J. Electrical Systems 20-5s (2024): 2403-2417

[1] Xueying Liu

[2]Ke Ma

[2*]Yuting Dong

The Application of Flipped Classroom Based on the Fias Analysis Model in the Online Teaching of Piano Art Instruction

Abstract: - This research investigates the use of the Flipped Classroom (FC) approach, based on the Flanders Interaction Analysis System (FIAS) analysis model, in the online teaching of piano art instruction. The FIAS analysis model is used to analyze the key factors that influence the effectiveness of the flipped classroom approach. The study uses a mixed-methods research design, combining surveys and interviews with students and teachers to gather data on the effectiveness of the flipped classroom approach. The study used piano theory for analysing the interaction analysis. The results indicate that the FC approach, based on the FIAS analysis model, can significantly improve student engagement and learning outcomes in online piano art instruction. The study also identifies several challenges and limitations of the approach, such as the need for adequate preparation time and the need for students to have access to suitable technology and resources. In this study, we have used ANOVA method to analyse the data. Overall, the study provides insights into the potential benefits and challenges of the FC approach in online piano art instruction and offers recommendations for future research and practice.

Keywords: Flipped Classroom, FIAS analysis model, online teaching, Piano art instruction, piano theory.

1. Background

1.1 Definition of Flipped Classroom (FC)

The Flipped Classroom (FC) or flipped learning model is a teaching approach where students first learn the new material outside of class, usually through videos or other online resources, and then come to class to engage in activities that reinforce and apply what they have learned. This allows teachers to focus on facilitating and guiding students learning rather than delivering lectures. The model was first popularized by teachers who used screencasts to flip their science classrooms in 2007. Since then, the FC has gained popularity as a way to personalize learning, promote active learning, and improve student outcomes [1]. The use of network technology and online resources can help to make the learning process more flexible and convenient for students, while also allowing teachers to monitor and support their progress more effectively. In the music classroom, the FC model can be particularly useful for activities that involve a lot of individual practice or preparation, such as learning music theory or practicing vocal techniques. By

[1]Minjiang University, Tsai Chi-Kun Academy of Music, Fuzhou, Fujian, China, 350108
[2]School of Music, University of Queensland, Brisbane, Australia, 4072
*Corresponding Author E-mail: 1728@mju.edu.cn

providing students with instructional materials online and using class time for group activities and practice, teachers can create a more engaging and interactive learning experience. The FC approach can also help to promote self-directed learning and develop students' critical thinking and problem-solving skills, which are important for success in any discipline [2]. Figure 1 Represents the analysis of Flipped Classroom.

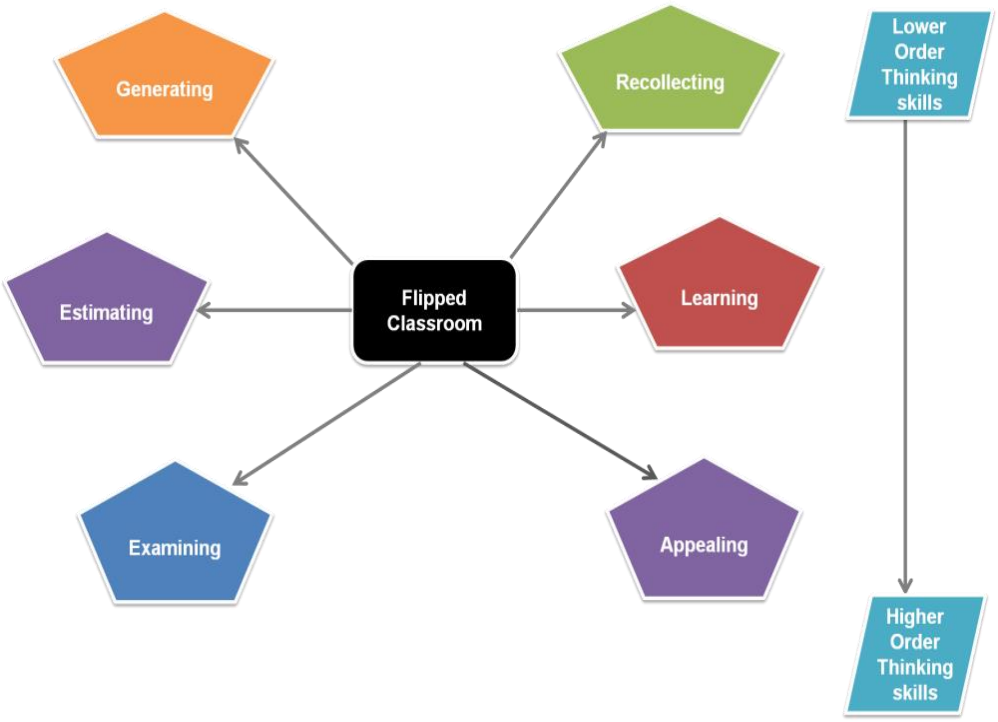

Figure 1. Analysis of Flipped Classroom

1.2 The Present State of Group Piano Instruction

In some areas, piano collective teaching is well-established and widely implemented, while in others it may be less common or still in development. However, there are some general trends and challenges that are common to many piano collective teaching programs. One challenge facing piano collective teaching is the need to balance individualized instruction with group activities and performance. In a large class setting, it can be difficult to provide personalized attention and feedback to each student, while also ensuring that all students are making progress and participating in group activities. Teachers may need to use a variety of teaching methods and techniques to address this challenge, such as using technology to provide individualized feedback and support or incorporating more collaborative and interactive activities into class time. Another challenge facing piano collective teaching is the need to keep pace with changing student needs and interests. As students' musical preferences and learning styles evolve, teachers may need to adapt their teaching methods and materials to ensure that they remain engaging and relevant. This may involve incorporating new technology and online resources or developing new teaching strategies and activities that reflect students' interests and abilities [3]. Despite these challenges, there are also many opportunities and advantages to piano collective teaching. However, due to the large class size and limited class time, it can be challenging to provide individualized instruction and ensure that all students can make progress. To

address these challenges, teachers may need to explore new teaching methods and strategies, such as incorporating technology or using an FC approach, to create a more flexible and personalized learning environment. By combining different teaching methods and techniques, teachers can help students to develop a deeper understanding and appreciation of music, while also improving their piano-playing skills. Additionally, by fostering a collaborative and supportive learning environment, teachers can help to create a positive and engaging classroom experience for all students [4].

1.3 The flipped classroom model enables more focused pre-class preparation

The flipped classroom approach can be particularly effective in helping to develop students' autonomy and independence. By providing students with instructional materials and resources outside of class, and giving them opportunities to practice and apply what they have learned in class, teachers can encourage students to take more ownership of their learning process. This can lead to greater engagement, motivation, and academic achievement, as students are more invested in their learning [5]. In the context of piano collective lessons, the FC approach can be used to help students develop their piano-playing skills and music theory knowledge. For example, teachers can assign students to watch instructional videos or read materials on music theory and piano techniques before class, and then use class time for hands-on practice and group activities. This can help to ensure that students have a solid understanding of the fundamentals of piano playing and music theory, and can apply this knowledge in their practice. Additionally, by using technology and online resources, teachers can provide students with personalized feedback and support, even in a large class setting. Overall, the FC approach has the potential to revolutionize piano collective lessons by creating a more engaging, personalized, and effective learning environment for all students [6].

1.4 Flipped Learning Increases Active Learning in the Classroom

The flipped classroom approach allows teachers to use class time more effectively by focusing on hands-on, interactive activities that reinforce and apply what students have learned outside of class. For example, in a piano collective lesson, teachers could use the FC approach to teach a song like" If You Are Happy" [7]. Students could watch a video or read materials on the basics of piano playing and music theory before class, and then use class time to practice and apply these concepts through ensemble playing, singing, and other activities. Teachers could also encourage students to experiment with different musical styles, rhythms, and arrangements, and to use their creativity to adapt the music and lyrics in new and interesting ways [8]. As we proposed, through the use of the FIAS analysis paradigm in an FC for online piano art training. The concept of conditional independence serves as the cornerstone of numerous research approaches.

2. Related works

The Research encouraged the pupils to do independent study before class and perform the assigned tasks while following the teacher's instructions. Also, there are a lot of students enrolled in the main courses of professional theory, making it impossible for instructors to adapt their lesson plans to the needs of every single student. Teachers are only able to care for the bulk of the class' somewhat intelligent kids in this

situation. Taking care of pupils who develop quickly and slowly may be challenging. The consequence is an unsatisfactory teaching outcome. The FC teaching method is being steadily developed in college and university classes due to the widespread use of electronic technologies [9]. The article examines Artificial intelligence and wireless networking as two key technologies that help flipping classes function. Via an interactive gadget with the help of clever networking features, instructors and students communicate with one another. The system is made intelligent by using a convolutional neural network, which provides automated course content categorization. The K-means method is contrasted with the suggested model [10]. The article analyzed the concept of the micro lecture FC, looks at the benefits of including piano teaching, and then gives a thorough examination of the micro lecture FC [11]. The case study determined Collective piano teaching has opened up new possibilities and advancements with the arrival of the big data era, and corresponding changes have been made in college education technology and teaching models. This has made it possible for universities and colleges to acclimate their collective piano education curriculum model to the big data era. This study examines fresh strategies and paths that are best for group piano teaching in academic institutions while taking into consideration the big data era [12]. The article discussed the social environment, college curriculum, and the instructors' and students' personal experiences, and based on these considerations, seeks ways to enhance the piano community lesson instruction. by improving the intellectual backgrounds of college and university piano teachers, effectively raising the bar for piano teaching in my country [13]. The research realized the intelligent wireless network optimization and the intelligent reform of online piano instruction. To determine the efficiency of each distinguishing variable, the Relief F weight method and the regression fitting algorithm are used first [14]. The article evaluated P-KNN and ML-SVM performance compared to that of KNN and the Information-Theoretic-Metric-Learning (ITML) technique. The results show that P-KNN and ML-SVM have recognition accuracy rates of 82.78% and 83.97%, respectively [15]. The article reviewed that the FC paradigm is a teaching strategy that blends in-person instruction in the classroom with learning activities that students do outside of school. The course material should be learned outside of class, and additional practice should be done there. On the other hand, to assess the model's total impact on the educational system, it is crucial to demonstrate what sort of trend the FC studies exhibit [16]. The study looks at masters research papers on the FC model in Turkish schooling and using a thematic content evaluation technique. Target publications were only postgraduate theses that were published in the area of education between 2014 and 2020. Thematic content analysis was utilized to determine the theses' general features, objectives, methods, samples, subjects for data collection, findings, and suggestions [17]. The article showed that the majority of these seek to determine the FC model's impacts on certain variables as well as the participants' perceptions and experiences of the FC. The mixed method is the most often used approach, while the embedded design and numerous case designs are the most widely utilized study patterns. In the research under review, FC learning environments are mostly created for teacher education and the teaching of foreign languages to participants. Similarly to this, the majority of the papers under review discuss the advantages of the FC model, its application, and its limitations. Finally, these provide suggestions for improving FC learning and provide information for other scholars [18]. The research comprised a description of the state of piano instruction in universities and a synthesis and interpretation of the research's results, written for educators and pupils, on the cognitive status

of informational piano education [19].The article determined the piano majors at institutions of higher learning; this section describes the direction of network information reform and building. It focuses on three key areas: creating a networked piano learning environment utilizing new media, employing piano "micro-courses" to augment conventional classroom training, and creating a structure for piano training [20].

Contribution of study

The work contributes by explaining how to use a theoretical approach to enhance the performance of a FIAS approach. The research's accomplishments are summarized as follows:

1. The FIAS analysis intervention model is developed in this study based on an analysis of results from prior studies.
2. To investigate the use of flipped learning, which is based on online piano instruction, and to apply certain methods and ideas to more real-world problems.

The remaining portion of the manuscript is organized as follows: The review in section 2 was made possible by the analysis of the applicable studies. The strategy we used to come up with our suggestions for Segment 3. In Segment 4, we go through the Discussion and Outcomes. The study concludes its analysis of the study's importance, limitations, and suggestions for more research in segment 5.

3. Experimental procedure

In this particular investigation, the FC structure was used to instruct piano art online in three distinct approaches.

3.1 Dataset

A total of 64 students from a piano art instruction program at a university in China participated in this study. They were randomly assigned to two groups: the Experimental Group (EG) (n=32) and the Control Group (CG) (n=32). The experimental group received FC-based online piano art instruction, while the control group received traditional online instruction [21].

3.2 Splitting of groups

By constructing groups with comparable ratings, the experimental and control groups were created with the understand ability of the changes in consideration. The students' pre-test and post-test skill ratings were calculated and the skill ratings were arranged in an experimental and control group. To optimize the effectiveness of an FIAS analysis model, it is essential to select the appropriate parameter values. The right hand and left hand technique, musicality, posture and grip and performance are common evaluation metrics used to evaluate the effectiveness of a classification model**.**

3.3 Instruments

Two instruments were used to collect data: a pretest-posttest questionnaire and a satisfaction survey. The pretest-posttest questionnaire consisted of 20 multiple-choice questions that assessed students' knowledge

and skills in piano art instruction. The satisfaction survey consisted of 10 items that assessed students' satisfaction with online instruction. To gauge students' understanding of behaviorism, cognitivism, and social learning theories, two seasoned instructors created three examinations. Each piano art instruction had a good grade of 100 and featured instruments such as Pitch (30%), Timbre (10%), Dynamics (10%), Touch (20%), and Pedals (30%). The objective questions attempted to evaluate students' retention and understanding of important ideas from piano art instruction and reading materials, while the subjective questions targeted the evaluation of intellectual abilities including analysis, applications, and drawbacks. In this research, we have used ANOVA method to analyse the data.

3.4 Flanders Interaction Analysis System (FIAS)

The FIAS method is based on the idea that classroom interactions can be analyzed and categorized into different types of communication behaviors, such as asking questions, giving feedback, or providing information. These communication behaviors are then further classified based on their level of cognitive demand, emotional tone, and other factors. By analyzing classroom interactions using the FIAS method, researchers and educators can gain insights into the quality and effectiveness of classroom communication, and identify areas for improvement. The method has been used in a wide range of educational settings, from elementary schools to universities, and has been applied to various subjects and content areas.

The Flanders classification was modified slightly to provide eight categories:

1. The instructor comments or inspires.
2. The instructor acknowledges the student's thoughts and/or emotions.
3. The instructor gives examples or explanations.
4. The instructor issues a directive.
5. The student speaks back to the instructor.
6. The student plays piano.
7. Talk starts with the student.

The three methods of instruction or therapies were as follows:

Teacher-directed lessons (T-dir): Refer to a teaching approach where the teacher plays a central role in delivering information and guiding students' learning. In this approach, the teacher typically leads class discussions, delivers lectures, assigns homework, and provides feedback and evaluation. The T-dir approach is often used in traditional classroom settings, where the teacher is seen as the primary source of knowledge and expertise. While the T-dir approach can be effective in certain contexts, it has some limitations. For example, it may not be suitable for students who have different learning styles and preferences, as it may not provide enough opportunities for active and experiential learning. Additionally,

it may not allow for sufficient individualized attention and feedback for students who need extra support or challenge.

Pupil-directed lessons (P-dir): refer to a teaching approach where the student takes an active role in their learning process, and the teacher acts as a facilitator or guide. In this approach, students are encouraged to explore and discover knowledge on their own, with the teacher providing support and feedback as needed. P-dir is often used in student-centered teaching methods such as inquiry-based learning, project-based learning, or problem-based learning. The P-dir approach can have several advantages for students. It promotes independent and critical thinking, creativity, and problem-solving skills. It can also increase students' motivation and engagement in the learning process, as they take more ownership of their learning. Additionally, P-dir can help to promote a more collaborative and supportive learning environment, as students work together to explore and discover new knowledge.

Pupil-centered lessons (P-Cen): refer to a teaching approach where the student is the focus of the learning process, and the teacher acts as a facilitator or guide. In this approach, the teacher creates a learning environment that is tailored to the individual needs and interests of each student and provides opportunities for students to actively participate in their learning. P-Cen is often used in student-centered teaching methods such as project-based learning, inquiry-based learning, or problem-based learning. The approach emphasizes hands-on, experiential learning, and encourages students to take an active role in their learning. FIAS categories for piano art instruction are shown in Table 1.

Table 1: FIAS categories for teaching in the piano art

	Teacher ratings					**Pupil ratings**		
Categories	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Week 2 (T-dir)								
Boy 1	29	14	27	110	45	30	155	17
Girl 1	28	31	22	105	28	28	162	24
Girl 2	34	28	9	77	29	27	121	21
Week 4 (P-dir)								
Boy 1	10	38	37	23	22	86	63	27
Girl 1	19	22	15	40	15	29	207	19
Girl 2	21	40	28	86	7	25	92	22
Week 10 (P-cen)								

Boy 1	15	62	24	41	5	67	30	58
Girl 1	15	51	24	60	7	39	146	31
Girl 2	27	37	35	52	24	39	115	25

4. Result and discussion

4.1 Experimental results

Piano posture and grip are important aspects of piano playing that can greatly affect the quality of sound produced and prevent injuries. The pre-test and post-test for piano posture and grip can be useful in assessing any changes or improvements in a student's technique over time. Figure 2 illustrates how similar the two groups scored on the post–test, and pre-test for posture and instrumental grip. It shows the post-test experimental group has better effectiveness.

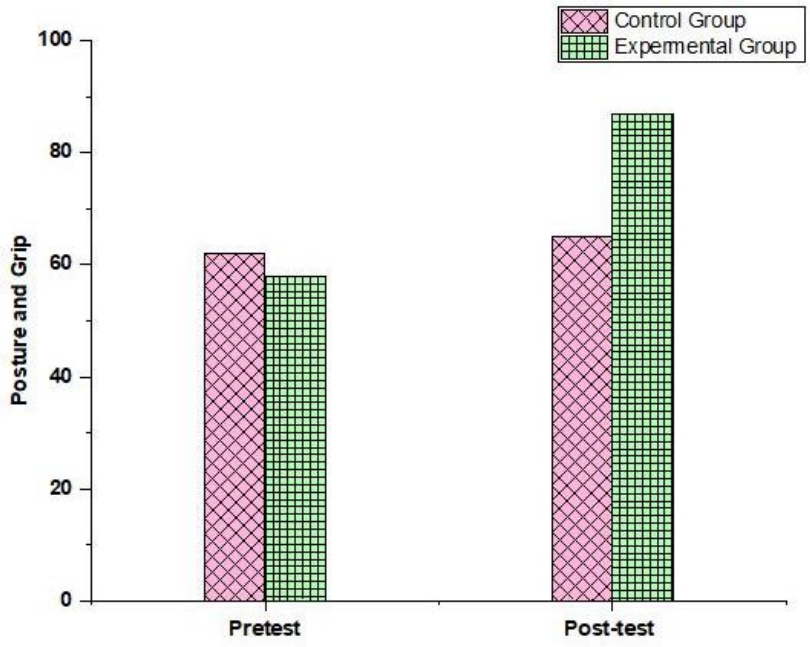

Figure 2: Comparison of CG and EG for posture and instrumental grip

Playing the piano involves using both hands, with the right hand typically playing the melody or higher notes and the left hand playing the accompaniment or lower notes. A pre-test and post-test for the piano right hand and left can be a useful way to assess a student's progress in coordinating both hands while playing the piano. Figure 3 illustrates how similar the two groups scored on the post–test, and pre-test for the piano right hand and left. It shows the post-test experimental group has better effectiveness.

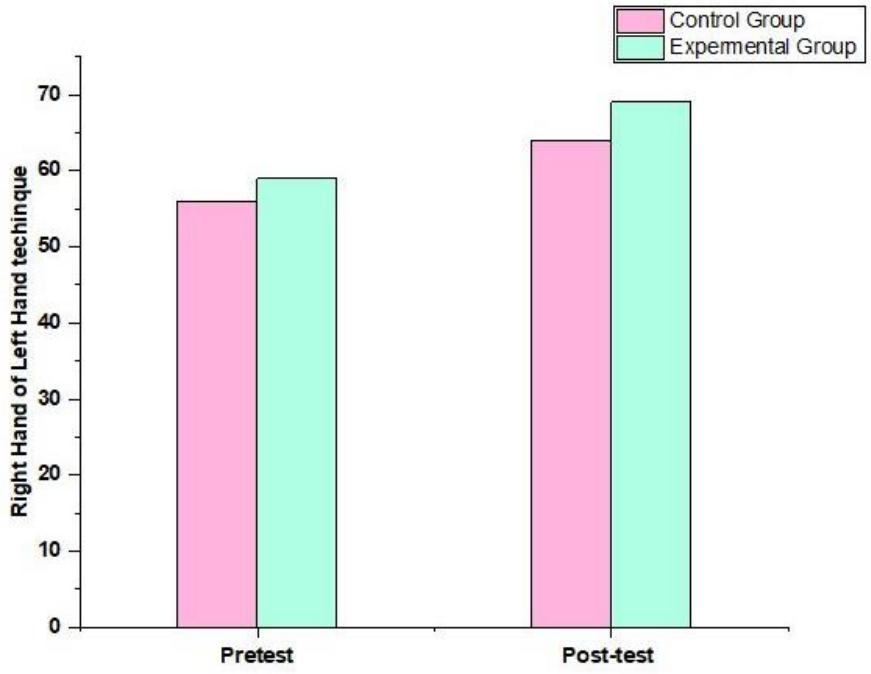

Figure 3: Comparison of CG and EG for right and left-hand technique

Musicality is an important aspect of piano playing and refers to the ability of a pianist to express the musical elements of a piece in a meaningful and artistic way. Figure 4 illustrates how similar the two groups scored on the post–test, and pre-test for evaluation based on musicality. It shows the post-test experimental group has better effectiveness.

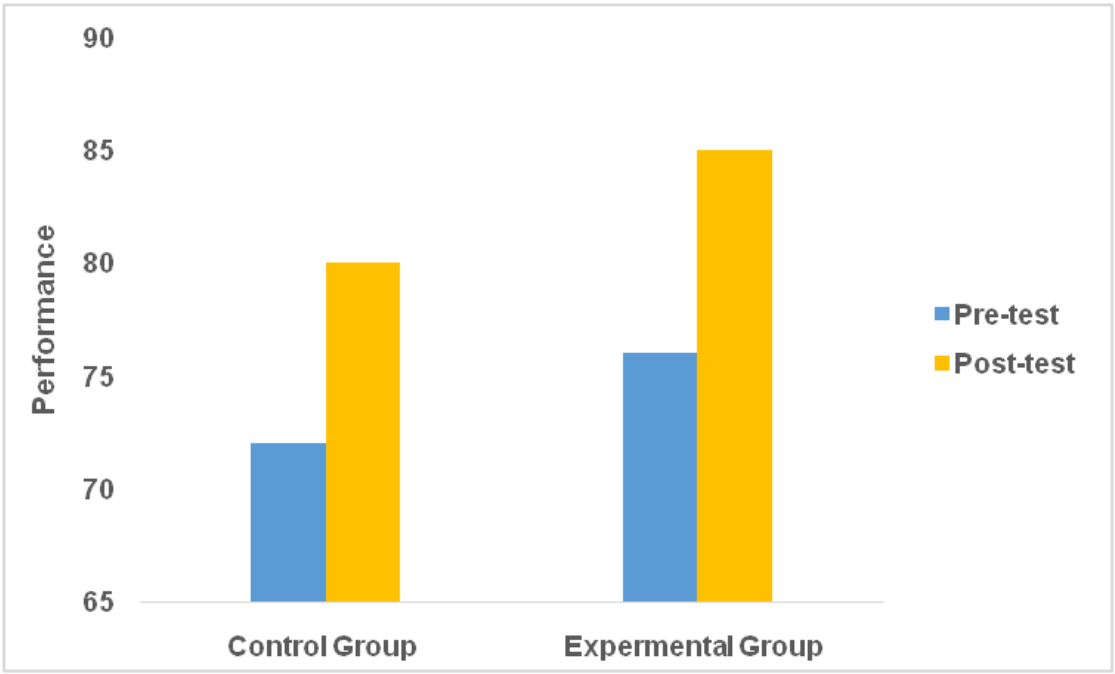

Figure 4: Comparison of CG and EG for musicality

A pre-test and post-test for piano performance can be useful ways to assess a student's progress in playing the piano. Figure 5 illustrates how similar the two groups scored on the post–test, and pre-test for evaluation based on performance. It shows the post-test experimental group has better effectiveness.

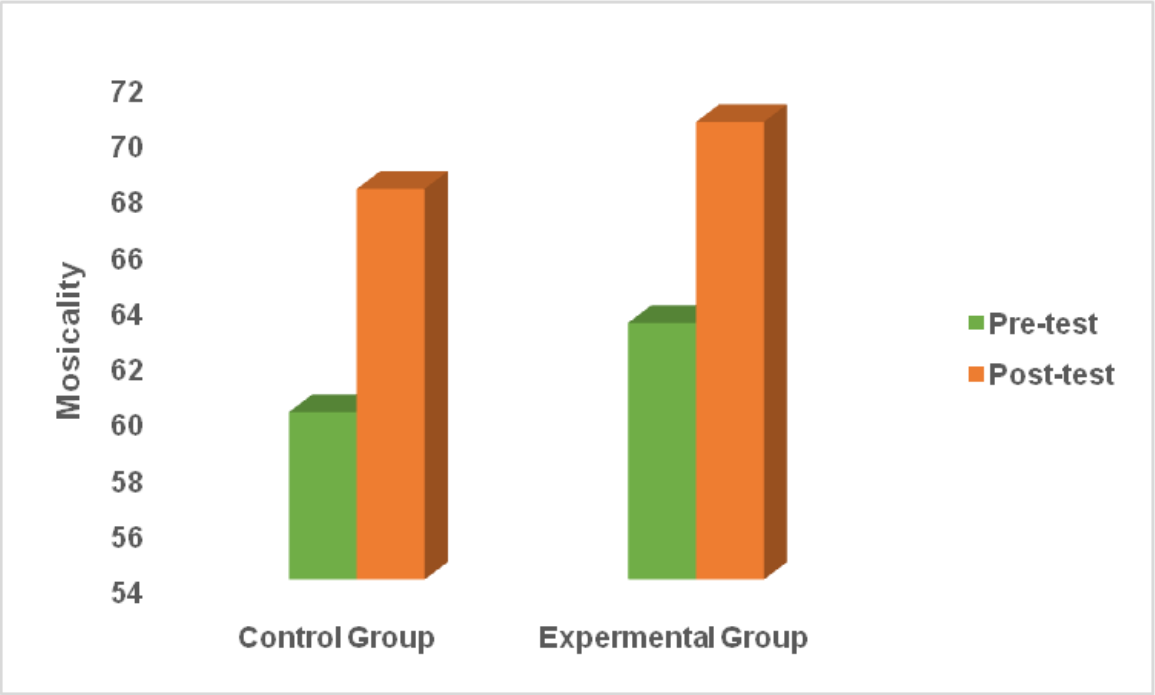

Figure 5: Comparison of CG and EG for performance

The same group of participants had three distinct treatments for their inside class piano educating students with high, moderate, and lower ranks of autonomy and their performances and learning experiences were compared using a repeated-measures experimental method (Phases A, B, and C respectively). A post-instruction exam was used to evaluate the piano art performances in each therapy. The best explanation for using a frequent strategy was to expose the students to all three types of flipped teaching so that they could compare their learning experiences in a more precise and relevant way. Moreover, it is well known that repeated-measures designs, with their consistent participants, increase the statistical power of the sample size. This research reduced the possible validity risks posed by experiential learning and the transfer impact by keeping the three treatments widely apart in time and concentrating on various educational subjects.

4.2 Statistical analysis results

This research compared assessments results from assessment one, two, and three to assess the effect of student abilities on piano performance. The primary descriptors for the Total ratings (Tot) and the sub-ratings for the Objective (Obj) and Subjective (Sbj) items are shown in Table 2. In general, compared to subjective assessments, objective ratings have a higher average and greater variance. Also, according to the findings of the Shapiro-Wilk test, all test results were regularly dispersed except for two: the objective and subjective ratings from assessments two and three, respectively.

Table 2: Results of the tests are described statistically (N= 64)

Assessments results	**One -Tot**	**Two-Tot**	**Three-Tot**	**One -Obj**	**Two -Obj**	**Three -Obj**	**One -Sbj**	**Two -Sbj**	**Three -Sbj**
Mean	76.14	72.32	84.61	41.39	38.56	45.75	35.52	34.86	39.75
SD	9.11	10.15	6.21	7.35	9.12	4.45	4.16	5.07	4.71
Shapiro–Wilk	1.87	1.78	1.69	1.59	1.85	1.82**	1.87	1.83*	1.88

The ANOVA was performed to see whether there were any notable variations in the results of the 3 experiments. Within-subjects impacts that have not been adjusted were found since the sphericity hypothesis was upheld for univariate analysis (p> .05), as shown in Table 3. In terms of overall ratings (F (3, 73) = 52.18, p>.01), objective ratings (F (3, 73) =23.14, p>.01), and subjective ratings (F (3, 73) = 33.99, p>.01), the findings showed that student performance varied across assessment one, two, and three. Also, partial eta squared $(\eta_p^2)$was computed to determine the extent of the impact that student agency had on academic achievement. The findings showed that subjective assessments performance had a bigger impact size (η_p^2=0.45) than objective performing routine (η_p^2=0.36).

Table 3: The results of the ANOVA for the piano test ratings (N=64)

	Test for sphericity		Within-Subjects Effects			
	Mauchly's W	Sig.	Df	F	Sig.	η_p^2
Overall ratings	.96	.337	(3, 74)	41.19	.000	.56
Objective ratings	.94	.220	(3, 74)	14.15	.000	.37
Subjective ratings	.93	.184	(3, 73)	34.88	.000	.46

Fisher's LSD was used in a post-hoc investigation to examine the effectiveness of piano art teaching at the three levels of pupil initiative. The outcomes of the pairwise comparison are shown in Table 4. Test C produced considerably better overall results and sub-ratings compared to the other two tests (p>.001), indicating that the lowest amount of pupil initiative was related to the highest learning performance.

Table 4: Correlation of the assessment results in groups (N=64)

	Total ratings		Objective ratings		Subjective ratings	
	$\bar{X}_{difference}$	Sig.	$\bar{X}_{difference}$	Sig.	$\bar{X}_{difference}$	Sig.
Assessment A and B	2.63**	.006	2.94**	.006	.67	.295
Assessment A and C	-8.68***	.000	-4.48***	.000	-4.24***	.000
Assessment B and C	-12.30***	.000	-7.41***	.000	-4.91***	.000

While there was no massive distinction in subjective ratings between Assessment A and B (p = 0.294> 0.05), learners fared marginally but considerably worse on the objective assessment questions on Assessment B (p = 0.005>0.01), which was linked with the lowest learning performance. As a consequence, it seems that in the FC, there is a non-linear link between student autonomy and piano art achievement.

5. Conclusion

In this research, we are looking at how online piano music education materials may be incorporated into an FC approach, which enables more independent learning and specialized training for piano students. The integration of the online piano music instruction materials via the FIAS analysis model is known from the preceding description. The resources that online piano music instruction can accommodate are likely to be expanded along with the invention and development of its teaching strategies as a result of the fast advancement of network information technology. This study has the view that the Internet-based piano music instruction method may become a mainstream growth path for piano education in the future. To implement FC piano teaching in higher vocational, it is first necessary to encourage the independent study of piano majors, free piano instructors from the demanding classroom teaching duties, and provide students with in-depth training and assistance in line with their potential. Another intriguing discovery was that in the FC, individual variations in learning performance seemed to be moderated by student agency.

Acknowledgement

Project one: Fujian Province Fund, "Piano Accompaniment first-class course project" in 2019.

Project two: the Ministry of Education Fund, "Cooperative Education Program" in 2020 (No.202002061006).

Project three: the Federation of Social Sciences of Zigong City, Sichuan Province Fund, "The National Folk Music and Dance Research Center Project" in 2021 (No.MYYB2001-7).

Project four: Minjiang University Fund, "Piano Accompaniment fine course ideological and political project" in 2021 (No.MJU2020KC523).

Project five: Minjiang University Fund, "first-class course project for History of Chinese Music and Appreciation of Masterpieces" in 2021 (No.MJU2021KC301).

Reference

[1] Tomas, L., Evans, N.S., Doyle, T. and Skamp, K., 2019. Are first-year students ready for a flipped classroom? A case for a flipped learning continuum. International Journal of Educational Technology in Higher Education, 16(1), pp.1-22.

[2] Mierowsky, R., Marcus, N. and Ayres, P., 2020. Using mimicking gestures to improve observational learning from instructional videos. Educational Psychology, 40(5), pp.550-569.

[3] Yang, Z.Y., 2020. Modern piano teaching technologies: Accessibility, effectiveness, the need for pedagogues. Ilkogretim Online, 19(3).

[4] Pinos-Vélez, V., Quinde-Herrera, K., Abril-Ulloa, V., Moscoso, B., Carrión, G. and Urgilés, J., 2020. Designing the pre-class and class to implement the flipped learning model in a research methodology course. IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, 15(1), pp.43-49.

[5] Al-Samarraie, H., Shamsuddin, A. and Alzahrani, A.I., 2020. A flipped classroom model in higher education: a review of the evidence across disciplines. Educational Technology Research and Development, 68, pp.1017-1051.

[6] Li, R., Lund, A. and Nordsteien, A., 2021. The link between flipped and active learning: a scoping review. Teaching in Higher Education, pp.1-35.

[7] Li, L., 2022. Teaching Mode of Basic Piano Course in Colleges Based on Students' Application Ability under FC Environment. Journal of Environmental and Public Health, 2022.

[8] Ng, D.T., Ng, E.H. and Chu, S.K., 2022. Engaging students in creative music making with musical instrument application in an online flipped classroom. Education and Information Technologies, 27(1), pp.45-64.

[9] Zhu, J., 2020. Reform of Piano Basic Course Teaching for College Music Performance Major–Research on the Application of Flipped Classroom in Teaching. Scholar Highlights in Education Research, 1, pp.693-699.

[10] Peng, Y. and Wang, X., 2022. Online education of music flipped classroom based on artificial intelligence and wireless network. Wireless Communications and Mobile Computing, 2022.

[11] Fu, J., 2020. Analysis of the piano teaching mode of flipped class in higher education. Frontiers in Educational Research, 3(14), pp.128-133.

[12] Wang, J., 2021, February. Innovative research on the teaching mode of piano group lessons under the background of big data. In Journal of Physics: Conference Series (Vol. 1744, No. 3, p. 032031). IOP Publishing.

[13] Gang, L., 2020, November. Innovative research on the teaching mode of piano group lessons in higher vocational preschool education based on ai. In Journal of Physics: Conference Series (Vol. 1651, No. 1, p. 012006). IOP Publishing.

[14] Guo, R., Ding, J. and Zang, W., 2021. Music online education reform and wireless network optimization using artificial intelligence piano teaching. Wireless Communications and Mobile Computing, 2021, pp.1-9.

[15] Chen, F. and Meng, H., 2022. The use of wireless networks combined with artificial intelligence technology in the reform of music online teaching systems. Wireless Communications and Mobile Computing, 2022, pp.1-10.

[16] Halasa, S., Abusalim, N., Rayyan, M., Constantino, R.E., Nassar, O., Amre, H., Sharab, M. and Qadri, I., 2020. Comparing student achievement in traditional learning with a combination of blended and flipped learning. Nursing Open, 7(4), pp.1129-1138.

[17] Ożadowicz, A., 2020. Modified blended learning in engineering higher education during the COVID-19 lockdown—Building automation courses case study. Education Sciences, 10(10), p.292.

[18] Uskoković, V., 2023. Natural sciences and chess: A romantic relationship missing from higher education curricula. Heliyon.

[19] Chen, Y. and Zheng, N., 2021. Ai-based research on exploration and innovation of development direction of piano performance teaching in university. Journal of Intelligent & Fuzzy Systems, 40(2), pp.3681-3687.

[20] Yang, Y., 2021. Piano performance and music automatic notation algorithm teaching system based on artificial intelligence. Mobile Information Systems, 2021, pp.1-13.

[21] Ma, W., 2022. A comprehensive evaluation system for realizing the ability of university piano teaching. Mobile Information Systems, 2022.