



Enhancing the Efficiency of Piano Learning Through Self-Regulated Learning Training

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Annotation. Self-regulated learning (SRL) is a powerful method to enhance learning efficiency. This study explores its application in piano education, focusing on goal setting and strategy use. Involving 32 piano students from the Vytautas Magnus University (VMU), the research showed that participants practicing SRL significantly improved their technique, expression, and rhythm after 8 weeks. A counterbalancing method confirmed SRL's effectiveness over traditional learning, highlighting its practical value in piano pedagogy.

Keywords: *piano learning, self-regulated learning, music performance, education.*

Introduction

Piano instruction differs from traditional classroom instruction in many ways, including flexibility and accessibility (Xu & Jaggars, 2014). For teachers, instruction is more flexible, and students can choose learning options under teacher guidance, including the choice of autonomous learning time and resources, and self-assessment. In self-regulated learning (SRL), students are required to have appropriate learning strategies within their own learning process, understand their own abilities, plan their learning routes reasonably, and monitor and adjust the task allocation of the learning process (Marzoli, 2021; Foubert et al., 2017). In other words, if the SRL method is applied to piano learning, the effectiveness of piano learning depends on students' metacognition ability (Suzuki & Mitchell, 2022). Traditional piano teaching can

guarantee teachers' course quality and accurately evaluate students' learning effect, while SRL piano education is still in its early stages (Dumlavwalla, 2017). Although teachers have full control over the courses, they encounter numerous challenges, particularly in the arena of music learning and, more specifically, in piano instruction (Comeau et al., 2019). Most of them need one-to-one classes, and students have individual differences. Capabilities in self-learning, self-management, and time spent practicing after class vary among students (Pike, 2017; dos Santos, 2018). Several studies have linked self-regulated learning methods to music education, such as Wagner (1975), who found that simply keeping records of practice time and reporting it to the teacher did not significantly improve student ability after 8 weeks, when compared to a group of control. Self-assessment has also been studied in considerable detail. Hewitt (2001) examined how junior high school instrumentalists were able to improve their performance using recorded models, self-listening, and self-assessment. He found a significant improvement in the performance of students who first used a recorded model and subsequently self-assessed over those who did not self-assess. In a related finding, Sparks (1990) reported a positive effect on the performance scores of music during self-assessment of elementary school students. In the same vein, Madsen and Geringer (1981) found elementary piano students who used self-assessment aids to practice, performed a great deal better than peers who did not. In this study (The independent learning program ran for a period of 8 weeks), we designed a new SRL scheme that was applied to piano teaching, the effectiveness evaluated through experiments.

Theoretical

Self-regulated learners exhibit cognitive, emotional, and behavioral engagement in the learning process, aiming to attain their learning objectives and enhance their academic performance (Al-Nasa'h & Ahmad, 2021). The literature identifies seven key theoretical perspectives on self-regulated learning: operational, phenomenological, information processing, social cognitive, volitional, Vygotskian, and cognitive constructivist – each providing unique insights into the phenomenon. For example, cognitive-focused researchers view self-regulated learning as a covert process, whereas behaviorists consider it overt and observable (Zimmerman, 2000). Nonetheless, despite the differences in these perspectives, they share four common features, as outlined by Pintrich (2000):

- Self-regulated learners actively establish their own goals during the learning process.
- They employ self-regulation to manage their cognition, motivation, and behavior to attain these goals.
- Personal or situational variances may present challenges to their efforts.

- Most models view self-regulatory activities as mediators connecting personal and situational traits to actual learning performance.

With these foundational principles, learners harness self-regulation to steer their cognition, motivation, and behavior toward their learning goals. Although educational psychologists have extensively studied metacognition, our understanding of how learners regulate their motivation within self-regulated learning remains limited. (Zeidner & Stoeger, 2019; Zusho, 2017). It is important to note that self-regulated learning is goal-oriented, and learning motivation significantly influences engagement in the desired learning, satisfaction, and outcomes. Thus, from this perspective, learning goal orientation is conceptualized as the extent to which learners are inclined to achieve their desired academic outcomes. According to Pintrich’s Self-Regulated Learning model, learning goal orientation and self-efficacy form the foundation for regulating learning behaviors such as engagement and emotional responses during the performance stage.

Building upon Pintrich’s SRL model, we investigated the process of motivational regulation in piano learning students within the SRL context. This process commences with the initial activation stage of learning goal orientation, which lays the foundation for the activation of learning goals. In our experiment, we achieved this by enhancing students’ cognitive engagement through the provision of additional theoretical background knowledge. Simultaneously, students’ self-efficacy was bolstered through self-assessment. Subsequently, we moved to the stage of monitoring and regulating the performance of learning behaviors, where learners fine-tune their learning inputs. This adjustment is reflected in their emotional experience, primarily learning satisfaction. These processes are maintained until learners reach their desired learning outcomes. For a detailed representation of the intricate dynamics between these dimensions, see Table 1.

Table 1
Self-Regulating Mental Mechanism for Piano Learning

	Cognition	Motivation	Behavior
Planning	Prior knowledge activation, Additional background knowledge of the repertoire	Setting the difficulty of the repertoire	Planning of study time
Monitoring regulation	Choice, Regulating learning minds	Selecting and regulating learning motives, playing famous songs	Setting of study hours
Reflection	Self-evaluation, scoring and summarizing		

In our study, we applied these three processes – cognition, motivation, and behavior to the piano learning domain. We devised experimental protocols to address the planning, monitoring, regulation, and reflection components associated with each of these processes. In order to assess whether SRL is effective in piano teaching, we used an experimental multifaceted assessment approach. This approach included quantitative analysis using scores and the controlled variable method. Our study aims to comprehensively assess the SRL impact on piano instruction, focusing on the complex interplay among these dimensions.

We implemented a differentiation strategy whether or not background knowledge of the music repertoire was learned, to assess whether students engaged in prior knowledge activation. In the fourth week, we introduced an explanation of the intellectual context of the music. For the remainder of the sessions, we maintained a controlled environment by providing students with the musical masterpieces that closely matched their proficiency level, ensuring that their motivation and self-efficacy remained consistent. The total instructional time spanned eight weeks to control students' behavioral engagement.

To distinguish between students' environmental influences, we applied a scoring system that evaluated students' self-assessment and monitored whether the teacher informed the students about their weekly learning objectives. This methodology allowed us to experimentally compare the effects of SRL in the context of piano instruction. Therefore, the purpose of this study was to explore students' piano repertoire performance learning in a SRL intervention and to compare the learning outcomes with those of traditional learning. In doing so, the following research questions were addressed:

1. Does SRL improve students' piano repertoire performance?
2. Which intervention (activated by recounting background knowledge of the repertoire and prior knowledge of the emotions of performance by multiple performers and creators) improves performance more quickly?

Methodology

Experimental subject

The plan was to select 32 piano students from the VMU Academy of Music as research subjects. They were divided into all groups of sixteen people, one as the group of control and one as the research (experimental) group. The number of males and females in each group was the same. There was no significant difference in the sample in terms of family background, academic background, and performance levels. Informed consent was obtained from the participants, and they were briefed on the nature and objectives of the study, the data collection procedures, and the confidentiality of personal information.

Experimental method

We referred to some international piano exam scoring standards and optimized the scoring standards that followed according to the actual situation (Sandu, 2023; Liu, 2023).

Grades were assessed in three parts: A – Playing technique and integrity; B – Musical expression and style and finally, C – Reading and rhythm. The final grade ‘S’ was calculated using the formula, $S=0.4A+0.3B+0.3C$.

32 participants were asked to learn to play a musical piece over a period of time. 16 people in the group of control and 16 people in the group of experimental (a total of 16 males and 16 females, divided equally). These four pieces are almost identical in length, but are played with different styles and emotions.

The practice period of the whole program was expected to be 8 weeks. This timescale remains consistent with other research of a similar design that has also produced evidence of change on musical performance measures over similar periods of time. During the research period, the group of control did not receive the under-study intervention, while the experimental group was subjected to a type of self-regulated learning curriculum aimed at strengthening time management and musical interpretation skills to reflect contemporary views on strategies for effective learning (Cremaschi, 2012). The group of control’s piano study is in addition to classroom instruction, with the first 4 weeks training in time planning and management skills, and the second 4 weeks training in score reading/writing skills. Students are asked to evaluate their performance for comparison with actual scores. The total score is calculated with the help of the teacher. [Excellent (90–100); Great (75–90); Pass (60–75); Failed (less than 60)]. Note that these scores are for students’ own use only and are not to be included as experimental data to be used for analysis and calculations. The data processing software used, was SPSS22.0.

Scoring System

Excellent (90–100)

Technique: Correct, standardized, skilled with varied touch, good accuracy, stable.

Rhythm: Accurate reading, correct and stable rhythm, clear phrase articulation, good rhythmic sense.

Musicality: Strong sense of music, accurate style interpretation, expressive, with imaginative and distinct character.

Great (75–90)

Technique: Correct method, good foundation, fewer mistakes.

Rhythm: More stable rhythm, clearer structure, better phrase mastery than Pass level.

Musicality: Good musical sense, more accurate style representation, clearer polyphony than Pass level.

Pass (60–75)

Technique: Acceptable execution, flexible fingers, but with some method issues.

Rhythm: Generally correct, though some rhythmic and reading inaccuracies.

Musicality: Adequate style, needs livelier performance and clearer dynamics.

Failed (less than 60)

Technique: Incorrect method, tension, lack of clarity, and control, poor finger positioning.

Rhythm: Inaccurate reading and rhythm, syntactical errors, unstable tempo.

Musicality: Lacking expressiveness, incorrect style interpretation, continuous errors musical performance.

Result and Analysis

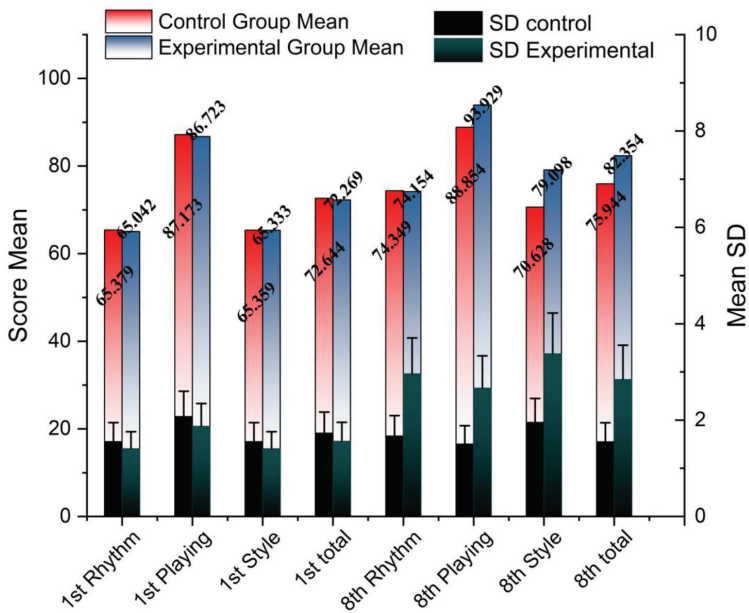
We compared the performance of all of students before and after the study, and Figure 1 provides statistics on the participants' performance of piano learning. The data show that there is a significant difference in performance. Notably, both groups of participants had comparable academic performance in the first week, with the experimental group even slightly lower on average than the group of control. With statistical results of $p > 0.05$, the difference was not statistically significant. This is consistent with our hypothesis, because we selected piano students with similar proficiency levels and maintained a consistent gender ratio in our sample. In addition, due to the same level of students selected, age and family environment background factors were not considered. To assess the differences in performance for individual items, we conducted an independent T-test for the scores of the three assessed items in the first week between the all groups. The mean scores for each item were almost the same, $p > 0.05$, with no statistical difference between the all groups of students, and participants having the same piano playing ability. According to Levene's test, the variances for music and rhythm ($F = .239$, $p = .628$), playing technique ($F = .239$, $p = .628$), and playing style ($F = .239$, $p = .628$) are roughly equal, consistent with the overall similarity observed in the initial sample.

After 8 weeks of study, the total scores of all groups of students in the last week were significantly different ($p < 0.05$). The experimental group not only improved significantly in all categories but also outperformed the group of control, with marked improvements in rhythm, playing, and style, leading to an overall higher total score by the end of the study period. Specifically, the experimental group's scores for playing increased from an average of 63.33 to 84.34, demonstrating a notable enhancement in

technical skills. This group's overall mean scores also rose from 69.08 to 79.34, reflecting a comprehensive improvement across all evaluated aspects of piano performance. This affirms the practical effectiveness of integrating self-regulation method into piano teaching to improve learning efficiency. It is important to investigate whether this improvement results from the SRL effectiveness or the relatively low efficiency of traditional methods. A paired sample analysis of the final week scores of the group of control also showed significant results, acknowledging the effectiveness of traditional teaching methods. Similar tests conducted in the experimental group confirmed the effectiveness of the independent learning program in improving the efficiency of piano learning ($p < 0.05$). Both the control and experimental groups showed a significant improvement in their individual scores before and after the intervention, which suggests that the traditional teaching methods used in the group of control were effective and also enhanced learning outcomes. In the experimental group, the results confirmed the efficiency of the independent learning plan combined with traditional methods for piano education.

Figure 1

The Mean Scores and Standard Deviation (SD) of Participants in the Control and Experimental Groups at Week 1 and 8

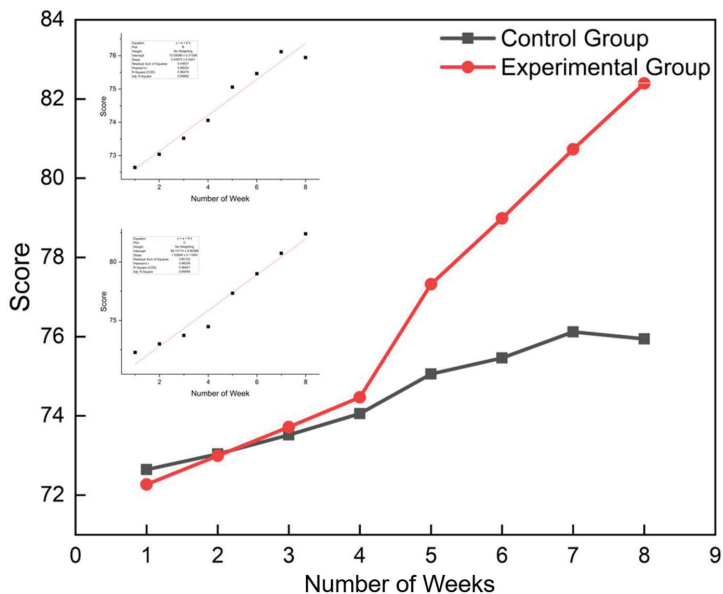


To depict the score differences between the all groups, we calculated their average weekly total scores and presented them in Figure 2, with the red line representing the experimental group and the black line indicating the group of control. The graph reveals a notably steeper upward trend for the experimental group, confirmed by linear analysis. Specifically, the students in the experimental group exhibit a linear slope of approximately 1.5, whereas the group of control only shows 0.5. It's important to note that the average grades of the group of control students decreased compared to the previous week (week 7), likely due to the fatigue induced by conventional teaching methods. From the onset, the group of control showed a slow but steady increase in scores, rising from around 74 in week 1 to about 76 by week 8. In contrast, the experimental group's performance displayed a dynamic pattern of change over time. Beginning from a similar score in week 1, their scores spiked dramatically by week 8 to a high of 82. This suggests a large return on investment with the SRL strategies enacted, presumably taking effect only after the initial phase of adaptation, thus speeding up learning effectiveness in a non-linear way.

Figure 2 insets offer a finer grain, depicting linear regressions showing how scores of each group progressed across the weeks. These insets add to the impression of a faster pace by appearing as notably steeper slopes in the group of experimental compared to their control counterparts, consistent with the Figure 2 expectations.

Figure 2

The Trend of the Overall Average Scores of the All Groups of Students. The Inset is the Linear Analysis of the Scores of the Group of Control (Black) and the Experimental Group (Red)



This distinct academic trajectory highlights the importance of SRL strategies in improving academic outcomes compared to standard strategies, especially when delivered over time, allowing students to adapt and master skills. By week 8, the mean score of the experimental group was significantly higher than that of the group of control, suggesting that SRL strategies can mitigate the effects of fatigue and potentially mitigate the decrease in motivation encountered with traditional, less interactive educational methods.

Table 2

Regression Results Between the Secondary Grades of the All Groups of Participants

	Group of control			
	Adjusted R Square	B	β	<i>p</i>
Reading and rhythm	0.548	0.683	0.812	<0.05
	0.325			
	0.646			
Playing technique and integrity	0.742			<0.05
	Experimental Group			
	Adjusted R Square	B	β	<i>p</i>
Reading and rhythm	0.831	0.764	0.99	<0.05
Playing technique and integrity	0.813	0.659	0.902	<0.05

In Table 2, the results of linear regression depict the influence of participants' musical background and playing style on their musical skills, as well as their ability to read music and rhythm. The analysis considered both the control and experimental groups, examining whether the observed effects were linked to the self-regulated learning method. The findings indicated statistical significance across all four regression models, with no outliers (*Std. Residual*_{Min} = 0.57, *Std. Residual*_{Max} = 1.75), and no evidence of autocorrelation (Durban-Watson statistic; *d* = 1.95) or multicollinearity issues.

Notably, the fit of the group of control (R Square) was found to be less than that of the experimental group. This suggests that participants in the group of experimental, who actively engaged in self-regulated learning strategies such as reflective observation, recording and scoring, and self-comparison, demonstrated more significant improvements. The activation of strategies based on prior knowledge also contributed to enhanced motivation among students in the group of experimental. It is important to note, however, that the increased scores were not solely attributed to the self-regulated learning style.

The finalized results imply that enhancements in music emotion and style may drive improvements in the other two dimensions. However, it cannot be definitively concluded that these improvements are exclusively caused by the self-regulated learning style.

Discussion

Using SRL Strategies in Piano Study

The approach to piano learning is intricately connected to the implementation of self-regulation strategies. Our primary research inquiry sought to delve into the impact of piano SRL on students' proficiency in repertoire acquisition. In our investigation, we embraced a self-regulating learning strategy that underscores learners' active construction of goals, the regulation of cognition, stimulation of motivation, and the adjustment of behaviors throughout the learning process. This aligns with prior research, exemplified by (Zimmerman & Kitsantas, 2007), who emphasize self-regulated learning as an implicit process. Other researchers have characterized learners' self-regulated behaviors as overtly observable responses.

Our study substantiated, through experiments, that the integration of self-regulated learning strategies into piano teaching, does yield substantial learning effects, and demonstrated the practicality of self-regulated learning over traditional methods. (Panadero, 2017). The outcomes depicted in Figure 1 furnish empirical evidence attesting to the effectiveness of piano SRL in elevating repertoire performance.

When comparing the individual scores of the two student groups in the final week, we observed significant disparities in the items "playing skill and integrity" and "musical expression and style", while detecting nearly negligible differences in the "reading and rhythm" category. This discrepancy might be attributed to students' existing extensive learning experiences, particularly in rhythm, which is a skill honed almost daily (Miendlarzewska, 2014). The application of the SRL method, especially with the aid of metronomes, becomes pertinent in this context, emphasizing that almost every student can recollect a piece of music. Students employing the SRL method exhibited more pronounced improvements in performance skills. Motivated by goal setting and self-assessment, students tended to perpetually compare their performance with that of a master, thereby continuously refining their skills by incorporating staccato legato, scale arpeggios, ring fingers, octaves, ornaments, and more. Consequently, their performance skills witnessed substantial enhancement, elucidating the notable differences in skill items.

In terms of musical expression and style, we added an introduction to musical context to the experimental group of students in week five. A deeper understanding of the work and the compositional context allows for a simpler empathy with the artistic thinking of the performer at the time, which is more useful for expressing the nuanced emotions in the work. As a result, students know when to use somber tones and when to be expressive. This repeated connection, reinforced by self-assessment, enables students to quickly express emotional differences as well as their own ideas and develop a unique style in their playing.

The effect of using SRL on performance improvement in piano learning

The second research inquiry aimed to compare two strategies employed by students in the group of experimental during the piano SRL process, specifically investigating whether the activation of prior knowledge strategies contributes to accelerated performance improvement. In the fifth week, the students in the experimental group exhibited a significant breakthrough in their average scores, a development correlated with the introduction of the performance background. Notably, the experimental group demonstrated a more rapid improvement in grades during the initial four weeks in comparison to the group of control, likely attributable to the novelty and excitement stemming from exposure to the new learning system (Bradley, 2010).

The analysis above underscores the critical importance of planning and managing piano learning time, emphasizing that even the most effective learning strategy must be applied diligently in piano practice. It is observed that students often do not approach piano practice with the seriousness it requires. However, when piano specialization is performed, the results seen by teachers are usually remarkable. The solution to this problem involves the student's learning time, and with sufficient contact time and a higher level of perseverance on the part of the student, it is possible to facilitate the use of strategies that lead to an understanding of what piano practicing is really all about, and the use of supervision of strategy selection and implementation has been shown by us to be far more effective in piano learning than merely instructing students in the classroom.

In our study, the experimental group made great progress in learning piano emotionally by utilizing prior knowledge to activate the learning strategy, leading to a significant difference in the final academic performance of all groups. As we mentioned before, such a strategy would make the students would think more positively about the meaning of playing. Our findings align with prior research, further substantiating the positive impact of self-regulated learning on academic achievement. For instance, Cleary & Platten (2013) and our study provide empirical evidence supporting this correlation. In addition, the results from the group of control underscore the efficacy of traditional teaching methods, consistent with previous studies affirming the effectiveness of traditional teaching approaches in enhancing academic achievement (Miyake, 2010; Zajacova, 2005).

The Effects of SRL Strategies to Improve the Emotional Style of Music on Performance Technique, and Rhythm:

The discussion then examines the impact of emotional style on playing skills and rhythm. We will discuss this in two ways.

Emotional Style and Performance Skills:

A performer's understanding of the emotional style of music can have a direct impact on the student's performance level and can have a facilitating effect on the technical aspects of technique. Some people are born with the ability to quickly pick up on subtle emotional changes in musical performance, while others need a lot of training, which may be related to the individual's musical intuition (Kirnarskaya, 2009). Of course, geniuses tend to be in the minority (Cooke, 2013). More learners need to use external help, such as the SRL method, to set learning goals and to improve their playing skills.

Influence of Emotional Style on Score Recognition and Rhythm:

The emotional style of playing can significantly affect the rhythm of playing. Learning the emotional context of a musical repertoire piece can help students to accurately grasp the rhythm of playing (Coats, 2006). Some students have strong rhythmic control and may be better suited to an instrument such as the drum kit, while others are sensitive to the pentatonic scale and are able to accurately play the length of the notes. The inclusion of musical style learning in SRL allows students to understand the repertoire more fully, adjusting the strengths and weaknesses appropriately across a range of moods but without compromising the original tempo of the performance, which is important in piano playing.

Conclusion

In summary, our study examined the effects of self-regulated learning on piano performance involving 32 university students at the VMU Academy of Music. Using a refined assessment based on international piano examination standards, we evaluated three key dimensions: performance skills, musical expression, and score recognition and rhythm. Participants were divided into a group of control and an experimental group, and both groups had to learn four different pieces in an eight-week program, with the experimental group receiving additional training in time planning, management, and musical background knowledge. The results have shown significant differences in performance between the all groups, confirming the ability of SRL to enhance the actual effectiveness of piano teaching and highlight the advantages of combining independent study programs with traditional methods. Linear regression analyses demonstrated that emotional enhancement of student performance can influence music reading and rhythm. Feedback observation and prior knowledge activation strategies were effective. It was determined that improvements in emotional style, did positively impact performance skills, score recognition, and rhythm, but this cannot

be attributed to SRL styles alone. Innate differences in individual musical intuition and expression also play a role in piano learning.

Limitation

Despite the remarkable findings obtained in our study, it is important to recognize some limitations that may affect the generalizability and interpretation of the findings. The first is sample specificity – our study sample is of university students studying piano in Europe, which may limit the generalization of the results to a broader population. Due to the proficiency levels and musical backgrounds of the academy's music students, it may not be fully representative of diversity in other educational settings. While the study recognized innate differences in musical intuition and expression, it did not delve into these individual differences. Further research could explore how these differences affect the effectiveness of self-regulated learning strategies for different learners. The study was conducted in Lithuania, and in terms of multicultural differences, we have not yet assessed this part of our work, which we intend to continue in the future. Secondly, an 8-week study period may not be sufficient to capture the long-term effects of self-regulated learning methods on the improvement of piano learning outcomes. A longer experimental period would allow for a more comprehensive understanding of the subsequent effects of SRL methods.

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Mokymosi groti fortepijonu veiksmingumo didinimas taikant savireguliacinį mokymąsi

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Santrauka

Savireguliacinis mokymasis (angl. *SRL*) yra efektyvus būdas mokymosi veiksmingumui gerinti. Šiame tyrime nagrinėjamas *SRL* taikymas mokymosi groti fortepijonu ugdymo procese, akcentuojant tikslų nustatymą ir strategijų naudojimą. Trys procesai – pažinimas, motyvacija ir elgesys – analizuojami mokantis groti fortepijonu. Šio tyrimo tikslas – visapusiškai įvertinti *SRL* poveikį mokantis groti fortepijonu, sutelkiant dėmesį į sudėtingą šių dimensijų sąveiką. Tyrime dalyvavo 32 Vytauto Didžiojo universiteto Muzikos akademijos studentai. Nustatyta, kad *SRL* praktikuojantys studentai po 8 savaičių reikšmingai pagerino grojimo fortepijonu techniką, raišką ir ritmą. Kontrbalansavimo metodas patvirtino *SRL* veiksmingumą lyginant su tradiciniu mokymusi ir atskleidė jo pridėtinę vertę mokymosi groti fortepijonu pedagogikoje.

Esminiai žodžiai: *mokymasis groti fortepijonu, savireguliacinis mokymasis, muzikinis pasirodymas, švietimas.*

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