UDC 37.02:78 **DOI** https://doi.org/10.34142/27091805.2026.7.02.05

Davi de Oliveira Emerick
School of Music, Universidade do Estado de Minas Gerais (UEMG), Belo Horizonte, MG, Brazil;
Professional Postgraduate Programme in Musical Practices (PPGPM), Research Line: Music Education,
Belo Horizonte, Brazil
email: daviemericko@gmail.com

Даві де Олівейра Емерік
Школа музики, Університет штату Мінас-Жерайс (UEMG), Белу-Орізонті;
Професійна магістерська програма з музичних практик (PPGPM), напрям: музична освіта,
Белу-Орізонті, Бразилія
email: daviemericko@gmail.com

DIGITAL FEEDBACK AND SELF-REGULATED MUSICAL LEARNING: A STRUCTURED INTEGRATIVE REVIEW OF PIANO AND ADJACENT PRACTICE

Object. This structured integrative review examines how digitally captured information becomes feedback in piano and adjacent music practice, and how that feedback relates to self-regulated learning (SRL) — with particular attention to a distinction that is easy to blur: observable practice traces are not the same thing as stronger claims about learning.

Methods & methodology. Four OpenAlex searches through 15 August 2026 yielded 327 records and 322 unique records. All unique records received title-and-abstract screening; 33 direct-scope metadata candidates were identified, and nine reconciled evidence units met a five-condition claim-level gate covering publication identity, population and task, intervention or exposure, outcomes, and limitations stated with maximum defensible wording. The synthesis was qualitative, because designs, measures, exposures, and outcome families were too heterogeneous for a defensible pooled estimate.

Scientific novelty. M-SRL is proposed as an unvalidated seven-dimension, music-specific evidence-reporting framework. It does not claim first-in-field status for technology-supported SRL or digital feedback; its search-bounded contribution is narrower — to align capture, inference, output, timing, agency, outcome, and artistic-pedagogical authority in one reporting vocabulary.

Results. Evidence was heterogeneous. Favourable findings for self-evaluation, metacognition, motivation, usability, or immediate performance coexisted with null findings, small samples, bundled interventions, short exposures, and divergent measures. No general superiority of visual, auditory, haptic, immersive, or AI-mediated feedback could be established from the reconciled evidence. Digital traces increase observability; they do not, by themselves, establish pedagogical effectiveness.

Conclusions. M-SRL separates observable traces from stronger pedagogical and artistic claims and offers a testable reporting vocabulary for future digital music-practice research, while preserving the role of teacher, learner, and artistic judgement.

Keywords: piano practice; self-regulated learning; feedback; music technology; instrumental learning; learning analytics.

ЦИФРОВИЙ ЗВОРОТНИЙ ЗВ'ЯЗОК І САМОРЕГУЛЬОВАНЕ МУЗИЧНЕ НАВЧАННЯ: СТРУКТУРОВАНИЙ ІНТЕГРАТИВНИЙ ОГЛЯД ФОРТЕПІАННОЇ ТА СУМІЖНОЇ ПРАКТИКИ

Об'єкт. У цьому структурованому інтегративному огляді досліджено, як цифрово зафіксована інформація перетворюється на зворотний зв'язок у фортепіанній та суміжній музичній практиці і як він пов'язаний із саморегульованим навчанням (SRL), з особливою увагою до відмінності між спостережуваними слідами практики та сильнішими твердженнями про навчання.

Методи та методологія. Чотири пошуки в OpenAlex станом на 15 серпня 2026 року дали 327 записів і 322 унікальні записи. Усі унікальні записи пройшли скринінг назв і анотацій; було

визначено 33 метадані-кандидати прямої сфери, а дев'ять узгоджених одиниць доказів відповідали п'ятиумовному критерію на рівні тверджень, що охоплював ідентичність публікації, популяцію і завдання, втручання або вплив, результати та обмеження, викладені з максимально обґрунтованою силою формулювання. Синтез був якісним, оскільки дизайни, вимірювання, впливи та групи результатів були надто неоднорідними для обґрунтованої об'єднаної оцінки.

Наукова новизна. M-SRL запропоновано як неперевірену семивимірну музично-специфічну рамку для звітування про докази. Вона не претендує на статус першої моделі саморегульованого навчання, підтриманого технологіями, або цифрового зворотного зв'язку; її внесок, обмежений пошуком, полягає в поєднанні фіксації даних, інференції, формату виходу, часу подання, агентності, типу результату та художньо-педагогічної авторитетності в єдиній мові звітності.

Результати. Докази були неоднорідними: сприятливі результати щодо самооцінювання, метакогніції, мотивації, зручності використання або виконання співіснували з нульовими результатами, малими вибірками, комплексними втручаннями, короткою тривалістю та різними показниками. Загальної переваги візуального, аудіального, тактильного, імерсивного або опосередкованого ШІ зворотного зв'язку встановити не вдалося. Цифрові сліди підвищують спостережуваність практики, але самі по собі не доводять педагогічної ефективності.

Висновки. M-SRL відокремлює спостережувані сліди від сильніших педагогічних і художніх тверджень та пропонує перевірювану мову звітності для майбутніх досліджень цифрової музичної практики, зберігаючи роль викладача, учня та художнього судження.

Ключові слова: фортепіанна практика; саморегульоване навчання; зворотний зв'язок; музичні технології; інструментальне навчання; аналітика навчання.

Formulation of the problem and its relation to important scientific or practical tasks. Much of instrumental learning happens between lessons. A learner sits down alone, sets a goal, monitors the attempt, tries to interpret what just happened, and adjusts — all while trying to stay faithful to pedagogical and artistic aims nobody is there to enforce in the moment. Self-regulated learning (SRL) offers a useful lens for this, because regulation is not just about receiving information. It depends on deciding what that information means and how it should change the next attempt (Butler & Winne, 1995; McPherson & Zimmerman, 2011; Panadero, 2017).

Digital systems have expanded what can be inspected during practice considerably. Audio playback supports later self-listening. MIDI, video, motion, and interaction logs can make aspects of performance observable. Visualisations and intelligent systems go a step further, turning those observations into comparisons or recommendations. But observability is not the same as pedagogical validity — that gap is the crux of this review. Trace data are theory-laden, and a stronger interpretation requires evidence that the measured trace actually represents the intended construct, and that its use supports appropriate consequences (Winne, 2020). This distinction is especially important in music, since timing, sound quality, phrasing, interpretation, bodily coordination, and artistic judgement resist reduction to a single technical indicator.

So the practical problem is not whether digital feedback exists. It clearly does. The problem is how captured information becomes feedback, when it reaches the learner, who controls the next action, what outcome is actually being measured, and whether technical inference is quietly allowed to displace pedagogical or artistic authority. This review addresses that problem by separating observable digital traces from claims about learning, and by proposing a reporting framework that keeps those distinctions explicit rather than letting them blur.

Analysis of basic research and publications. Research on feedback and SRL provides a broad conceptual foundation. Butler and Winne (1995) describe feedback as embedded in regulatory cycles rather than as an isolated stimulus. Panadero (2017) compares major SRL models. McPherson and Zimmerman (2011) adapt social-cognitive regulation specifically to musical learning. Music-specific work builds on this: reflective practice and self-observation have been linked to changes in practice behaviour and self-evaluation (Pike, 2017; Boucher et

al., 2021), and digital listening tools and technology-supported instrumental practice have been framed as possible supports for self-regulation (Wan et al., 2022, 2023).

The digital literature remains heterogeneous, reflecting how differently each study approaches the problem. Visual feedback has been studied in higher-education piano learning and performance (Hamond et al., 2019, 2020). Audio feedback has been tested with advanced piano students (Nusseck et al., 2025). Computer-assisted instruction has been compared with conventional piano teaching (Kaleli, 2020). Other work examines robotic self-assessment (Song et al., 2024), AI-assisted feedback in vocal training (Li et al., 2025), mixed-reality strategies for piano education (Amm et al., 2024), augmented and virtual reality tutoring (Wilson & Pfeiffer, 2023), and visual-information systems across music education technologies more broadly (Behzadaval et al., 2026). Recent reviews describe online piano education as methodologically diverse (Turan, 2026) and identify pedagogical approaches intended to promote self-regulation in instrumental learning (Utermohl de Queiroz et al., 2025).

Two problems recur across this body of work, and neither has a tidy fix. First, studies routinely bundle several components together — technology, teacher guidance, tasks, reflection prompts, interface features, exposure duration — so a favourable outcome cannot automatically be credited to the feedback modality alone. Second, studies measure genuinely different things under the same label: immediate performance, self-evaluation, motivation, metacognition, usability, practice behaviour, retention, artistic or pedagogical judgement. Call all of that "digital feedback" and the label starts hiding exactly the distinctions that matter for interpretation.

Prior work also constrains how any claim to novelty can honestly be framed here. Wan et al. (2022) already connected digital technology with self-regulation in instrumental practice through a teaching-and-learning framework and literature synthesis. Wan et al. (2023) showed that digital listening tools can support specific self-regulatory processes, though that support stayed dependent on learner preferences and sustained teacher facilitation. Utermohl de Queiroz et al. (2025) mapped pedagogical approaches intended to promote self-regulation across instrumental learning more broadly. Close instrument-learning work predates this synthesis too. López-Calatayud and Tejada (2024) examined self-regulatory processes during four weeks of Plectrus-supported beginner violin and viola practice, and a companion multiple-case report from the same research family examined self-efficacy during Plectrus use (López-Calatayud & Tejada, 2023). Both reinforce a point this review takes seriously: software-generated performance information and stronger claims about regulation or learning are not the same thing, and conflating them is easy to do without noticing. M-SRL therefore makes no claim to originate technology-supported SRL, digital feedback, or a general SRL framework. Its purpose is narrower and more mechanical — evidence reporting. It separates what a system captures, infers, outputs, and times from who controls the next action, which outcome is actually measured, and where artistic-pedagogical authority still lives.

Formulation of the goals and objectives of the article. The aim is to examine how digitally captured information becomes feedback in piano and adjacent music practice, and how that process relates to SRL. Four objectives follow from that aim: (1) map the direct literature identified through a reproducible bibliographic search; (2) reconcile a smaller claim-level evidence set under explicit inclusion and interpretation rules; (3) distinguish favourable, null, mixed, and method-limited findings without pooling incompatible outcomes; and (4) propose a music-specific reporting framework that aligns capture, inference, output, timing, agency, outcome, and artistic-pedagogical authority.

Presentation of the basic material and its results. *Method.* This is a structured integrative review, not a systematic review or a meta-analysis. That choice was deliberate: the relevant literature spans experimental, quasi-experimental, observational, design-oriented, review, and conceptual work, and an integrative design is built to handle exactly that spread (Whittemore & Knafl, 2005). OpenAlex served as the primary discovery index (Priem et al., 2022). Four English title-and-abstract search concepts ran through 15 August 2026, with no lower publication-date limit, returning 327 raw records and 322 unique records after deduplication.

Every unique record received a documented title-and-abstract screening decision. To count as a direct-scope metadata candidate, a record needed a final scholarly publication, instrumental or closely adjacent music practice or learning, a digital feed-

back, representation, or self-regulation component, and clear relevance to the review question. The final audit contained 33 direct-scope metadata candidates — 19 outcome-signal and 14 technology/design — alongside 22 context-only records, 254 scope exclusions, 11 document or non-final exclusions, and two research-family duplicates. Access or reporting quality did not decide eligibility on its own; it limited how strongly a source could be used once included.

Detailed synthesis applied a five-condition claim-level gate: publication identity and purpose; population and musical task; intervention or exposure and comparator where applicable; outcomes, including favourable, null, or contradictory findings; and limitations, stated with maximum defensible wording. Nine reconciled evidence units cleared this gate. Critical appraisal was matched to each source's evidence role rather than collapsed into a single score, and the synthesis stayed qualitative — designs, measures, exposures, and outcomes were too heterogeneous for a defensible pooled effect estimate.

Coverage mapping and claim-level synthesis are kept deliberately separate here. The 33 direct-scope records describe the breadth of relevant work; only the nine reconciled evidence units support the detailed outcome claims made in this article. Screening and appraisal were conducted by a single reviewer with AI-assisted organisation under the stated criteria. OpenAlex was the sole primary discovery index, and title-and-abstract searching may have under-retrieved work that was labelled differently or simply not indexed. These are real limits on recall and reproducibility compared with a multi-database review using independent duplicate screening — and they are the reason this study is described as a structured integrative review rather than a systematic one.

Results. The direct evidence does not support a general claim that digital feedback improves instrumental learning — and it is worth being precise about why. Nusseck et al. (2025) found changes in some self-ratings after audio-feedback conditions, but did not establish a general expert or MIDI-performance gain. Song et al. (2024) reported favourable immediate motivation and performance signals in a robot-supported self-assessment condition; the condition was bundled, though, and the report carries limitations that constrain how far causal interpretation can go. Li et al. (2025) reported favourable metacognitive outcomes in a six-week AI-assisted vocal-training bundle, but attrition, bundled components, and sparse statistical reporting limit how much of that can be attributed to AI feedback specifically.

Piano-specific comparisons were similarly mixed, not uniformly disappointing but not clean either. Kaleli (2020) reported some favourable achievement and retention findings in a small non-random comparison, yet the total post-test piano-skill result was not uniformly favourable, and the report contains an internal statistical-test inconsistency. Osaki et al. (2026), in an exploratory six-participant piano pilot, found individual patterns but no consistent subjective superiority of one visualisation protocol over another. Studies of visual feedback in higher-education piano learning (Hamond et al., 2019, 2020) show pedagogically meaningful uses of digital representation — meaningful, but not evidence of universal superiority for visual feedback. Mixed-reality and augmented/virtual-reality work mostly informs feasibility, interaction, and design mechanisms rather than general learning effects (Amm et al., 2024; Wilson & Pfeiffer, 2023).

Adjacent studies push in the same direction: separate the outcome families, don't extend effects to piano that were never measured on piano. Reflective and self-observation work can support metacognitive or self-evaluative processes (Pike, 2017; Boucher et al., 2021), but those changes are not the same thing as durable performance improvement. Broader music-SRL research points to learner agency, practice strategy, and interpretive autonomy as relevant to regulation (dos Santos Silva et al., 2024; Fujimoto, 2026; López-Íñiguez & McPherson, 2024). Put together, the most defensible synthesis is conditional rather than sweeping: digital systems can change what learners and teachers can observe, compare, or revisit, but the educational effect depends on how those traces get interpreted and folded into regulation — not on the technology alone.

A post-audit sensitivity check on 18 August 2026 turned up additional close evidence that reinforces this conditional reading. López-Calatayud and Tejada (2024) followed four beginning violin and viola learners, aged 10–11, through four weeks of practice with Plectrus, a real-time intonation training and assessment system. The participants showed diverse self-regulatory strategies and behaviours, but the authors could not establish a relationship between software scores and self-regulation. A companion report from the same Plectrus research family de-

scribed positive self-efficacy beliefs, noting that positive perceptions coincided with good software marks (López-Calatayud & Tejada, 2023); because it concerns the same small learner context, it is not treated here as an independent causal replication. Ou et al. (2025) reported favourable results in a four-month quasi-experimental study of 40 violin majors using an AI-assisted practice application, including differences in performance and self-efficacy and qualitative evidence of support across SRL phases. These records surfaced after the bounded OpenAlex screening audit, so they are reported here as sensitivity evidence rather than folded retrospectively into the 327/322/33/9 audit counts. Taken together, they keep the evidence base from being called uniformly weak or null — but they still fall short of establishing general superiority across instruments, feedback modalities, learner populations, or systems.

M-SRL framework. To make these conditions reportable, seven theory-informed dimensions were specified a priori and refined only in wording and boundaries during synthesis. M-SRL is proposed as an unvalidated evidence and reporting framework — not a validated scale, not an intervention, not a causal model, not a replacement for established SRL theories, and not a claim of first-in-field novelty. Its contribution is to place seven distinctions in one music-specific reporting vocabulary, so a study can state plainly what the system observes, what it infers, how it communicates, when it communicates, who controls action, what outcome is actually tested, and where artistic-pedagogical judgement remains located. The dimensions work as reporting lenses, not independent latent constructs, and they are not meant to be summed into a score.

Table 1. M-SRL seven-dimension evidence and reporting framework

Dimension	Examples	Reporting question	Evidence boundary
Capture / data	MIDI; audio; score; video/motion; interaction logs	What information enters the system?	Descriptive trace; does not by itself establish pedagogical validity.
Inference	Observed event; computed comparison; model output; pedagogical interpretation	What transformation or claim is made?	Construct and consequential validity must be established for stronger claims.
Output	Visual; auditory; text; haptic; mixed	What reaches the learner or teacher?	No universal optimum is established by the reconciled evidence.
Timing	Concurrent; post-attempt; delayed / session-level	When is feedback delivered?	A testable design variable; no universal timing advantage is established.
Agency	Learner; teacher; shared; system-directed	Who chooses, interprets, or acts?	Agency is part of regulation and should not be hidden by interface labels.
Outcome	Performance; self-evaluation; motivation; metacognition; practice behaviour; usability	What is actually measured?	Outcome families are not interchangeable and should not be pooled rhetorically.
Artistic-pedagogical authority	Learner; teacher; score / rule; model; hybrid	Who or what defines quality?	Technical precision is not equivalent to artistic or pedagogical truth.

Note. M-SRL is proposed as an unvalidated reporting framework, not as a validated scale, causal model, or intervention.

Conclusions. Digital systems can make music practice more observable. That is not the same as making learning more effective, and the nine reconciled evidence units show why: favourable results for self-evaluation, metacognition, motivation, usability, or immediate performance sit alongside null findings, small samples, bundled interventions, short exposures, divergent measures, and real reporting limitations. Nothing in that evidence justifies ranking visual, auditory, haptic, immersive, or AI-mediated feedback against each other in general terms.

M-SRL responds to this specific evidence problem — not by proposing a new theory of SRL, and not by claiming digital feedback works in general, but by aligning seven reporting dimensions: capture, inference, output, timing, agency, outcome, and artistic-pedagogical authority. What the framework actually does is separate a digital trace from the interpretation built on top of it, and separate both of those from whatever learning outcome ends up being claimed. That separation matters because it guards against a specific mistake: treating technically pre-

cise data as if it were automatically equivalent to pedagogically or artistically valid judgement. It is not. The framework remains unvalidated and should be tested prospectively rather than treated as an established measurement instrument.

Prospects for further research and recommendations. Future studies would do well to manipulate one evidence layer at a time where possible, report comparator conditions and exposure duration clearly, and keep the measured outcome separate from whatever the intervention is called. Three comparisons stand out as priorities: concurrent versus post-attempt feedback, trace-only versus interpreted feedback, and learner-controlled versus system-directed feedback. Studies should also say plainly whether technical inferences are advisory or authoritative, and should keep teacher, learner, and artistic judgement as explicit components of the design rather than assumed background.

For research reporting, M-SRL is intended as a checklist rather than a scoring system. Replication across instruments, learner levels, repertoires, and cultural settings is still needed before anyone can make stronger claims about generality, moderation, or causal mechanisms.

Фінансування / Funding
Дослідження здійснено без залучення зовнішнього фінансування.

Використання Штучного Інтелекту / Use of Artificial Intelligence
Автор запевняє, що технології штучного інтелекту при підготовці цієї статті не застосовувалися.

Конфлікт інтересів / Conflict of Interest
Автор підтверджує відсутність будь-якого конфлікту інтересів — фінансового, особистого, авторського чи іншого, — який міг би позначитися на проведенні дослідження або на викладених у статті результатах.

Надійшла до редакції / Received: 03.08.2026
Прорецензовано / Peer-reviewed: 25.08.2026
Рекомендовано до публікації / Accepted for publication: 31.08.2026

REFERENCES

Amm, V., Chandran, K., Engeln, L., & McGinity, M. (2024). Mixed reality strategies for piano education. *Frontiers in Virtual Reality*, 5, 1397154. **https://doi.org/10.3389/frvir.2024.1397154** [in English]

Behzadaval, B., Serra Marin, L., & Nijs, L. (2026). Application of visual information in music education digital technologies: A scoping review. *Education Sciences*, 16(2), 309. **https://doi.org/10.3390/educsci16020309** [in English]

Boucher, M., Creech, A., & Dubé, F. (2021). Video feedback and the self-evaluation of college-level guitarists during individual practice. *Psychology of Music*, 49(2), 159–176. **https://doi.org/10.1177/0305735619842374** [in English]

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245–281. **https://doi.org/10.3102/00346543065003245** [in English]

dos Santos Silva, C., Araújo, M. V., & Marinho, H. (2024). Attitudes in music practice: A survey exploring the self-regulated learning processes of advanced Brazilian and Portuguese musicians. *Frontiers in Psychology*, 15, 1324100. **https://doi.org/10.3389/fpsyg.2024.1324100** [in English]

Fujimoto, M. (2026). Interpretive autonomy predicts self-regulated learning behaviors in lessons, practice, and performance among classical musicians. *Frontiers in Psychology*, 17, 1859878. **https://doi.org/10.3389/fpsyg.2026.1859878** [in English]

Hamond, L., Himonides, E., & Welch, G. (2020). The nature of feedback in higher education studio-based piano learning and teaching with the use of digital technology. *Journal of Music, Technology & Education*, 13, 33–56. **https://doi.org/10.1386/jmte_00015_1** [in English]

Hamond, L. F., Welch, G., & Himonides, E. (2019). The pedagogical use of visual feedback for enhancing dynamics in higher education piano learning and performance. *OPUS*, 25(3), 581–601. **https://doi.org/10.20504/opus2019c2526** [in English]

Kaleli, Y. S. (2020). The effect of computer-assisted instruction on piano education: An experimental study with pre-service music teachers. *International Journal of Technology in Education and Science*, 4(3), 235–246. **https://doi.org/10.46328/ijtes.v4i3.115** [in English]

Li, W., Cui, X., Manoharan, P., Dai, L., Liu, K., & Huang, L. (2025). AI-assisted feedback and reflection in vocal music training: Effects on metacognition and singing performance. *Frontiers in Psychology*, 16, 1598867. **https://doi.org/10.3389/fpsyg.2025.1598867** [in English]

López-Calatayud, F., & Tejada, J. (2023). Self-efficacy in instrumental practice with intonation assessment software: A multiple case study with novice violin and viola students. *Journal of Music, Technology & Education*, 16(1–2), 57–76. **https://doi.org/10.1386/jmte_00060_1** [in English]

López-Calatayud, F., & Tejada, J. (2024). Self-regulation strategies and behaviors in the initial learning of the viola and violin with the support of software for real-time instrumental intonation assessment. *Research Studies in Music Education*, 46(1), 48–65. **https://doi.org/10.1177/1321103X221128733** [in English]

López-Íñiguez, G., & McPherson, G. E. (2024). Using a music microanalysis protocol to enhance instrumental practice. *Frontiers in Psychology*, 15, 1368074. **https://doi.org/10.3389/fpsyg.2024.1368074** [in English]

McPherson, G. E., & Zimmerman, B. J. (2011). Self-regulation of musical learning: A social cognitive perspective on developing performance skills. In R. Colwell & P. Webster (Eds.), *MENC handbook of research on music learning: Vol. 2. Applications* (pp. 130–175). Oxford University Press. **https://doi.org/10.1093/acprof:osobl/9780199754397.003.0004** [in English]

Nusseck, M., Wild, F., Sischka, C., & Spahn, C. (2025). Effects of audio feedback interventions with the Disklavier on the performance of piano students. *Frontiers in Psychology*, 16, 1568021. **https://doi.org/10.3389/fpsyg.2025.1568021** [in English]

Osaki, I., Fujioka, T., Schumann, E., & Maezawa, A. (2026). Piano practice support system with visual feedback and evaluation protocols for learning experience based on subjective and objective metrics. In *Proceedings of the 18th International Conference on Computer Supported Education (CSEDU 2026)* (Vol. 1, pp. 535–544). **https://doi.org/10.5220/0015064300004021** [in English]

Ou, J., Nogueira, J., & Qin, C. (2025). Exploring the impact of AI-assisted practice applications on music learners' performance, self-efficacy, and self-regulated learning. *Frontiers in Psychology*, 16, 1675762. **https://doi.org/10.3389/fpsyg.2025.1675762** [in English]

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, 8, 422. **https://doi.org/10.3389/fpsyg.2017.00422** [in English]

Pike, P. D. (2017). Exploring self-regulation through a reflective practicum: A case study of improvement through mindful piano practice. *Music Education Research*, 19(4), 398–409. **https://doi.org/10.1080/14613808.2017.1356813** [in English]

Priem, J., Piwowar, H., & Orr, R. (2022). OpenAlex: A fully-open index of scholarly works, authors, venues, institutions, and concepts. *arXiv*. **https://doi.org/10.48550/arXiv.2205.01833** [in English]

Song, H., Tsiakas, K., Ham, J., Markopoulos, P., & Barakova, E. I. (2024). 'How would you score yourself?': The effect of self-assessment strategy through robots on children's motivation and performance in piano practice. *International Journal of Social Robotics*, 16, 327–340. **https://doi.org/10.1007/s12369-023-01080-3** [in English]

Turan, H. S. (2026). A thematic review of online piano education research (2019–2024). *Music Education Research*. Advance online publication. **https://doi.org/10.1080/14613808.2026.2655762** [in English]

Utermohl de Queiroz, D., Foletto, C., & López-Íñiguez, G. (2025). Pedagogical approaches to promote self-regulation in musical instrument learning: A PRISMA scoping review. *Psychology of Music*. Advance online publication. **https://doi.org/10.1177/03057356251348414** [in English]

Wan, L., Crawford, R., & Jenkins, L. (2022). Facilitating self-regulation of instrumental practice with digital technology: A framework, a synthesis of literature and a call for research. *Australian Journal of Music Education*, 54(2), 83–98. [in English]

Wan, L., Crawford, R., & Jenkins, L. (2023). Digital listening tools to facilitate children's self-regulation of instrumental music practice. *Journal of Research in Music Education*, 71(1), 67–90. **https://doi.org/10.1177/00224294221093521** [in English]

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, 52(5), 546–553. **https://doi.org/10.1111/j.1365-2648.2005.03621.x** [in English]

Wilson, K., & Pfeiffer, P. E. (2023). Feedback in augmented and virtual reality piano tutoring systems: A mini review. *Frontiers in Virtual Reality*, 4, 1207397. **https://doi.org/10.3389/frvir.2023.1207397** [in English]

Winne, P. H. (2020). Construct and consequential validity for learning analytics based on trace data. *Computers in Human Behavior*, 112, 106457. **https://doi.org/10.1016/j.chb.2020.106457** [in English]