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Development and Validation of a Questionnaire for Evaluating Cooperative Learning in Terms of Learning Motivation among Beginner Students of Piano Sight-Reading

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Abstract

This study investigated the effectiveness of cooperative learning in improving the sight-reading ability of piano beginners and their attitudes towards group piano teaching. This study used a questionnaire consisting of 20 items, which were divided into three dimensions: ability, autonomy, and relevance. Specifically, the ability (5 items) focuses on students' perceptual ability and achievement in piano sight reading; Autonomy (4 items) tests students' freedom to decide on learning progress and task selection; Relatedness (11 items) evaluates students' interactions and relationships in group learning environments. This study was conducted among approximately 220 non piano major students at Guangdong Education University. Data collection includes pre-test and post-test questionnaires, as well as a visual reading test as a post-test to measure students' performance. Reliability and validity analyses were conducted to ensure the accuracy and effectiveness of the questionnaire. The research findings aim to provide insights into the applicability and effectiveness of collaborative learning strategies for piano beginners, filling a key gap in existing research. By exploring students' motivation, learning attitude, and performance in piano collective classes, this study aims to contribute to the development of more effective teaching methods in music education. This study helps to understand the role of cooperative learning in music education, especially in improving the sight reading ability of piano beginners and cultivating a positive attitude towards group teaching.

Keywords: Cooperative Learning, Beginner Piano Students, Sight-Reading Abilities, Learning Motivation, Group Instruction

Introduction

Group piano instruction, which involves studying how to play the piano in a collective setting, contrasts with the more traditional individual/private lesson format (Pike, 2017). This method has gained significant popularity among college students due to its efficiency and the

inherent advantages of group learning (Amoriello, 2016). In China's normal universities, an overwhelming majority of 90% of non-piano majors participate in group piano classes, highlighting their widespread adoption (Klang, 2021). However, despite their prevalence, there is a lack of a unified teaching system for these group piano lessons, prompting educators to explore alternative teaching methods such as cooperative learning (Fisher, 2010). In recent years, scholars and educators have increasingly focused on the influence of cooperative learning on piano sight-reading abilities. Cooperative learning, a teaching method grounded in collaboration and interaction, aims to enhance students' understanding and mastery of knowledge, while simultaneously improving their learning motivation and performance (Dillenbourg, 1999; Springer et al., 1999). This approach not only complements traditional piano instruction but also fosters an environment conducive to active participation in sight-reading activities. Through joint practice, constructive feedback, and collective problem-solving, students can effectively engage with the material and improve their sight-reading skills (Qi et al., 2022).

Several studies have already highlighted the positive impact of cooperative learning on piano sight-reading abilities. Hallam (2010) found significant differences in sight-reading skills between pianists specializing in collaborative performance and those focusing on solo repertoire, with those having more accompanying experience displaying superior skills. Similarly, Nancy (2008) noted that peer teaching positively influenced sight-reading achievement and attitudes among undergraduate music major piano groups. Despite these promising findings, there has been a notable lack of theoretical exploration and methodological development specific to college piano group classes in China (KURTULDU, 2021). Many teachers have inadvertently applied individual class concepts and methods to group settings, blurring the distinction between group and individual instruction and hindering the progress of group classes (Chenfen, 2015). Currently, most group piano classes merely change the format without corresponding adjustments to content and methods (Cota, 2019). Furthermore, research on piano sight-reading instruction in China has limited exploration in piano group lessons and cooperative teaching, even though visual reading skills among normal college students in China generally lag, with over 90% of music students lacking professional visual training (Qi, 2022).

Cooperative learning has garnered significant attention in the field of education due to its demonstrated positive impact across various educational contexts. Research has shown that cooperative learning not only leads to academic gains but also fosters improved interpersonal relations and enhances personal development (Kurtuldu, 2019; Gao, 2023). However, a critical gap exists in understanding the applicability and effectiveness of these strategies for beginner-level piano students. While cooperative learning has shown promise in advancing sight-reading abilities among experienced musicians (Li, 2021), there is a notable scarcity of research addressing its impact on beginners in piano education. The current literature predominantly overlooks the unique challenges faced by novice piano students, with limited exploration into sight-reading within group piano settings (Wang, 2024). Given this gap in the literature, the present study aims to investigate the effect of cooperative learning on sight-reading skills and learning motivation among university beginner piano students. This research context is particularly interesting and warrants further investigation, as it has the potential to provide valuable insights into improving piano education for beginner students in China.

Theoretical Background

Cooperative Learning

David W. Johnson and Johnson (1987) define it as "the instructional use of small groups so that students work together to maximize their own and each other's learning" (Johnson, 1987). Cooperative learning techniques involve structured forms of group work where students collaborate to achieve shared learning goals and complete tasks. These techniques are designed to promote interaction and cooperation among students, enhancing their learning and social skills. As a result of the work of the leading cooperative learning proponents, various methods for implementing cooperative learning theory in the classroom were developed during the past several decades. Over time, these methods were refined, and more methods were added to the existing body of material so that teachers had many tools available to them for guiding the cooperative learning process in their classrooms. The cooperative learning methods outlined in this document were those methods that had been the most extensively researched and were the most widely used (Johnson & Stanne, 2000; Slavin, 1983). The TGT learning model has a student center characteristic focused on constructing student knowledge, where students are expected to find important information for constructing their own knowledge (Slavin, 2018). Some study results show that active learning can improve student academic performance (Huang,2019; Huang, 2022; Wang, 2025); improve the ability of critical thinking and attachment of students with the field of science, as well as develop a positive attitude in learning (M. G et al., 2017; Huang, 2019). Slavin modified the jigsaw method by adding cooperative incentives (group grades or recognition) to the cooperative task method. In Slavin's variation, called Jigsaw II, the students read the same passage of literature, such as a short story or biography. The students were each assigned a different topic related to the passage and proceeded to become the expert on that topic. (Slavin, 2018). Several other jigsaw methods were developed to alter or improve the previous jigsaw methods. Jigsaw III was developed by Alexander Gonzalez and M. Guerrero (1983) to improve interaction in biracial classrooms where language might be a barrier. Jigsaw IV was developed by Dwight Holliday to improve Jigsaw II and Jigsaw III. This method incorporated assessment quizzes throughout the learning process to guide future learning (Barchas, 2021). As more teachers apply cooperative learning techniques in their classrooms, they may continue to alter the various methods to help their students more effectively.

The synthesis of research suggests that integrating cooperative learning strategies in music education could be highly beneficial. Given the established benefits of both cooperative learning and music education in academic and non-academic areas, it's plausible to hypothesize that employing cooperative learning in music classrooms could significantly enhance various aspects of student life.(Huang, 2019; Furuya, 2018; Bent & Margaret, 2019; Liu, 2020).This approach is likely to yield positive results, not only in musical proficiency but also in social, cognitive, and personal development areas, suggesting a holistic impact on students' educational experiences. Moreover, Ali Sulaiman emphasize that cooperative learning is underutilized in music education, particularly in ensemble settings, despite its potential for promoting social skills and interdependence (Ali Sulaiman, 2022). 5th grade key signature recognition improved with CL (Cogliati et al., 2016). Listening for melody, timbre, and meter in music significantly increased in college students (Chi et al, 2020). Secondary band and choir students scored on average 20 percent higher than the individual learners when reading rhythms (Campayo-Muoz, 2020). Gritten highlight the advantages of using

cooperative learning in music composition, noting its ability to foster positive social interactions (Gritten et al., 2021). Markovic offers practical guidance for music educators by providing specific learning activities that align cooperative learning with music standards (Markovic, 2020). These activities cover various areas such as singing, instrument performance, improvisation, composition, and music analysis, demonstrating the diverse applications of cooperative learning in music education.

Group Piano Instruction

Group piano instruction denotes a learning situation in which two or more students interact under the guidance of the teacher in a dynamic learning complex (Johnson,1987). The application of group piano teaching first appeared in Dublin around 1815 when the German musician, Johann Bernhard Logier, began instructing piano solely in classes （ Markovic, 2020). In some American college, a majority of undergraduate music majors are expected to enroll in group piano courses to learn keyboard skills and complete required piano competencies (Chen， 2020). The main objective of the group learning is to master music theory and keyboard theory rather than developing advanced technique (Millis, 2023). A study of New Zealand colleges conducted by John Emeleus compared achievement of two groups of piano students: one group was taught using traditional individualized instruction and the other group was taught using cooperative learning methods. He found that the cooperative learning group was more advanced in keyboard skills and general musicianship than the group that was taught in an individualized manner (Suryadi, 2024). Furthermore, Mendo-Lázaro combined quantitative and qualitative data to determine the effects of cooperative learning methods on the achievement, self-efficacy, practice habits, and attitudes of group piano students. Results indicated that the use of cooperative learning techniques seemed to contribute to increased keyboard skill achievement and a positive attitude towards piano study (Mendo-Lázaro et al., 2022).

Several studies have pointed out limitations in piano group teaching in Chinese universities. In a study by Liu (2020) on chamber music courses, it was found that the full potential of this training, which includes informal group learning and self-directed learning, often remains unrealized. Scaffolding is crucial for effective group work in chamber music. Wang (2024) highlighted that teachers in higher vocational preschool education sometimes have a superficial understanding of cooperative learning, leading to one-sided and superficial implementations of cooperative teaching and a lack of classroom control skills. Garcia (2021) emphasized that many GPI classes in China lack genuine applications of cooperative teaching, overlook individual student differences, and suffer from a lack of harmony between teachers and students. In piano group lessons, there are also numerous challenges when it comes to teaching sight-reading skills. This lack of clear direction often results in sight-reading training being neglected within typical piano lessons (Yang et al., 2022). Developing students' sight-reading skills is crucial for enhancing their overall piano performance and application. Unfortunately, in Chinese normal universities, sight-reading hasn't been given the attention it deserves. It's not treated as a separate, systematic course of instruction, and teachers often don't focus enough on cultivating their students' sight-reading abilities. As a result, teaching methods tend to be traditional, content is relatively basic, and there's a lack of systematic training methods. In general, research on cooperative piano groups in Chinese universities is extremely limited, and there is virtually no research specifically addressing the content of

sight-singing and ear training instruction within these groups. This study aims to fill this research gap in the Chinese context

Hypotheses Development

In piano teaching, cooperative learning is widely adopted to improve students' piano skills, especially in key aspects such as sight reading ability, rhythm, treble, and continuity. Music sight-reading is an indispensable skill for professional musicians, often required to perform an unfamiliar score without any practice (Schulze et al.,2025). This skill involves complex processes related to many different factors such as a performer's cognitive ability, motor skills, memory, musical ability, and music training (Breitman, 2021). Many researchers have worked tirelessly to be able to elucidate the entire process of visual reading. This is a complex process that involves at least two types of skills: reading skills and the mechanical frontier of psychological skills (Furuya et al., 2018). Research has shown that cooperative learning encourages students to share their learning experiences and skills, which helps them understand music scores from different perspectives and deepen their understanding and comprehension of musical works (Barchas, 2021).

Research points out that rhythmic training improves performance in SR (Cogliati et al. 2016; Chi et al., 2020). Rhythmically accurate students tend to be more fluent in reading notes. But the opposite is not true: correct reading of notes does not guarantee rhythmic accuracy. In general, rhythm perception also increases the efficiency of motor tasks that require accurate planning of physical movements (Chen et al. 2022). Piano motor skill is a direct physical response to mental perceptions; consequently, changes in perception would lead to changes in motor responses in the same way Chen et al. 2022). In research on rhythmic SR training, a greater emphasis on rhythmic training can have positive effects on students' SR, as rhythmic training improves overall flow and continuity of piano playing (Suryadi, 2024). Moreover, the research suggests that prioritizing rhythmic training can enhance students' sight-reading abilities by improving the overall fluidity and consistency of their piano performance, supported by Suryadi (2024), while also highlighting the significant relationship between motor pattern skills and rhythmic perception, as indicated by Chen et al. (2022). Based on the above theoretical research, the hypotheses formulated as follows.

1. Null Hypothesis (H0) 1: There is no significant effect of the Cooperative Learning Strategy on the improvement of sight-reading abilities among beginner piano students in college.
2. Null Hypothesis (H0) 2: There is no significant effect of cooperative learning on rhythm accuracy within sight-reading skills for beginner piano students.
3. Null Hypothesis (H0) 3: There is no significant effect of cooperative learning on pitch accuracy within sight-reading skills for beginner piano students.
4. Null Hypothesis (H0) 4: There is no significant effect of cooperative learning on the continuity within sight-reading skills for beginner piano students.

Several theories underpin the relationship between cooperative learning and motivation. Social interdependence theory suggests that cooperative learning creates interdependencies among group members, fostering positive relationships and mutual motivation (Slavin,2018). Self-determination theory (SDT) posits that cooperative learning can satisfy basic psychological needs for autonomy, competence, and relatedness, thus

enhancing intrinsic motivation. Vygotsky's social constructivism also provides a basis for understanding how collaborative interactions in cooperative learning contexts can motivate learners by scaffolding knowledge construction within their zone of proximal development. Studies have shown that cooperative learning strategies, such as jigsaw and group investigation, significantly increase students' intrinsic motivation by making learning activities more relevant and engaging (Ridwan & Hadi, 2022). Meanwhile, cooperative learning enhances students' self-efficacy beliefs. Working in groups allows students to observe peers' efforts and strategies, which, in turn, boosts their confidence in their abilities (Ali & Kasim, 2022). Cooperative learning has been linked to a shift towards mastery-oriented goals and away from performance-oriented goals. This shift is believed to foster a more intrinsic form of motivation, where learners are driven by the desire to understand and master the material rather than by external rewards or recognition (Chan, 2024). The social aspect of cooperative learning, including peer support and recognition, plays a significant role in enhancing motivation. Students often feel more motivated when they perceive their contributions as valuable to the group's success (Çelik, 2024; Sari., 2024).

Furthermore, Slavin posits that the way goals are structured in a learning environment can profoundly affect students' motivation. In cooperative learning settings, goals are structured so that the success of the group depends on the individual learning of all members. This structure, known as positive interdependence, motivates students to engage more deeply with the material and to support their peers' learning ((Slavin,2018). Moreover, A critical component of Slavin's cooperative learning model is individual accountability. Each student is responsible for their contribution to the group's success, ensuring that all members are motivated to participate and learn. This accountability is motivational because it ties personal effort and achievement to the group's outcomes, encouraging students to take ownership of their learning (Slavin, 2018). Slavin emphasizes the importance of providing all students with equal opportunities to contribute to and benefit from the group's success. This aspect of cooperative learning ensures that tasks and roles are designed so that students of different ability levels can participate meaningfully. This inclusivity can enhance motivation by ensuring that all students feel valued and capable of contributing to the group's objectives (Slavin, 2018). Thus, educators can leverage the motivational benefits of cooperative learning by incorporating group activities that emphasize positive interdependence, individual accountability, and group processing. Designing tasks that are challenging, yet achievable, and that require diverse skills and perspectives can further enhance motivation (Wang, 2021; Li et al., 2024; Kosberg, 2024). Additionally, providing clear instructions, roles, and expectations, as well as facilitating reflection on group dynamics, can help maximize the motivational outcomes of cooperative learning.

5. Null Hypothesis (H0) 5: There is no significant effect of cooperative learning on learning motivation for beginner piano students' sight reading.
6. Null Hypothesis (H0) 6: There is no significant effect of cooperative learning on students' learning attitudes towards piano group classes.
7. Null Hypothesis (H0) 7: There is no significant effect of cooperative learning on students' autonomy in piano sight-reading.
8. Null Hypothesis (H0) 8: There is no significant effect of cooperative learning on students' social relatedness in piano sight-reading.

9. Null Hypothesis (H0) 9: There is no difference in the effect of cooperative learning on students with high versus low scores in the college entrance examination.

Method

Questionnaire Structure

The questionnaire designed to assess the impact of cooperative learning on piano sight-reading skills and motivation among first-year undergraduate music students without formal prior piano training, comprises 20 items categorized into Competence (5 items, e.g., "I believe I can make steady progress in piano sight-reading"), Autonomy (4 items, e.g., "I am able to freely decide my own pace of learning in piano sight-reading"), and Relatedness (11 items, e.g., "Working with classmates who have higher piano sight-reading skills motivates me to improve"). Please refer to Appendix 1 for detailed information. To ensure the accuracy of the sample, two screening questions were included: whether the respondent is a first-year undergraduate music student and whether they received formal piano training before university. Only responses from eligible students were analyzed. To validate the content of the questionnaire, it was reviewed by three PhD experts specializing in music education, psychology, and cooperative learning. The experts evaluated the clarity of the items, their alignment with the three core dimensions of Self-Determination Theory (SDT), and content consistency, ensuring each question effectively measured the impact of cooperative learning in piano sight-reading. Based on their feedback, modifications were made to refine the wording and better reflect cooperative learning principles, such as revising Item 8 from "My piano teacher allows the class to choose how to approach piano practice" to "My piano teacher encourages the class to decide how to approach learning piano sight-reading collaboratively" (in English) and "我的钢琴老师鼓励我们共同商讨决定钢琴练习的方式" (in Chinese), as experts suggested that "allows" did not adequately reflect cooperative learning.

Data Collection and Participants

The population for this study comprises non-piano major students from the non-piano major class conducted in Guangdong Education University in the 2024, totaling around 220 students (the researcher will determine the exact number when the new semester begins). This population will be selected based on several strategic considerations that align with the research objectives. Firstly, the choice of non-piano major students is pivotal to the study's focus on evaluating the impact of cooperative learning on novice piano students. By excluding piano majors, the research ensures that participants possess limited prior piano training, making them suitable candidates for assessing the effectiveness of cooperative learning strategies on beginners. Secondly, the accessibility and availability of the 2024 class at Guangdong Education University make it a practical and diverse source for participant recruitment. Moreover, this population choice adheres to ethical standards, avoiding potential biases or favoritism that may arise from selective distribution of educational interventions among students within the same major. Lastly, the manageable size of this population aligns with the study's logistical constraints, making it a feasible and resource-efficient option for conducting the research. Thus, the final questionnaire was distributed in several universities in Guangdong Province, resulting in 226 responses. After excluding 20 responses that did not meet the inclusion criteria, 206 valid responses were retained for analysis.

Participant Demographics

- Total Valid Sample: 206 first-year undergraduate piano students
- Gender Distribution: 62% female, 38% male
- Age Range: 18–22 years
- Prior Formal Piano Training: None (per inclusion criteria)

Research Instrument

The instrument utilized in this research included a Sight-Reading test, which was administered solely as a post-test, and a questionnaire, which was conducted both as a pre-test and a post-test. The first component was a sight-reading test employed as a post-test to gauge students' sight-reading performance. The ABRSM sight-reading music pieces for levels 1 and 2 were used as material for assessing sight-reading abilities in the post-test. Participants were videotaped playing the level-appropriate piece only at the end of the semester. These videotaped post-tests were analyzed for pitch, rhythm, and continuity accuracy using an observation form. The scoring process from the Watkins-Farnum Performance Scale for Instrumentalists (Watkins & Farnum, 1962), a standardized achievement test for all band instruments, was adapted for this study to measure sight-reading performance and provide data for analysis.

The second instrument was a questionnaire used to measure students' motivation towards piano learning before and after the experiment. The measure of motivation employed in this study was the Piano Learning Motivation Questionnaire. The researcher adapted the "Self-Determination Theory of Piano Learning Scale," which was modified from the "Self-Determination Theory of Second Language Scale (SDT-L2)." It encompassed two general types of motivations: autonomous motivation and controlled motivation. All options were derived from responses to the question "Why are you learning Piano?" The questionnaire consisted of 20 items on a five-point Likert-type scale, with 5= strongly disagree, 4= disagree, 3= neither agree nor disagree, 2= agree, and 1= strongly agree. The purpose of the study was to assess the distinct impacts of cooperative learning groups on students' sight-reading skills and their motivation to learn.

Reliability Analysis

This study conducted reliability analysis to check the internal consistency of the questionnaire. Cronbach's Alpha is used to measure reliability, where a value above 0.7 indicates good internal consistency. The overall reliability of 0.919 confirms that the questionnaire has strong internal consistency. All subscales have Cronbach’s Alpha values above 0.8, indicating excellent reliability. Corrected Item-Total Correlation (CITC) analysis showed that all items had values above 0.5, confirming that all items contributed meaningfully to the construct (as shown in the Table 1).

Table 1
Internal Consistency (Cronbach's Alpha)

Dimension	Items	Cronbach's α
Competence	5	0.867
Autonomy	4	0.826
Relatedness	11	0.932
Overall Reliability	20	**0.919**

Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) was conducted to examine the factor structure of the questionnaire using Principal Component Analysis (PCA) with Varimax Rotation.

KMO and Bartlett's Test for Sphericity

To determine the suitability of the dataset for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were conducted. The KMO value of 0.915 suggests that the dataset is highly suitable for factor analysis. Bartlett's Test of Sphericity is significant ($p < 0.001$), indicating that the correlation matrix is not an identity matrix, further supporting factor analysis (as shown in the Table 2).

Table 2
KMO and Bartlett's Test Results

Test	Value
Kaiser-Meyer-Olkin (KMO) Measure	0.915
Bartlett's Test of Sphericity	$\chi^2 = 2412.550$, $p < 0.001$

Total Variance Explained

After factor extraction, the cumulative variance explained by the first three factors was 63.195%, exceeding the commonly accepted 60% threshold for construct validity. The first three factors account for 63.195% of the variance, confirming that they adequately capture the construct, and the result shown in the Table 3. Moreover, to determine how strongly each item loads onto its respective factor, the Rotated Component Matrix was analysed using Varimax Rotation (see in the Table 4). All items have factor loadings above 0.6, which is considered acceptable for construct validity. No items show high cross-loadings, indicating that each item measures only one construct. Thus, the three-factor structure aligns with the Self-Determination Theory (SDT) framework: Factor 1: Competence (Q3-Q7) – Represents students' confidence in their ability to improve in piano sight-reading. Factor 2: Autonomy (Q8-Q11) – Reflects students' control over their learning process. Factor 3: Relatedness (Q12-Q20) – Captures students' social connections in cooperative learning environments. This confirms that the questionnaire effectively measures the impact of cooperative learning on motivation.

Table 3
Total Variance Explained

Component	Initial Eigenvalues	Initial Eigenvalues	Initial Eigenvalues	Extraction Sums of Squared Loadings	Extraction Sums of Squared Loadings	Extraction Sums of Squared Loadings	Rotated Sums of Squared Loadings	Rotated Sums of Squared Loadings	Rotated Sums of Squared Loadings
	Total	Variance Percentage	Cumulative %	Total	Variance Percentage	Cumulative %	Total	Variance Percentage	Cumulative %
1	8.204	41.022	41.022	8.204	41.022	41.022	6.414	32.071	32.071
2	3.234	16.172	57.194	3.234	16.172	57.194	3.472	17.361	49.432
3	1.200	6.002	63.195	1.200	6.002	63.195	2.753	13.763	63.195
4	0.818	4.089	67.284	-	-	-	-	-	-
5	0.718	3.588	70.872	-	-	-	-	-	-
6	0.651	3.254	74.127	-	-	-	-	-	-
7	0.594	2.968	77.094	-	-	-	-	-	-
8	0.556	2.781	79.876	-	-	-	-	-	-
9	0.521	2.606	82.481	-	-	-	-	-	-
10	0.437	2.183	84.664	-	-	-	-	-	-
11	0.405	2.025	86.689	-	-	-	-	-	-
12	0.401	2.007	88.696	-	-	-	-	-	-
13	0.387	1.937	90.633	-	-	-	-	-	-
14	0.349	1.744	92.377	-	-	-	-	-	-
15	0.307	1.536	93.912	-	-	-	-	-	-
16	0.288	1.439	95.351	-	-	-	-	-	-
17	0.259	1.297	96.648	-	-	-	-	-	-
18	0.247	1.236	97.884	-	-	-	-	-	-
19	0.247	1.233	99.117	-	-	-	-	-	-

Component	Initial Eigenvalues	Initial Eigenvalues	Initial Eigenvalues	Extraction Sums of Squared Loadings	Extraction Sums of Squared Loadings	Extraction Sums of Squared Loadings	Rotated Sums of Squared Loadings	Rotated Sums of Squared Loadings	Rotated Sums of Squared Loadings
20	0.177	0.883	100	-	-	-	-	-	-

Table 4
Rotated Component Matrix

Measurement Items	Component		
	1	2	3
Q3		0.736	
Q4		0.801	
Q5		0.766	
Q6		0.766	
Q7		0.759	
Q8			0.812
Q9			0.739
Q10			0.672
Q11			0.688
Q12	0.718		
Q13	0.777		
Q14	0.729		
Q15	0.759		
Q16	0.773		
Q17	0.728		
Q18	0.823		
Q19	0.804		
Q20	0.768		
Q21	0.641		
Q22	0.707		

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis using AMOS is a method to judge the validity of a questionnaire. It mainly conducts statistical analysis on the data collected from the questionnaire through AMOS software to test whether the explanatory relationship between a variable factor in the questionnaire and the corresponding measurement items conforms to the researcher's pre - set variable structure and whether this structure meets certain effectiveness. The model fit - goodness test is usually judged by calculating some fit indexes. The main judgment indexes include: X^2/df should be less than 3 as an ideal standard, but less than 5 is also an acceptable level; GFI, AGFI, and NFI generally need to be greater than 0.8 to indicate good model fit, and greater than 0.9 indicates a better model effect; TLI and CFI must be greater than 0.9 to indicate a good model match; RMSEA should be less than 0.08 to indicate a good model fit. Based on the above analysis of the confirmatory factor analysis model fit indexes, we have a clear understanding of the overall fit of the model.

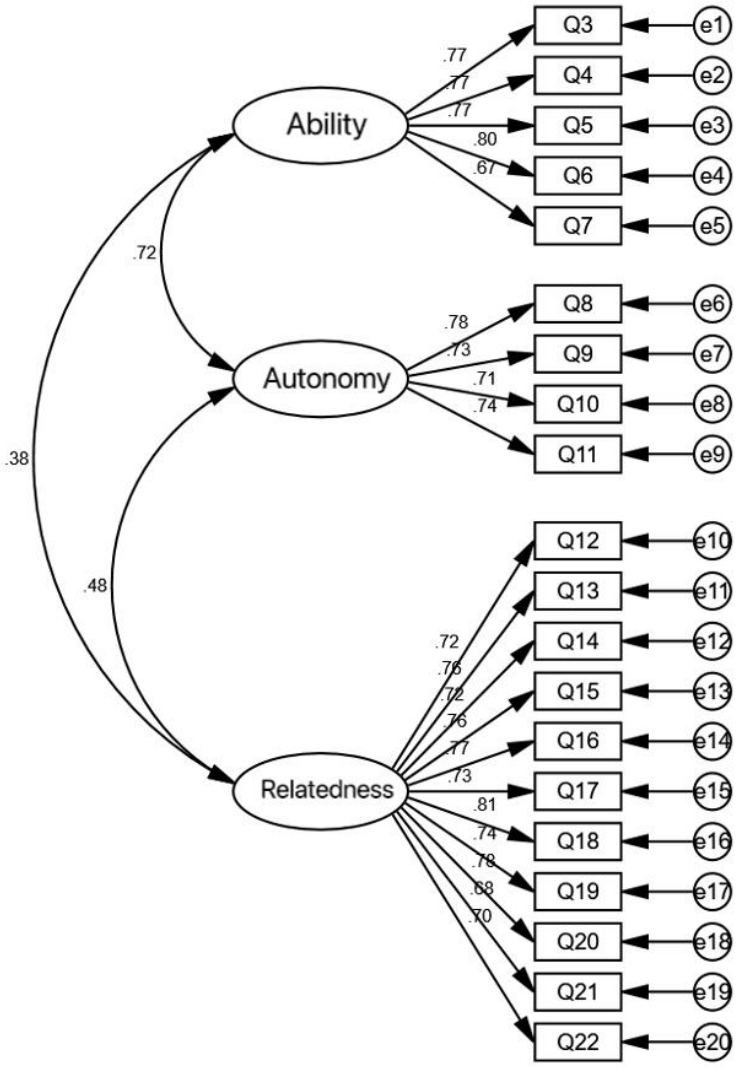

Figure 1. Confirmatory factor analysis

As shown in Figure 1, the confirmatory factor analysis model diagram visually presents the relationships between latent variables (Competence, Autonomy, and Relatedness) and their corresponding measurement items. First, for the latent variable "Competence", we can observe that all the measurement items (Q3 - Q7) are strongly associated with it, with relatively high standardized factor loadings. This indicates that these items effectively measure the concept of "Competence" in the context of this study. For example, the high loading of Q4 on "Competence" implies that this item is a reliable indicator of students' perceived competence in piano sight - reading learning through cooperative learning. Second, regarding the latent variable "Autonomy", the connections between measurement items (Q8 - Q11) and it are also well - defined. The factor loadings suggest that these items capture different aspects of students' sense of autonomy in the learning process. For instance, Q9 has a significant loading, which may reflect students' self - determination in choosing learning

methods during cooperative piano sight - reading. Finally, for the latent variable "Relatedness", the measurement items (Q12 - Q22) show a relatively strong and stable relationship with it. This indicates that the items comprehensively measure the relatedness among students, teachers, and the learning environment in the cooperative learning setting. For example, Q18's high loading reflects its importance in assessing the sense of relatedness in the piano sight - reading classroom. Overall, the model diagram validates the theoretical structure of our questionnaire, and the relationships between latent variables and measurement items are in line with our expectations, further confirming the good validity of the questionnaire. The results of the confirmatory factor analysis model fit indexes are shown in Table 5.

Table 5
The Results of the Confirmatory Factor Analysis Model

Fit Index	Judgment Standard	Actual Value
Chi - Square to Degrees of Freedom Ratio X^2/df	< 5 acceptable; < 3 ideal	2.026
Goodness - of - Fit Index GFI	> 0.8 acceptable; > 0.9 ideal	0.865
Adjusted Goodness - of - Fit Index AGFI	> 0.8 acceptable; > 0.9 ideal	0.830
Normed Fit Index NFI	> 0.8 acceptable; > 0.9 ideal	0.865
Incremental Fit Index IFI	> 0.9	0.927
Comparative Fit Index CFI	> 0.9	0.926
Non - Normed Fit Index NNFI(TLI)	> 0.9	0.916
Root Mean Square Error of Approximation RMSEA	< 0.08	0.071

According to the fit index results of the confirmatory factor analysis model, the test result value of X^2/df is 2.026, less than the standard value of 3. The GFI index result is 0.865, the AGFI index result is 0.830, the NFI index result is 0.865, the IFI index result is 0.927, the CFI index result is 0.926, the TLI index result is 0.916, and the RMSEA index result is 0.071, less than the standard level of 0.08. The above results show that all the fit - goodness indexes of the model in this study reach and exceed the general standard values. Therefore, it can be explained that the confirmatory factor analysis model presented in this study is effective, and the matching degree between the model and the collected survey data meets the standard. The results of standardized factor loadings, composite reliability (CR), and convergent validity (AVE) are shown in Table 6.

Table 6
Regression Result of the Standardized Factor Loadings, CR and AVE

Variable	Measurement Items	Standardized Factor Loading	S.E.	T	P	CR	AVE
Competence	Q3	0.766	-	-	-	0.869	0.571
	Q4	0.766	0.096	10.963	***		
	Q5	0.770	0.095	11.023	***		
	Q6	0.796	0.097	11.431	***		
	Q7	0.673	0.106	9.525	***		
Autonomy	Q8	0.781	-	-	-	0.828	0.546
	Q9	0.727	0.083	10.121	***		
	Q10	0.707	0.078	9.841	***		
	Q11	0.739	0.081	10.301	***		
Relatedness	Q12	0.720	-	-	-	0.932	0.555
	Q13	0.762	0.105	10.693	***		
	Q14	0.720	0.100	10.088	***		
	Q15	0.763	0.111	10.710	***		
	Q16	0.765	0.108	10.740	***		
	Q17	0.730	0.100	10.244	***		
	Q18	0.814	0.102	11.450	***		
	Q19	0.744	0.095	10.435	***		
	Q20	0.784	0.106	11.019	***		
	Q21	0.683	0.100	9.565	***		
	Q22	0.697	0.094	9.770	***		

The general test criterion for discriminant validity holds that the correlation coefficients between latent variables should be controlled within a critical value of 0.85. If it is greater than 0.85, it indicates that the correlations between variables or dimensions are too strong, and an ideal discriminant validity has not been achieved. Secondly, the square root of the AVE value of each variable or dimension is compared with the correlation coefficients between variables to determine whether there is a good discriminant validity. When the square root of the AVE value of each variable is greater than the correlation coefficient between variables,

it indicates that there is a good discriminant validity between variables. The results of discriminant validity are shown in Table 7.

Table 7
Discriminant Validity

	1	2	3
Competence	0.755		
Autonomy	0.607	0.739	
Relatedness	0.338	0.430	0.745

Note: The bold numbers represent the square root values of AVE, and the values below the diagonal are the correlation coefficients between variables.

As can be seen from the above table, the correlation coefficients between latent variables are all less than the upper limit of the 0.85 standard value, indicating that there is a certain correlation between variables, but there is no excessive correlation. The square roots of the AVE values of each variable are also greater than the correlation coefficients between variables, which fully demonstrates that there is a good discriminant validity between variables. Overall, the total variance explained is 63.195%, which is above the accepted threshold. The Rotated Component Matrix confirms that each item loads onto its respective factor without cross-loadings. These results validate the underlying structure of the questionnaire, supporting its use in future studies on cooperative learning and motivation in piano sight-reading.

Validity Analysis

The results of the validity analysis in this study are as follows: KMO Test: 0.915 (acceptable for factor analysis); Bartlett's Test: $\chi^2 = 2412.550$, $p < 0.001$ (significant); Variance Explained: 63.195% (above the 60% threshold). A three-factor structure aligned with SDT dimensions. CFA results confirm good model fit, validating the three-factor structure as see in the Table 8.

Table 8
Model Fit Indices

Fit Index	Ideal Standard	Actual Value
χ^2/df	< 3 ideal, < 5 acceptable	**2.026**
GFI	> 0.8	**0.865**
AGFI	> 0.8	**0.830**
CFI	> 0.9	**0.926**
TLI	> 0.9	**0.916**
RMSEA	< 0.08	**0.071**

This study successfully developed and validated a psychometrically sound instrument for measuring the impact of cooperative learning on motivation in piano sight-reading. The questionnaire has high reliability and strong construct validity. It aligns with Self-Determination Theory (SDT), measuring Competence, Autonomy, and Relatedness. The

instrument can be used in future music education research to explore the role of collaborative learning strategies.

Implications

This research holds substantial significance for various stakeholders within the realm of music education and beyond. It contributes to the advancement of cooperative learning as an effective pedagogical approach within music education, specifically by demonstrating its positive impact on piano sight-reading skills. By doing so, it provides music educators with empirical evidence to incorporate cooperative teaching methods into their instruction, thereby enhancing piano education, particularly at the novice level. As cooperative learning is shown to improve students' competence and confidence in piano playing, it can lead to more successful and motivated piano students. Furthermore, the insights gained from this research inform teaching practices, offering valuable information on how cooperative teaching can be used to teach piano sight-reading effectively. This knowledge can ultimately benefit both teachers and students by improving teaching practices. Additionally, the study's focus on the effects of cooperative learning on students' motivation, attitude, autonomy, social relatedness, and intrinsic motivation in piano sight-reading contributes to a deeper understanding of how different teaching approaches influence student motivation, which is particularly important in music education where motivation plays a critical role in student engagement and success. By examining the differential impact of cooperative learning on students with varying levels of motivation, the study acknowledges and addresses individual differences in learning, potentially leading to more personalized teaching approaches that cater to the diverse needs of students. Overall, this study addresses the research gap in the context of cooperative learning and piano sight-reading, adding to the body of knowledge in music education research and opening avenues for further research and exploration into the intersection of teaching methods and music learning outcomes. Finally, the study encourages Normal University piano instructors in China to consider the benefits of cooperative piano instruction and sight-reading within group classes, potentially reforming and enriching piano education at the university level. In summary, this research offers valuable insights into the potential of cooperative learning to enhance piano sight-reading skills and student motivation, with broader implications for music education and teaching practices that ultimately benefit students and educators alike.

Limitations and Future Research

While this study employed a rigorously designed and validated questionnaire, several limitations should be noted. First, the sample was limited to non-piano major students at Guangdong Education University, which restricts the generalizability of the findings to other regions or populations. Future studies should validate the instrument across diverse educational contexts and geographical locations to enhance its broader applicability. Second, this study only focuses on the direct impact of cooperative learning on the visual reading motivation and learning attitude of piano beginners. The long-term impact on skill development, retention, and sustained motivation has not been explored. Longitudinal research is needed to evaluate how cooperative learning affects students' progress over time. In addition, although the study controlled for previous formal piano training by excluding students with such experience, individual differences in other factors such as learning style, intrinsic motivation, and previous music experience (e.g. vocal or instrumental training in

other fields) may affect the results. Future research should incorporate these variables to gain a more detailed understanding of the effectiveness of cooperative learning.

Conclusion

This study explores the impact of cooperative learning on the visual reading motivation and learning attitudes of piano beginners, contributing to the field of music education. The findings reveal that cooperative learning strategies significantly enhance students' learning motivation, ability, autonomy, and sense of relevance in piano visual reading. Participants reported increased feelings of competence and autonomy, as well as stronger connections with peers and teachers during collaborative activities. These results highlight the effectiveness of cooperative learning in fostering a more engaging and supportive learning environment for piano beginners. The validated questionnaire used in this study provides a reliable method for music educators and researchers to evaluate the impact of cooperative learning on student motivation. Based on these findings, we recommend integrating cooperative learning strategies into piano group courses to foster higher levels of student engagement and improve learning outcomes. Educators can design collaborative activities that encourage peer interaction, shared problem-solving, and mutual support, thereby enhancing students' motivation and autonomy. Additionally, the positive social dynamics observed in this study suggest that cooperative learning can help build a sense of community among students, which is particularly beneficial for beginners who may feel isolated in traditional individual instruction settings. However, this study has certain limitations, including its specific context and sample size, which highlight the need for further research. Future studies should validate these findings in diverse educational settings, such as different cultural contexts or age groups, to ensure the generalizability of the results. Longitudinal research is also essential to explore the long-term impact of cooperative learning on skill development and retention in piano education. Furthermore, incorporating variables related to individual differences, such as prior musical experience, learning styles, or personality traits, could provide a more nuanced understanding of how cooperative learning interacts with these factors. Finally, examining the interplay between cooperative learning and other teaching methods, such as technology-assisted instruction or traditional one-on-one lessons, could offer valuable insights into optimizing piano education for beginners.

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