - laptop - tablet Synchronous tools - Asynchronous tools		
Level of training	Beginner		It lasts about 9 months.
Learning theory	Complies with system patterns		
Educational strategies	Organizing strategy	Content sequences from simple to complex	Bruner Spiral Curriculum
	Instructional strategy	e-learning Web based	
	Training strategy	Student-centered Teacher-centered Subject-oriented	
	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		

When design framework and its details are specified, the design model can be selected with the help of this framework. After reviewing the system models, the seven-step Reigeluth model was selected as the most suitable model for the current course design. This model was developed in 1992 by Santia Leshin, C. B., Pollock, J., & Reigeluth, C. M. 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 of the models introduced by different experts are limited to a specific type of learning objectives or a specific way of providing training; While the Reigeluth model includes a variety of learning objectives, teaching methods and content delivery systems, and in this regard, it can 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 designs at the micro and macro levels to follow systemic patterns and is also suitable for cognitive learning and skill learning. As mentioned, Nuance [3]is a web-based setar training using the Persian language. Students must first enter the course environment by connecting to the Internet.

[3] - For detailed information about the Nuance framework, check the Attachments.

Materials and methods

This research is Applied research. The proposed approach is evaluated using a quasi-experimental research method consisting of control and experimental groups with post-test. Since the level of all subjects is the same before the research, there is no need to perform a pre-test.

Experiment population

The population of this study includes all Setar elementary students in Sanandaj city (Kurdistan province of Iran) and students of the Khonyagar online music education site who were learning music in 2021.

Experimental and control groups

The present study has two groups of experiments and controls (See Table 2).

1. Experimental group: Students trained by the Nuance course.
2. Control group: Students trained in the Khonyagar site.

Table 2. Experimental and control groups

Group	Pre-test	independent variable	Post-test
Experimental	-	X	**T2**
Control	-	-	**T2**

Sampling

The first step in sampling this study was to find students interested in learning setar through the nuances course. Because the course took about nine months to train and was relatively long for research, Samples should have participated in the course voluntarily to prevent sample loss. Accordingly, a research participation form was distributed in high schools in Sanandaj to find volunteers. Among the volunteers, 15 were randomly selected to be trained in the Nuances course. After identifying the samples of the Nuance group, the method of matching samples based on the Nuance group was used for sampling the control group. The criteria of age, gender and education were used in matching.

The Control group includes students who have been trained on the Khonyagar site. From the introductory students of this site, 15 people were selected. All of them were matched with the Nuance group. (See Table 3)

Table 3. Sample selection

Group	Number	Gender	Sample selection method
Nuance	15	۸ males ۷ females	Random selection of volunteer samples
Khonyagar	15	۸ males ۷ females	Targeted and matched with the Nuance group

Research tools

Since no relevant research was found to provide standard questionnaires and collection tools, researcher-made tools are used in this research. The three basic tools [4]used are as follows:

• A questionnaire to collect general and basic information about the subjects : This questionnaire includes 23 questions about gender, age, education, and music background, which helped the researchers to match the groups.

[4] All questionnaires, tests and forms have been designed with the cooperation of 5 experts in this field.

• A researcher-made test to assess cognitive learning: This test included 63 multiple choice questions. The coefficients of the questions were the same and finally the score was converted into a percentage and determined the cognitive learning of the students.
• A researcher-made form for measuring skill learning: This test included the performance of a piece of music. After performing and recording the piece, 5 music trainer gave points to each of the subjects based on the form created by the researcher. Each form contains 22 questions with different coefficients. Finally, the average score recorded by the judges for each subject was considered as a skill learning score[5].

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

Table 4. Components

Main variables	Components	
Cognitive learning	music theory	Instrumentation
	History of music	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 Hearning 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

Validity and reliability of research tools

Content validity was used to determine the validity of this test. Content validity implies that test content should include an accurate sample of curriculum content and educational objectives. Therefore, the questions, as well as the forms, were designed wholly based on the educational goals of the course and the content that was intended. To ensure content validity, the test questions and forms were reviewed by a panel of 5 subject matter experts who teach this course. The experts examined the tests to evaluate how well the questions aligned with the educational goals and course content. Each expert rated the relevance of each test item on a 4-point scale. Items rated as 3 or 4 (quite relevant or highly relevant) by at least 4 of the 5 experts were retained. This process resulted in the final test forms containing only questions that closely reflect the content and objectives of the curriculum. In order to evaluate the reliability of the tests, Cronbach's alpha

[5] All questionnaires and tests are presented in the attached file.

method was used, which in the Cognitive test had a reliability of 0.91, and the skill test had a reliability of 0.88. The high Cronbach's alpha coefficients provide further evidence supporting the content validity of the tests.

Data analysis

The raw data from the assessments were analyzed using SPSS software version 25 and descriptive and inferential statistics. The main purpose of this study is to compare the mean scores of two cognitive and skill learning variables between the Khonyagar and Nuance groups. The independent t-test was used to compare their means and examine the test defaults, normal variables and homogeneity of variance between groups. Shapiro-Wilk and Levon tests were used, respectively. The significance level in this study is 95%, and the alpha is less than or equal to 0.05.

Results

Findings related to research variables

The mean and standard deviation of the research variables by groups in the post-test are presented in table 5, Chart 1 and Chart 2.

Table 5. Average grades of groups in post-test

Variables	Groups	Standard deviation ± mean	Mid
Cognitive learning	Khonyagar	47.4 ± 9.2	47
	Nuance	60.9 ± 8.2	63
	Total	54.1 ± 9.2	54
Skill learning	Khonyagar	361 ± 65.6	359
	Nuance	486 ± 63	490
	Total	423 ± 89.9	426

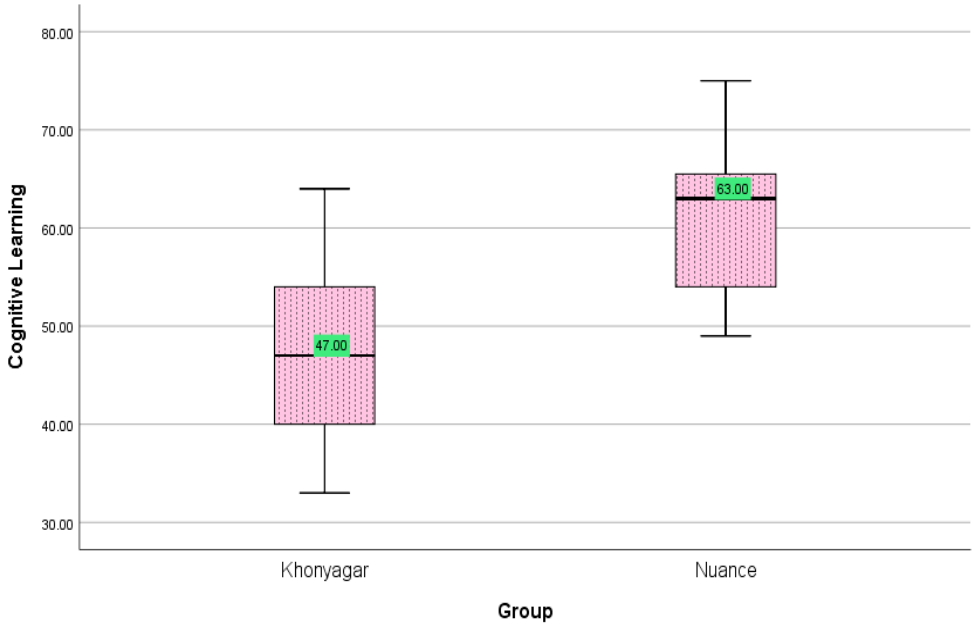

Figure 1. Comparison of means in the cognitive learning variable between khonyagar and Nuance

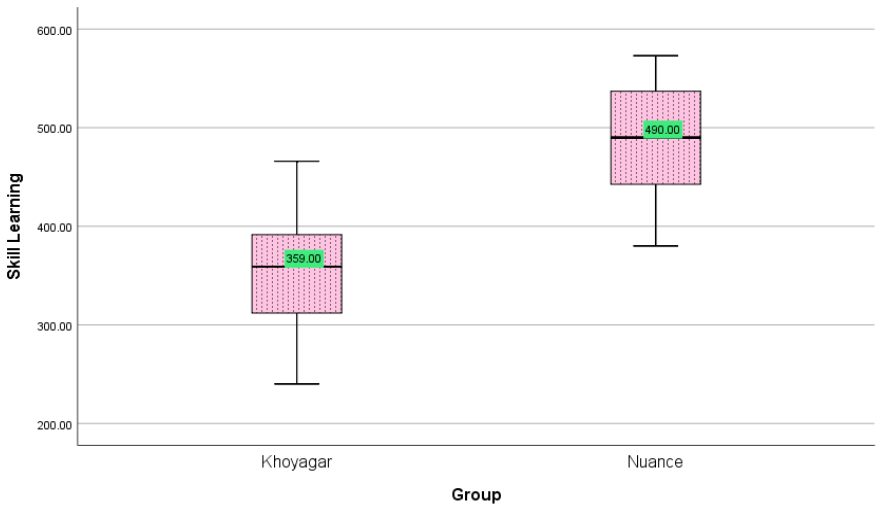

Figure 2. Comparison of means in the skill learning variable between khonyagar and Nuance

Investigating the normality of research 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 greater than 0.05, the data will be normal(See Table 6).

Table 6. Shapiro-Wilk test results for research variables

Variables	Groups	Shapiro-Wilk test	Degrees of freedom	Sig
Cognitive learning	Khonyagar	۰/۹۶۲	۱۵	۰/۷۳۱
	Nuance	۰/۹۴۱	۱۵	۰/۳۹
	Total	۰/۹۷۸	۳۰	۰/۷۷۵
Skill learning	Khonyagar	۰/۹۵۵	۱۵	۰/۶۰۶
	Nuance	۰/۹۲۷	۱۵	۰/۲۲۴
	Total	۰/۹۶۸	۳۰	۰/۴۴۷

Considering that the significance level (Sig) for assuming normalcy should be greater than 0.05, it can be seen that the overall significance level for the variables of cognitive learning and skill learning is 0.775 and 0.447, which are greater than 0.05, so these variables are normal. Also, the value of sig for their subgroups, Khonyagar and Nuance, is more than 0.05, and clearly, the variables are normal in all subgroups.

Test of research hypotheses

In the descriptive statistics section, we observed that differences in the averages of Khonyagar and Nuance were observed in the levels in the cognitive learning variable, and we saw that the mean scores of Nuance were descriptively and graphically higher than Khonyagar scores, then inferentially using the test. 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).

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
CognitiveLearning	Equal variances assumed	0.069	0.795	-4.235	28	0.000	-13.46667	3.17980	-19.98019	-6.95315
	Equal variances not assumed			-4.235	27.599	0.000	-13.46667	3.17980	-19.98445	-6.94888
SkillLearning	Equal variances assumed	0.078	0.782	-5.349	28	0.000	-125.66667	23.49461	-173.79320	-77.54013
	Equal variances not assumed			-5.349	27.956	0.000	-125.66667	23.49461	-173.79662	-77.53671

The findings of the independent t-test table clearly show that the significance level for Levene's Test in the cognitive learning variable is 0.795, 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 significance level in the t-test for the cognitive learning variable at the levels of Khonyagar and Nuance, which is less than the standard error value, so it rejects the hypothesis of equality of means. The opposite hypothesis, related to the first hypothesis and the difference, Expresses meaning in the average of cognitive learning at the levels of Khonyagar and Nuance.

With a similar argument, the second hypothesis can be confirmed. As can be seen in the table of findings, the level of significance for skill learning is zero, so the equality of means is rejected, and the hypothesis of a significant difference between the means of skill learning at the levels of Khonyagar and Nuance is accepted.

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

Discussion

Research quistion RQ1

The development of the Nuance music educational assistant involved the systematic application of instructional design principles and incorporation of multimedia features. Specifically, RQ1 which examined the elements used in designing Nuance was addressed through:

- Adopting the Reigeluth 7-step instructional design model to provide macro and micro level guidance
- Aligning learning outcomes, assessments, and content sequencing based on the Spiral Bruner Curriculum to scaffold complexity
- Leveraging multimedia by including textual explanations, diagrams, videos, animations, and audio samples as per Mayer's Multimedia Learning Principles
- Applying student-centered strategies centered around communication, assessment, and collaboration
- Incorporating features like skill assignments, feedback, tracking, and assessments based on best practices for online learning systems
- Developing rich, interactive content spanning theoretical concepts, historical knowledge, technical skills, and musical compositions
- Ensuring accessibility across devices like computers, tablets, and smartphones

Hypotheses RH1

Based on the results of the analysis available in Table 9, the hypothesis RH1 Has been accepted, and it is concluded that Nuance educational course has a significant effect on the Cognitive learning of elementary music students. Also, compared to the training method of Khonyagar(a common method of online music learning), it has a much more significant effect on cognitive learning(See Chart 3).

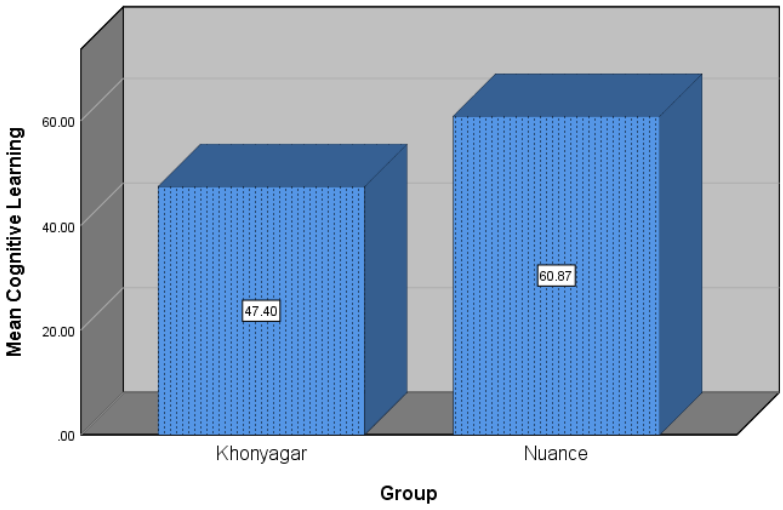

Figure 3. Cognitive learning variable

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 e-learning 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 image, audio, text, Film, Infographic, Motion Graphics, Using Reigeluth educational design model, Proper Organization of Multiple Theoretical Content, providing Cognitive Tests, Providing Extensive and Rich Knowledge of Music History, Instrumentation, Music and Geography, Composing and Hearing Training.

Hypotheses RH2

Based on the analysis results in table 9, hypothesis RH2 Has been accepted, and it is concluded that the Nuance music educational course significantly affects the Skill learning of elementary music students. Also, compared to the Khonyagar site, it has a much more significant effect on Skill learning(See Chart 4).

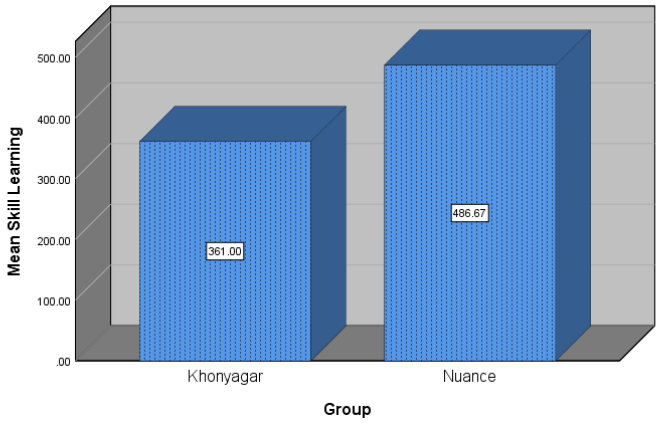

Figure 4. Skill learning variable

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 courses:

- Principles of learning music
- Using the Reigeluth educational design model based on Skill Learning
- Supervise the student's training process by the teacher
- Student support online by the teacher
- providing skill assignments and feedback by the teacher
- Use the latest findings in music practice

Conclusion

The present study aimed to teach setar at a Beginner level in an organized course with the latest principles and foundations of music learning. This course has been constructed in the current research process by music and educational science experts, educational technologists and software engineers. Theoretical knowledge, skill training and practice are the main processes for learning music. The appropriate and standard combination of these leads us to ideal learning (Colwell et al., 2002). This course, considering the same point and all the obstacles and problems facing 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.

The quantitative results clearly showed that students in the Nuance experimental group achieved higher scores in assessments of cognitive knowledge as well as practical skill technique and musical ability. The mean scores on both measures were markedly higher for Nuance students compared to the control group using regular online videos.

These results align with prior research that found e-learning designed based on systematic instructional models and multimedia principles enhances learning outcomes more than just digitizing traditional teaching (Johnson, 2020; Macrides & Angeli, 2018). The effectiveness of Nuance mirrors similar studies demonstrating the benefits of integrating technology in music education using software, virtual environments, and customized platforms (Chan et al., 2006; Innocenti et al., 2019; Cano & Sanchez-Iborra, 2015).

The significant improvements in student cognition and skills can be attributed to Nuance's strong grounding in evidenced-based instructional, multimedia, and online learning best practices. The use of design models, multimedia integration, interactive elements, assessments, and alignment with objectives contributed to its success. Students also had greater engagement with the variety of Media and self-paced learning. This underscores the importance of applying pedagogical principles in developing online music education rather than direct replication of face-to-face instruction.

One of the problems we encountered in this research was the problems that the students faced while practicing and did not have a teacher to help them. Although online courses like Nuance can cover this problem to some extent, they do not entirely solve it. A standard solution to such a problem could be intelligent voice recognition technology. Such technology can give real-time feedback to the students during practice and inform them of their strengths and weaknesses. This could be a suggestion for future work by researchers in this field.

Also, another critical point in the research process was considering students' motivation. Due to the long process of learning music, reducing students' motivation seems obvious. According to the latest research, Gamification and Game-based learning are valuable ways to maintain learners' engagement 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.

In summary, this study demonstrates that systematic instructional design combined with multimedia integration can significantly enhance the effectiveness of online platforms for music learning. These findings open up new possibilities for leveraging education technology to provide engaging, flexible, and highly effective music training. Further research can explore optimal ways to translate additional best practices in music pedagogy to online environments.

Acknowledgment

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