THE SCIENTIFIC TEMPER (2026) Vol. 17 (1): 5429-5434

E-ISSN: 2231-6396, ISSN: 0976-8653

Doi: 10.58414/SCIENTIFICTEMPER.2026.17.1.05

https://scientifictemper.com/

RESEARCH ARTICLE

Improvising the Mind: Metacognitive Skill Formation Through Musical Practice Among Youth

Medha*

Abstract

The purpose of this study is to explore how structured music education influences the development of metacognitive skills—such as self-regulation, planning, monitoring, and evaluation—among youths. The rationale for the study is grounded in the growing recognition that music learning engages higher-order cognitive processes, promotes reflective thinking, and enhances students' ability to manage their own learning. Despite evidence linking arts education to improved academic and emotional outcomes, limited empirical research has examined the specific relationship between music training and metacognitive awareness in the youth population. The study employs a quasi-experimental design with 120 students from urban area, divided equally into two groups: students receiving formal music education for at least one academic year and those with no structured musical training. The Metacognitive Awareness Inventory (MAI) by Dr. Punita Govil were used to assess metacognitive components. Statistical analysis (Mean, SD, t-test) compare mean scores between groups. Preliminary observations from a pilot group suggest that musically trained students demonstrate higher levels of self-monitoring, goal-setting, and strategic learning behaviours compared to non-trained peers. These findings point toward the potential use of music education as a non-clinical, developmental tool to enhance metacognitive growth and self-directed learning. The study has implications for educational and therapeutic practices, emphasizing music-based interventions as supportive frameworks for cognitive and emotional self-regulation.

Keywords: Music Education, Metacognitive Skills, youths, Cognitive Development, Educational Psychology, pilot study, Developmental tool, non-clinical tool.

Introduction

Music therapy and education have long been recognized for their capacity to enhance cognitive, emotional, and social functioning. Music engages multiple brain systems simultaneously, activating auditory, motor, and prefrontal regions responsible for attention, planning, and emotional regulation (Koelsch, 2014). Within educational settings, structured music learning develops not only artistic skills but also executive and metacognitive functions such as self-monitoring, problem-solving, and reflective thinking (Hallam, 2010).

Assistant Professor, Department of Psychology, Patna Women's College (autonomous), Patna, Patna University, Bihar, India

***Corresponding Author:** Medha, Assistant Professor, Department of Psychology, Patna Women's College (autonomous), Patna, Patna University, Bihar, E-mail: medha.me2016@gmail.com

How to cite this article: Medha. (2026). Improvising the Mind: Metacognitive Skill Formation Through Musical Practice Among Youth. The Scientific Temper, **17**(1):5429-5434.

Doi: 10.58414/SCIENTIFICTEMPER.2026.17.1.05

Source of support: Nil

Conflict of interest: None.

Indian classical music, with its unique system of *ragas* (melodic frameworks) and *talas* (rhythmic cycles), has been used therapeutically to evoke emotional balance and mental clarity. Empirical studies suggest that participation in musical activities enhances working memory, emotional awareness, and self-regulation (Schellenberg, 2005; Rickard et al., 2013). However, while music therapy has been widely applied in clinical populations, its role as a developmental tool for enhancing *metacognitive skills* in youth population remains underexplored, especially in the Indian educational context.

Conceptual and Theoretical Background

From a cognitive-psychological perspective, metacognition refers to "thinking about one's own thinking" (Flavell, 1979). It encompasses two key components: metacognitive knowledge (awareness of one's learning processes) and metacognitive regulation (control over those processes). Music learning inherently involves such metacognitive engagement — students plan practice sessions, monitor accuracy, and evaluate performance outcomes.

Metacognition

Metacognition refers to the awareness and understanding of one's own thinking processes. Often described as "thinking

Received: 08/12/2025 **Accepted:** 22/12/2025 **Published:** 25/01/2026

about thinking," metacognition involves the ability to monitor, regulate, and evaluate cognitive activities such as learning, problem-solving, decision-making, and memory. The concept was first introduced by developmental psychologist John Flavell in the late 1970s, who defined it as the knowledge individuals have about their own cognitive processes and their ability to control them. Since then, metacognition has become an important area of study in education, psychology, and cognitive science.

Metacognition consists of two major components

metacognitive knowledge and metacognitive regulation. Metacognitive knowledge includes an individual's understanding of their strengths, weaknesses, learning strategies, and the demands of tasks. For example, a student may know they learn better by using visual aids rather than reading large amounts of text. Metacognitive regulation involves planning, monitoring, and evaluating cognitive activities. During learning, metacognitive regulation enables a person to select strategies, adjust them if needed, and assess whether learning goals have been achieved.

Metacognition plays a significant role in academic achievement and lifelong learning. Individuals with strong metacognitive skills tend to be better at organizing information, identifying errors, reflecting on outcomes, and adapting strategies. These learners are more independent because they understand how to approach tasks effectively and evaluate their progress accurately. Research consistently shows that metacognition enhances critical thinking, creativity, comprehension, and problem-solving abilities across diverse educational settings.

Developmentally, metacognitive skills emerge gradually. Young children often engage in learning without consciously reflecting on how they learn. As children grow, especially during adolescence, they develop a better ability to evaluate and control their learning. This period is crucial because metacognition becomes linked to identity, motivation, and personal responsibility for learning. Additionally, cultural and environmental factors influence metacognition. Supportive learning environments that encourage reflection, questioning, and experimentation tend to foster stronger metacognitive development.

Various strategies have been shown to enhance metacognition. These include self-questioning, goal setting, journaling, peer teaching, and reflective discussion. Instructional methods such as problem-based learning and inquiry-based approaches also encourage students to reflect on how they think and learn. Importantly, teaching metacognition explicitly can help learners become more strategic and conscious about their learning process.

In recent years, metacognition has also been studied in connection with emotional intelligence, mindfulness, and brain-based learning. Neuroscientific research suggests that metacognition is closely associated with activity in the prefrontal cortex, an area responsible for executive functions such as planning, reasoning, and decision-making. This connection highlights the importance of cognitive flexibility and self-awareness in human development.

In conclusion, metacognition is a foundational skill that empowers individuals to reflect upon, guide, and improve their own thinking. It supports effective learning, enhances academic and real-world performance, and contributes to personal growth and adaptive behavior. As a lifelong competency, metacognition enables individuals not only to acquire knowledge but to use it meaningfully and intelligently.

Review of Literature

In the title "From Practice to Reflection: A Systematic Review of Mechanisms Driving Metacognition and SRL in Music", Wang et al(2025) found that Metacognition and self-regulated learning (SRL) are essential for musical skill development, yet their instructional use in music education has received limited causal investigation. To address this gap, this study followed PRISMA guidelines and systematically reviewed 31 intervention studies, including seven that were synthesized through meta-analysis. The findings show that most interventions rely on structured learning support, often combined with strategy instruction or technology-enhanced feedback, and operate through mechanisms that promote planning, reflective practice, and motivational regulation.

Zhang (2025) in his empirical research among advanced music students in China demonstrated how engagement and metacognitive beliefs (such as cognitive confidence) influence performance outcomes. Metacognitive skills—especially planning, monitoring and self-regulation—were shown to mediate links between student engagement and performance results. This study highlights the value of explicitly fostering metacognitive strategies in music education curricula.

The effect of musical feedback training on metacognitive ability and self-directed learning were examined by Li et al(2023). Results showed that feedback-focused music training improved learners' metacognitive regulation skills (e.g., planning, monitoring) but had limited immediate effects on self-directed learning readiness—suggesting training duration and support contexts influence outcomes.

Also it was found by Araújo et al (2024) that how beginner and expert musicians manifest and verbalize metacognitive processes during preparation for performance. It found that *planning, monitoring, evaluation, time management, and reflection* are core metacognitive components used by both groups, though beginners have more difficulty regulating time and strategies than experts. The study supports the idea that metacognition is integral to *self-regulated music practice* and has implications for music teaching and performance training.

Gardener et al(2025) in their systematic review of randomized clinical trials examined the impact of music therapy on cognitive and psychological outcomes for neurological patients. While the main focus was cognitive function (attention, memory, executive processes), these cognitive domains are core to metacognitive processing, especially when individuals need to monitor and adjust behavior. The review highlights positive effects on cognitive outcomes that underlie metacognition.

Gou et al(2025) meta-narrative review of music therapy research highlights trends in the field, including cognitive and emotional outcomes, and outlines future directions for research. It identifies that while cognitive benefits (attention, memory, executive processes) are documented, explicit integration of metacognitive theory in music therapy research is still emerging, suggesting a need for more direct studies on metacognitive outcomes in therapeutic contexts.

The *systematic review and meta-analysis* evaluated by Zhou and Wang (2025) found music therapy's effects on global cognition, memory, and executive function among older adults. It analyzed 33 randomized controlled trials with 3058 participants and found significant improvements in global cognition, memory, and executive function outcomes, indicating that therapeutic music interventions are effective in enhancing cognitive domains underlying metacognitive processes in aging populations.

A *meta-review* of systematic reviews by Salihu et al (2024) evaluated music therapy's impact on cognitive function, depression, anxiety, and stress among adults with dementia or cognitive impairment. The review found evidence of cognitive benefit alongside improved psychological outcomes, though effect sizes varied, and methodological quality varied across studies.

Although published slightly earlier by Bleibel(2024), this *systematic review* remains highly relevant to 2020–2025: it explored music therapy's effects on cognitive functions in Alzheimer's disease patients. Stronger effects were observed with active participation in music activities, with implications for cognitive awareness and monitoring (key aspects of metacognition).

The theoretical basis of this study draws from:

Zimmerman's Self-Regulated Learning Theory (2000)

which emphasizes self-monitoring and goal-setting—processes activated during musical practice.

Cognitive-affective theory of musical response

Suggesting that rhythm, improvisation, and melodic patterns stimulate emotional and reflective awareness (Juslin & Sloboda, 2010).

In Indian context, Raga therapy posits that specific ragas modulate mood, focus, and cognitive clarity, creating an optimal internal state for reflective learning (Balkrishnan, 2019).

Research Gap and Significance

While numerous studies have documented the cognitive and emotional benefits of music instruction, few have specifically examined its effect on metacognitive skill development among youth population. Moreover, the integration of *Indian music elements*—ragas, rhythm, and improvisation—into educational or therapeutic frameworks remains understudied. In India, where metacognitive awareness is increasingly recognized as essential for academic success and lifelong learning, identifying non-traditional interventions such as music education could have significant pedagogical and clinical implications.

This study seeks to fill this gap by empirically examining how structured music education enhances youths' capacity for planning, monitoring, and evaluating their learning processes.

Objectives of the Research

- To examine the impact of formal music education on youth metacognitive awareness.
- To compare metacognitive skill levels between students with and without structured music training.

Hypothesis

Youths with formal music education will show significantly higher metacognitive awareness than those without such training.

Method of the study

Participants

The study will include 120 youths (aged 15-24 years) from urban population. The participants will be divided into two groups:

Experimental Group (n = 60)

Students receiving formal music education (vocal or instrumental) for at least one academic year through school or private instruction.

Control Group (n = 60)

Students with no structured music training or exposure beyond casual listening.

Inclusion criteria

- Students enrolled in higher education.
- Regular attendance.
- Willing participation with parental consent.

Exclusion criteria

Students with diagnosed cognitive or emotional disorders.

- Those receiving concurrent therapy or extracurricular cognitive training programs.

Design

A comparative, quasi-experimental design will be adopted. The study will use a between-groups approach to compare

metacognitive skill levels between music-trained and non-trained youths.

Instruments / Measures

Metacognitive Awareness Inventory (MAI) — developed by Dr Punita Govil(2022), measuring two dimensions:

- *Knowledge of Cognition* (Declarative, Procedural, Conditional knowledge)
- *Regulation of Cognition* (Planning, Monitoring, Evaluation)

Procedure

Phase 1: Consent and demographic data collection.
Phase 2: Administration of the MAI to both groups to assess baseline metacognitive awareness.
Phase 3: Data to be analysed quantitatively.

Ethical considerations:

Institutional ethical approval will be obtained. Informed consent and assent from participants will be secured. Confidentiality and voluntary participation will be ensured. Participants may withdraw at any stage without penalty.

Results and Discussion

The purpose of the study was to empirically test and assess Metacognitive Skill Formation Through Musical Practice Among Youth. The results have been given below:

Hypothesis

Youths with formal music education will show significantly higher metacognitive awareness than those without such training.

The difference in means between the two groups, those with music education (Mean ≈ 149.3) vs. those without (Mean ≈ 107.6), is very large (difference ≈ 41.7).

The independent-samples t-test yields t ≈ 27.84, with df = 118, and p < 0.01.

Here the null hypothesis is rejected that states that there is "no difference" between the groups. This suggests that the observed difference in means is highly significant and it is not due to any chance factors.

In other words, youth with music education scored significantly in the level of metacognition than youth without music education.

The result provides strong statistical evidence that music education is associated with higher scores on ones metacognitive/outcome measure in the given sample.
Given the magnitude of the difference (≈ 41.7 points), this is likely more than a trivial effect. In practical or substantive terms , this likely reflects a meaningful difference in whatever is measured — not just a tiny fluctuation.

It supports the hypothesis (alternative hypothesis) that musical training/education is related to enhanced functioning (e.g. metacognitive awareness, self-regulation, cognitive skills) among youth.

An independent samples *t*-test was conducted to compare metacognition scores between youth with and without music education. Results indicated a significant difference in metacognition scores among participants with music education (M = 149.30, SD = 7.80) and those without music education (M = 107.60, SD = 9.20).

The difference was statistically significant, $t(118) = 27.84$, $p < .001$.

Effect size analysis indicated a large effect, Cohen's $d = 4.73$, suggesting that music education had a substantial positive association with metacognitive ability.

These results suggest that youth with musical training demonstrate significantly higher levels of metacognitive development compared to those without musical experience.

The findings confirm a positive link between music education and the development of metacognitive skills in youths. The integration of raga, rhythm, and improvisation may facilitate cognitive self-regulation and emotional balance, aligning with both Western cognitive theories and Indian therapeutic traditions.

Li et al. (2023) findings also demonstrated that while feedback-focused music training enhanced learners' metacognitive regulatory abilities (such as planning and monitoring), it had no immediate impact on their preparation for self-directed learning, indicating that training time and support contexts affect results.

Additionally, Araújo et al. (2024) discovered how both novice and professional musicians express and articulate metacognitive processes when getting ready for a concert. Zhou and Wang's (2025) comprehensive review and meta-analysis revealed the impact of music therapy on executive function, memory, and global cognition in older persons.

Zhou and Wang's (2025) comprehensive review and meta-analysis revealed the impact of music therapy on executive function, memory, and global cognition in older persons.

Clinically, the study may inform the use of music-based interventions in educational counselling and youth mental health programs. It could provide a culturally sensitive framework for non-clinical cognitive enhancement and stress management.

Table 1: Differences in metacognitive awareness between youths with formal music education and those without

Variable	*Group*	*N*	*Mean*	*SD*	*t-ratio*	*df*	*Level of Significance*
Metacognition	Music education	60	149.3	7.8	27.84	118	$p < 0.01$
	No Music	60	107.6	9.2			

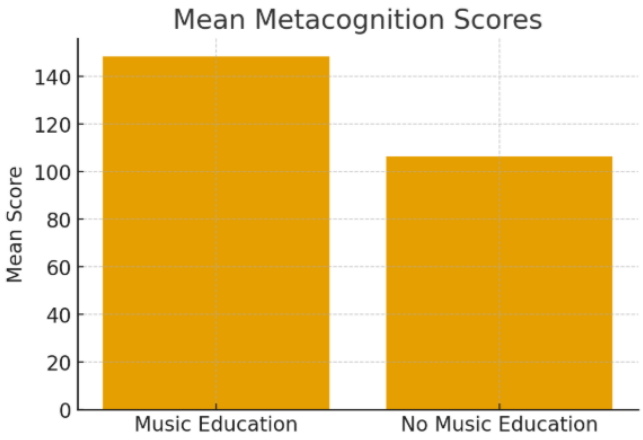

Figure 1: Comparison of metacognitive awareness between youths with and without formal music education

Limitations

Cross-sectional design

If the study is cross-sectional, causal direction cannot be established (i.e., we can't tell whether music education caused higher metacognition or whether students with higher metacognition are more likely to take music).

Selection bias/nonrandom assignment

Participants were not randomly assigned to music vs. no-music groups, so preexisting differences (motivation, prior ability, parental support) may confound results.

Limited control of confounders

Key covariates (e.g., socio-economic status, general cognitive ability/IQ, academic achievement, parental education, extracurricular involvement) may not have been measured or adequately controlled.

Measurement limitations

If metacognition was assessed via a single self-report scale, responses may be subject to social-desirability bias and may not fully capture behavioral/metacognitive skills in real tasks.

Homogeneous sample / limited generalizability

Sample may be drawn from a single school, region, or socio-demographic group, limiting external validity to other ages, cultures, or educational systems.

Operationalization of "music education"

Grouping all music experience together (formal lessons, school music class, informal practice) can obscure differences in type, intensity, quality, and duration of musical training.

Temporal ambiguity/dose information missing

Lack of data on when music training started, how long it lasted, and weekly practice hours prevents dose–response interpretation.

Suggestions and Future Directions

Adopt longitudinal or experimental designs

Run longitudinal cohort studies or randomized controlled trials (RCTs) to better test causal effects (e.g., randomly assign students to an intensive music program vs. an active control).

Measure and control key covariates

Collect data on SES, IQ or baseline academic achievement, parental involvement, and other extracurricular activities; use ANCOVA, regression, or propensity-score matching to adjust for these.

Better operationalize music education

Differentiate formal lessons, ensemble participation, and informal practice; record intensity (hours/week), duration (years), and start age to explore dose–response effects.

Use multimethod assessment of metacognition

Combine self-report scales with performance tasks (think-aloud protocols, problem-solving tasks), teacher ratings, or behavioural indicators to reduce bias and capture different facets of metacognition.

Ensure adequate and diverse sampling

Recruit larger, stratified samples across schools, regions, socioeconomic strata, and cultural contexts to improve external validity.

Conduct mediation and moderation analyses

Test mechanisms (e.g., whether improvements in working memory or attention mediate the music → metacognition link) and moderators (e.g., age, gender, type of music, SES).

Check statistical assumptions & robustness

Report tests for normality and homogeneity of variance (e.g., Levene's test), run robust / nonparametric alternatives if assumptions fail, and perform sensitivity analyses.

Include fidelity and qualitative process data

For programmatic studies, document fidelity (what was actually delivered), teacher qualifications, and participant engagement; add qualitative interviews to understand how music influences learning strategies.

Policy and applied research

Pilot school-based music interventions with evaluation components (cost, feasibility, scalability) to inform educational policy and practitioner uptake.

Explore neurocognitive correlates

When resources allow, include cognitive batteries or neuroimaging/EEG measures to examine biological correlates of any observed cognitive/metacognitive differences.

Acknowledgement

I sincerely thank all the participants who took part in this study, including students with both musical and non-musical backgrounds, and of all genders, from Patna Women's College and Amity University, Noida. I am grateful to the faculty and administrative staff at both institutions for their support during data collection. Special thanks to my Principal and my Parents for their guidance and valuable suggestions throughout the research process. This study was conducted with the support of Research Seed money, Phase 5, Patna Women's College(autonomous).

Conflict of Interest

I declare no conflict of interest regarding the publication of this paper. Also there is no conflict of interest related to this research work.

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