

Changes in Music Performance outcomes among Lower Secondary School Students Participating in A Piano–Electronic Keyboard Club: A one–Group Pretest–Posttest Study

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Abstract: *This study examined changes in music performance outcomes among lower secondary school students between the beginning and end of a 16-session Piano–Electronic Keyboard Club programme. The programme integrated guided keyboard and song-accompaniment practice, peer practice and feedback, presentation and application of musical products, and supported practice between sessions. A one-group pretest–posttest design was used with 18 students at a lower secondary school in Vietnam. Students were assessed in the first and final sessions using a five-criterion rubric. Total scores were analysed using a paired-samples t-test, while criterion-level scores were examined as exploratory outcomes using Wilcoxon signed-rank tests with Holm adjustment.*

Mean total scores increased from 12.39 to 16.78, with a mean difference of 4.39 points, 95% CI [3.60, 5.17], $p < .001$, and Cohen's $d_z = 2.78$. Scores at the end of the programme were higher across all five criteria, and the exploratory comparisons remained statistically significant after Holm adjustment ($p \leq .004$). The findings indicate pre–post changes across multiple assessed dimensions among participating students. However, given the one-group pretest–posttest design, absence of a control group, and limitations related to measurement and rating, the findings do not support causal attribution of the observed changes to the programme. This study provides initial evidence from a Vietnamese lower secondary education context and highlights the need for further investigation of extracurricular keyboard programmes using more rigorous research designs.

Keywords: *extracurricular music activities; instrumental music education; keyboard; lower secondary school students; music performance*

I. INTRODUCTION

In music education, instrumental learning involves not only the accurate execution of technical requirements but also opportunities for learners to apply their skills in musical expression and performance. Learners' progress, therefore, cannot be adequately understood through technical accuracy alone. Moura et al. (2024), in a systematic review of music performance assessment, showed that performance assessment typically encompasses multiple dimensions, including technique, interpretation and expression, and musical features such

as pitch and rhythm. The review also identified the use of rubrics to describe different levels of performance. Taken together, these findings support examining music performance outcomes across multiple dimensions rather than relying on a single indicator of technical proficiency.

Beyond individual practice, interaction with peers can provide opportunities for learners to practise together, observe one another, exchange ideas, and receive feedback during instrumental learning. Nielsen et al. (2018) documented forms of peer interaction, including discussion and joint practice, in their study of peer learning among instrumental music students, although the study was conducted in a higher music education context. More broadly, Fernández-Barros et al. (2023) found that peer tutoring has been investigated across different educational levels in music education, including school settings. Together, these studies provide a basis for considering peer interaction as a feature of the instrumental learning environment, without equating the peer practice used in the present study with a formal peer-tutoring intervention.

Instrumental learning also extends beyond periods of direct instruction, as learners continue to practise between lessons. Leon-Guerrero (2008), in a study of middle school instrumental musicians, documented the use of self-regulation strategies during practice. Among younger learners, Wan et al. (2023) found that digital tools designed to support listening and practice could facilitate aspects of self-regulation as children practised their instruments between lessons.

Keyboard instruments have also been examined in research with lower secondary school-age students in general music education. Wig and Boyle (1982) compared a keyboard learning approach with a traditional general music approach among sixth-grade students, examining music achievement and attitudes, while Chan et al. (2006) investigated the use of technology to support the development of keyboard skills among Year 8 students in a secondary school music classroom in England. These studies demonstrate the use of keyboard-based learning within school music education and provide a relevant basis for considering keyboard learning among students of this age.

Beyond classroom-based music activities, extracurricular music programmes provide another context in which school-age students can engage in musical practice. Among middle school students, Ilari and Cho (2023) examined participation in school-based and extracurricular music programmes, indicating that extracurricular activities form part of the broader range of musical experiences available to this age group. In a more specifically instrumental context, Goodrich (2021) investigated a structured extracurricular music class in which students engaged in instrumental learning with teacher guidance and peer interaction. Taken together, these studies provide a basis for considering keyboard learning and extracurricular music participation among school-age learners, but offer limited direct evidence concerning multidimensional music performance outcomes within structured extracurricular keyboard programmes for lower secondary school students.

The present study was conducted at a lower secondary school in northern Vietnam, where a Piano–Electronic Keyboard programme was implemented as a guided extracurricular music activity. It aimed to examine pre–post changes in the assessed music performance outcomes of students participating in the programme. The following research question guided the study: *How do lower secondary school students' assessed music performance outcomes change from the beginning to the end of the programme in terms of the total rubric score and individual assessment criteria?*

II. METHODS

2.1. Research Design

The study employed a one-group pretest–posttest design. The same group of students was assessed using the same rubric in the first and final sessions of the Piano–Electronic Keyboard Club programme, and changes were examined for the total rubric score and individual criterion scores. As the design included neither a control nor a comparison group, differences between the two time points were interpreted as observed changes within the participating group and were not used to support causal inferences.

2.2. Research Context and Participants

The study was conducted at a lower secondary school in northern Vietnam, where the Piano–Electronic Keyboard Club was implemented as an extracurricular music education activity. Prior to the study, the school had not regularly offered a keyboard club.

Participants were selected from students who voluntarily registered for the Club. Because registrations exceeded the planned capacity, 18 students in Grades 6–9 were selected based on their interest in keyboard learning, availability to participate across the 16-session programme, and consideration of prior keyboard experience to include students with differing levels of previous experience. The selected group included students with varying levels of prior experience, ranging from those who had never learned to play a keyboard instrument to those with previous playing experience. The resulting sample was non-probabilistic and was not intended to be representative of the broader lower secondary school student population.

The programme was implemented with the school’s permission. Parents were informed about the study through the school’s parent communication channel and provided verbal consent for their children’s participation. Students were informed that participation was voluntary and that they could choose not to participate. Participant-identifying information was coded during data processing and analysis.

2.3. Extracurricular Piano–Electronic Keyboard Club Programme

The Piano–Electronic Keyboard Club programme was implemented from January to April 2026 and comprised 16 face-to-face sessions of approximately 90 minutes each, organised and facilitated by the researcher. The initial assessment was conducted during the first session and the final assessment during the final session of the programme. Between sessions, students completed practice tasks outside the scheduled Club sessions.

The programme was implemented using two electronic keyboards, with 18 students rotating between individual, pair, and small-group practice. The core programme structure was maintained across the group, while task difficulty was adjusted according to students’ prior keyboard experience. Four components were integrated throughout the programme rather than delivered as separate activities (Table 1).

Table 1. Components of the Piano–Electronic Keyboard Club Programme

Component	Main focus	Format
1. Keyboard and song-accompaniment practice	Chords, maintaining a steady beat, chord changes, and song accompaniment	Individual, pair, and small-group practice
2. Collaborative practice and feedback	Coordination, presentation, feedback, and adjustment	Pair and small-group practice
3. Presentation and application	Refining musical products and participating in performance	Individual and group activities
4. Supported practice	Independent practice, digital learning materials, and feedback between sessions	Individual practice with guidance

The keyboard content progressed from foundational skills and basic chords to chord changes, maintaining a steady beat, song accompaniment, and application in suitable songs. More experienced students could support their peers when needed, and relatively complete performances were presented within the Club and, where appropriate, as part of school activities. Between sessions, students completed practice tasks appropriate to their level, supported by metronomes, audio and video materials, recordings of their own playing, and feedback.

The 16-session programme was organised into four stages, with supported practice between sessions maintained throughout (Table 2).

Table 2. Programme Implementation Sequence

Stage	Sessions	Main focus
1. Foundation	1–4	Initial assessment; basic chords and song-accompaniment skills
2. Skill development	5–8	Song accompaniment; coordination; presentation and feedback
3. Application	9–12	Performance preparation; presentation; adjustment
4. Consolidation and assessment	13–16	Skill consolidation; performance refinement; final assessment
Throughout	Between sessions	Independent practice; supporting materials; feedback

The components were implemented as an integrated programme; the study did not examine the separate effects of individual components.

2.4. Outcome Assessment

Students' outcomes were assessed using an analytic rubric developed by the researcher to evaluate music performance within the context of the study. The selection of criteria was informed by previous research on multidimensional music performance assessment (Moura et al., 2024), criteria-specific assessment of instrumental performance (Saunders & Holahan, 1997), and self-regulation in instrumental practice (Miksza, 2012).

Drawing on this literature and the content of the programme, the rubric comprised five criteria: (1) song-accompaniment technique; (2) musical expression; (3) coordination; (4) performance; and (5) practice and self-regulation. The criteria were developed specifically for the context of keyboard accompaniment and Club activities and were not adopted from an existing scale. Before use, the rubric was reviewed by a music education specialist, whose feedback informed revisions to the criteria and performance-level descriptors. Each criterion was rated on a four-point scale from 1 to 4 (Table 3).

Table 3. Analytic Rubric for Assessing Music Performance Outcomes

Criterion	4 – Good	3 – Satisfactory	2 – Developing	1 – Needs Improvement
Song-accompaniment technique	Maintains a steady beat; changes chords accurately	Generally accurate, with minor errors	Inconsistent; requires support	Does not yet meet the basic requirements
Musical expression	Appropriate tempo, dynamics, and expression	Generally appropriate, with limited expression	Tempo and dynamics are inconsistent	Does not yet meet the basic requirements
Coordination	Coordinates smoothly and performs the assigned role effectively	Coordinates reasonably well and completes the task	Coordination is inconsistent; requires support	Does not complete the assigned role
Performance	Performs independently and completes the task effectively	Participates and completes the task	Partially completes the task; requires support	Does not complete the task
Practice and self-regulation	Practises independently;	Practises and makes adjustments in	Practises inconsistently; requires reminders	Practises infrequently; shows limited

	monitors and adjusts own practice	response to feedback		evidence of self- adjustment
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Note. The level descriptors shown here are abbreviated from the rubric used in the study.

Scores on the five criteria were summed with equal weighting to produce a total score ranging from 5 to 20, while criterion-level scores were retained for separate analysis. Because the rubric was developed for the study context and had not undergone formal psychometric validation, the total score was treated as a composite indicator of music performance outcomes rather than as a score from a standardised scale. The five criteria were treated as assessed dimensions and were not assumed to represent independent psychometric constructs.

In the first session, the 18 students completed song-accompaniment, coordination, and presentation tasks and were assessed using the rubric. For the practice and self-regulation criterion, the initial assessment was based primarily on observations of students' responses to feedback and their ability to make adjustments while completing the tasks. In the final session, students were assessed again using the same rubric, criteria, and scoring scale.

Both assessments were conducted by the researcher, who also organised and facilitated the programme. Observations and students' task performances were used as supporting information for the assessments; during the programme, selected audio and video recordings provided additional information about students' between-session practice. Consequently, the sources of information supporting the assessment of the practice and self-regulation criterion were not fully equivalent at the two time points, and findings for this criterion were interpreted with particular caution.

2.5. Research Procedure and Data Collection

In the first session of the programme, before the instructional activities began, all 18 students completed the initial assessment using the rubric described in Section 2.4. Following this assessment, students participated in the Club activities and completed between-session practice tasks according to the sequence described in Section 2.3. During programme implementation, observations and selected practice outputs were used as supporting information for assessment. In the final session, students were assessed again using the same rubric, criteria, and scoring scale.

Each student was assigned a unique identification code that was used at both time points to match the assessment data, resulting in 18 paired observations for analysis. All 18 students completed both the initial and final assessments and were included in the final dataset; there were no dropouts or missing assessment data at either time point.

2.6. Data Analysis

Analyses were conducted on the 18 complete paired observations. Descriptive statistics were used to summarise scores at the beginning and end of the programme. The total rubric score (range: 5–20) was treated as the primary composite outcome; means, standard deviations, and the mean difference between the two time points were calculated.

The distribution of the post–pre difference scores for the total rubric score was examined using the Shapiro–Wilk test. The test did not indicate a statistically significant departure from normality in the total-score differences; therefore, a paired-samples *t*-test was used to compare total scores between the two time points. The mean difference was reported with a 95% confidence interval (CI), and Cohen's *dz* was calculated to describe the magnitude of the observed change.

Scores on the five individual criteria were treated as secondary exploratory outcomes. Because each criterion was rated on a four-point scale (1–4) and the difference scores were discrete, a Wilcoxon signed-rank test was used for each criterion. Effect sizes were reported as rank-biserial correlations, and the numbers of students whose scores increased, remained unchanged, or decreased were also examined to aid interpretation of the direction of change.

The p -values from the five criterion-level comparisons were adjusted using the Holm method. Statistical significance was set at $\alpha = .05$ for two-sided tests. Criterion-level analyses were considered secondary and exploratory to the analysis of the total rubric score.

III. RESULTS

3.1. Change in Total Rubric Scores from the Beginning to the End of the Programme

Total rubric scores for the 18 students were compared between the beginning and end of the programme. The results are presented in Table 4.

Table 4. Total Rubric Scores at the Beginning and End of the Programme

n	Beginning M (SD)	End M (SD)	ΔM [95% CI]	$t(df)$	P	Cohen's dz
18	12,39 (2,75)	16,78 (2,24)	4,39 [3,60; 5,17]	11,81 (17)	< .001	2,78

Note. Total rubric scores ranged from 5 to 20; ΔM was calculated as the end-of-programme score minus the beginning-of-programme score.

The mean total score increased from 12.39 ($SD = 2.75$) at the beginning of the programme to 16.78 ($SD = 2.24$) at the end, with a mean difference of 4.39 points, 95% CI [3.60, 5.17]. The difference between the two time points was statistically significant, $t(17) = 11.81$, $p < .001$, Cohen's $dz = 2.78$.

3.2. Changes in Individual Criterion Scores

Table 5 presents changes across the five rubric criteria and the results of the Wilcoxon signed-rank tests after Holm adjustment.

Table 5. Changes in Individual Criterion Scores from the Beginning to the End of the Programme

Criterion	Beginning M	End M	ΔM	Increased / Unchanged / Decreased	Holm-adjusted p	Rank-biserial r
Song-accompaniment technique	2,28	3,39	+1,11	17 / 1 / 0	< .001	1,00
Musical expression	2,56	3,39	+0,83	13 / 5 / 0	.001	1,00
Coordination	3,00	3,56	+0,56	11 / 6 / 1	.004	0,83
Performance	2,17	3,06	+0,89	15 / 3 / 0	< .001	1,00
Practice and self-regulation	2,39	3,39	+1,00	15 / 3 / 0	< .001	1,00

Note. Each criterion was rated on a four-point scale (1–4). ΔM represents the mean end-of-programme score minus the mean beginning-of-programme score. The p -values were adjusted using the Holm method for the five criterion-level comparisons. Pairs with no change were excluded from the Wilcoxon signed-rank calculations; rank-biserial r was calculated from the non-zero signed ranks.

Mean scores at the end of the programme were higher than those at the beginning across all five criteria, and all comparisons remained statistically significant after Holm adjustment (adjusted $p \leq .004$). Score increases predominated across all criteria. No decreases were observed for song-accompaniment technique, musical expression, performance, or practice and self-regulation, whereas one student showed a decrease in coordination.

Rank-biserial correlations were 1.00 for the four criteria in which all non-zero differences were in the direction of higher scores and 0.83 for coordination. These values were considered alongside the numbers of students whose scores increased, remained unchanged, or decreased.

IV. DISCUSSION

4.1. Interpreting Changes in Music Performance Outcomes

Pre–post changes were observed not only in the total rubric score but across all five assessed dimensions, indicating that the pattern was not confined to song-accompaniment technique but also extended to musical expression, coordination, performance, and practice and self-regulation. This is consistent with a multidimensional approach to music performance assessment, in which performance outcomes are considered across multiple dimensions rather than solely in terms of technical accuracy (Moura et al., 2024). The change in the total score should therefore be interpreted alongside the criterion-level findings.

The magnitude of the differences between the two time points varied across criteria, but these differences should not be used to rank the relative degree of change across dimensions. Coordination scores were higher at the beginning of the programme than scores on the other criteria, leaving less room for upward movement; conversely, criteria with lower initial scores had more room for change. The ordinal nature and restricted range of the four-point scale further limit direct comparisons of the magnitude of change across criteria.

Findings for practice and self-regulation require additional caution because the sources of information supporting assessment were not fully equivalent at the two time points. Overall, the data indicate a pattern of pre–post change across multiple dimensions captured by the rubric within the participating group. How this pattern relates to the structure of the programme is considered in the following section.

4.2. Findings in Relation to the Integrated Programme Structure

The Club programme combined guided keyboard and song-accompaniment practice, peer practice and feedback, presentation and application, and supported practice between sessions. These components were integrated throughout the programme rather than implemented as separate interventions. They therefore provide a context for interpreting the observed pattern of change but do not allow the contribution of any individual component to be estimated.

Keyboard and song-accompaniment practice formed the central musical focus of the programme, progressing from foundational skills and basic chords to maintaining a steady beat, changing chords, and applying these skills in song accompaniment. There was therefore direct alignment between some of the content practised during the programme and the requirements of the rubric. Such programme–measure alignment may have increased the likelihood of detecting change in directly practised skills and should be considered when interpreting the findings.

Alongside guided practice, students worked in pairs or small groups, observing one another, exchanging ideas, receiving feedback, and adjusting their playing. These activities share features with peer interaction in instrumental practice (Nielsen et al., 2018) and with peer tutoring in music education (Fernández-Barros et al., 2023), although peer tutoring was not implemented as a distinct intervention in the present programme. This literature provides a context for considering interaction among students as a feature that may support the practice process, rather than as evidence that such interaction directly explains the observed changes.

Presentation and application activities provided opportunities for students to bring together technique, rhythm, coordination, and expressive requirements within a musical performance rather than practising these elements only in isolation. Between-session practice further extended opportunities for practice beyond the scheduled Club sessions. Previous research suggests that instrumental learners may use self-regulatory strategies during practice (Leon-Guerrero, 2008; Miksza, 2012), while digital tools may support some of these processes when accompanied by appropriate guidance (Wan et al., 2023). In the present programme, learning materials, recordings of students' playing, and feedback were used to support between-session practice rather than as a separate technology-based intervention.

The present findings can also be considered alongside earlier studies of keyboard use in school music education. Wig and Boyle (1982) compared a keyboard learning approach with a traditional general music approach among sixth-grade students and reported differences in music achievement and attitudes, including pre–post changes on some measures within the keyboard group. Chan et al. (2006), in a different classroom context, investigated technology-supported keyboard skill development among Year 8 students. The present study differs

from these earlier studies in its organisational context: it examined a structured extracurricular programme in which 18 students with differing levels of prior keyboard experience rotated between individual, pair, and small-group practice using two electronic keyboards. These differences in design, setting, and outcome measurement mean that the present results should not be treated as directly equivalent to those of the earlier classroom-based studies. At the same time, the current design does not allow conclusions that the extracurricular format is superior to other forms of provision.

Overall, the multidimensional pattern of change observed in the rubric scores can be situated within a learning environment that connected guided practice, peer interaction, presentation and application, and between-session practice. This interpretation is informed by the structure of the programme and related literature, rather than constituting evidence of an underlying mechanism. Testing potential mechanisms or estimating the contribution of individual programme components would require designs that allow programme conditions to be compared or separated.

4.3. Contributions, Limitations, and Implications

This study adds an empirical case from the Vietnamese lower secondary school context involving an integrated extracurricular Piano–Electronic Keyboard programme, with pre–post changes examined in both the total rubric score and multiple assessed dimensions. Its contribution is context-specific and provides preliminary evidence to support further investigation of this type of programme, rather than establishing its general effectiveness.

Several limitations should be considered when interpreting the findings. First, the one-group pretest–posttest design, without a control group or random allocation, does not allow alternative explanations such as maturation, familiarity with the assessment tasks, or concurrent musical experiences to be ruled out. The observed changes therefore do not establish a causal relationship with the programme, nor does the design allow the contribution of individual programme components to be separated. Second, the rubric was developed for this study and underwent specialist review but has not been independently psychometrically validated. The researcher both implemented the programme and rated students at both time points without being blinded to assessment occasion, creating a risk of rater bias. For the practice and self-regulation criterion specifically, the sources of supporting information were not fully equivalent across the two assessments. In addition, the alignment between programme content and the rubric does not indicate whether the observed changes would transfer to other musical tasks or contexts.

Generalisability is limited by the small sample of 18 students from a single school and by the recruitment of participants from students who voluntarily registered for the Club. The participating group may therefore have differed from the broader lower secondary school student population in their interest in and willingness to engage in keyboard activities. The findings cannot be assumed to generalise to other student groups, schools, resource conditions, or programme facilitators. The programme nevertheless provides a practical example of how keyboard practice, peer interaction, presentation and application, and between-session practice can be integrated within an extracurricular activity; however, the current evidence is insufficient to support recommendations for widespread implementation.

Future research should include larger samples, multiple schools, and comparison or control groups where feasible. The use of independent raters, blinding raters to assessment occasion, examination of inter-rater reliability, and standardisation of evidence sources across time points would strengthen measurement quality. Future studies could also examine whether observed changes transfer to other musical tasks and use comparative designs when the aim is to estimate the contributions of individual programme components.

V. CONCLUSION

This study examined changes in music performance outcomes among 18 lower secondary school students from the beginning to the end of a 16-session Piano–Electronic Keyboard Club programme. The total rubric score was higher at the end of the programme than at the beginning, with a pattern of higher scores also observed across

all five assessed dimensions: song-accompaniment technique, musical expression, coordination, performance, and practice and self-regulation.

The study provides preliminary evidence from the Vietnamese lower secondary school context concerning an integrated extracurricular keyboard programme. However, given the one-group pretest–posttest design, the small sample from a single school, and limitations related to measurement and rating, the observed changes cannot be causally attributed to the programme or assumed to generalise directly to other student groups and contexts. Future research using stronger comparative designs, more independent assessment procedures, and implementation across multiple settings is needed to examine the replicability and generalisability of the observed changes.

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