Opportunities to Support Musicians' Score-based Practice with Context-Specific Annotations on Tablet

Xintian Fu
xintian.fu@universite-paris-saclay.fr
Université Paris-Saclay, CNRS, Inria
Orsay, France

Vincent Cavez
vcavez@stanford.edu
Stanford University
USA

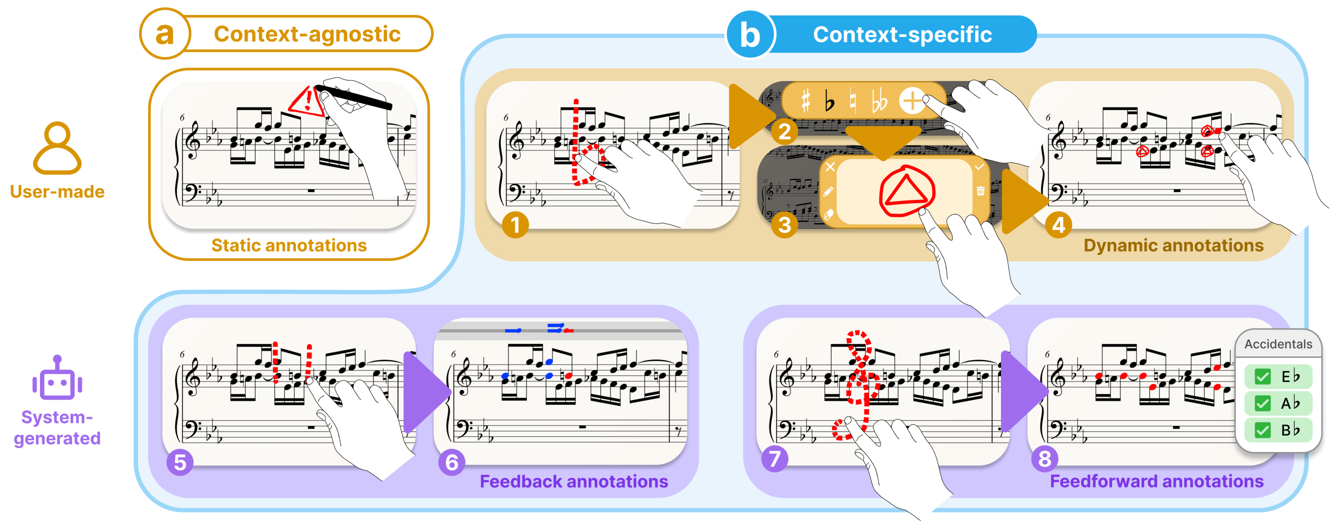

Figure 1: Overview of the proposed integration of context-agnostic and context-specific annotations. (a) The user draws a warning sign above a staff to draw attention to a delicate passage. (b-1) The user makes an accidental-sign finger gesture (b-2) to open a panel of symbols to choose from, (b-3) click on "+" to create a personalized symbol, (b-4) and then apply it to numerous noteheads. (b-5) The user makes two vertical lines with the finger (b-6) to trigger a visualization that gives feedback on rhythm. (b-7) The user makes a treble clef gesture (b-8) to automatically display all accidentals that match the key signature.

Abstract

Musicians frequently annotate scores to draw attention to specific issues and interpretative choices as they learn and perform. Current tablet score readers merely replicate paper-based workflows, supporting only static annotations that cannot offer more information than users explicitly encode in them. We see significant opportunities to complement these annotations with features tailored to musicians' evolving needs. We observed 17 musicians learning new pieces and conducted 10 interviews to better understand their practice habits and challenges. Building on their insights, we propose different kinds of context-specific annotations: system-generated feedback annotations that respond to performance like a teacher would, system-generated feedforward annotations that anticipate known difficulties, and user-made dynamic annotations that can be parameterized and systematically managed. We illustrate these through the design of five features implemented in Tactus, a tablet-based research probe, and report encouraging preliminary evaluation results. We discuss implications and next steps.

ACM Reference Format:

Xintian Fu and Vincent Cavez. 2018. Opportunities to Support Musicians' Score-based Practice with Context-Specific Annotations on Tablet. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX).* ACM, New York, NY, USA, 7 pages. https://doi.org/XXXXXXX.XXXXXXX

1 Introduction

When learning a new piece, musicians alternate between playing and annotating their score. These annotations usually serve to draw attention to specific issues and interpretative choices [10, 16]. They are essential, as they encode information important to the musician but absent from the score.

Annotations made on tablet score readers such as forScore [12], digitalScore [22], or Piascore [21] are identical to those made on paper, whereas they could benefit from tablet affordances to be more dynamic and information-rich. Currently, these annotations

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.
Conference acronym 'XX, Woodstock, NY
© 2018 Copyright held by the owner/author(s). Publication rights licensed to ACM.
ACM ISBN 978-1-4503-XXXX-X/2018/06
https://doi.org/XXXXXXX.XXXXXXX

are **context-agnostic**: they do not have any knowledge of their own environment and cannot offer more information than the user explicitly encodes in them (e.g., drawing a warning sign above a staff to emphasize a difficult passage (Figure 1a)). Recent research has demonstrated that digital scores can provide rich, interactive workflows, either through actionable annotations and flexible score structure [2, 3] or real-time visual feedback for practice, such as timing guidance for beginners [1], dynamics visualization [20] or error tracking [14].

We see significant opportunities to build on this work by investigating how such features could be designed and integrated into musicians' varied and well-established practice workflows.

We conducted a formative study with 17 musicians who provided us with video-recordings of practice sessions during which they discovered a music piece of their choice. We then conducted in-depth interviews with 10 of them to understand how they use annotations to master pieces conceptually and technically, and what challenges they face in their current practice workflows. This shed light on the distinct performance-oriented and practice-oriented strategies they adopt, revealing a reliance on external tools that well-designed digital annotations could replace, and on embodied practice they could support.

Building on this, we devised a way to empower musicians with alternatives to their traditional annotations that we term **context-specific** annotations: annotations that are semantically linked to the score content, enabling them to exhibit unique behaviors related to the practice context and to be easily discarded once they have served their purpose. Context-specific annotations can be automatically generated by the system to provide feedback like a teacher or an external tool would (Figure 1b, bottom-left), or feedforward like a musician aware of their own weaknesses would (Figure 1b, bottom-right). Context-specific annotations can also be user-made to offer more dynamic control (e.g., enabling users to parameterize and systematically manage them) (Figure 1b, top). We designed five features derived from our participants' practices, iterating between Figma mock-ups and implementation in Tactus, a tablet-based research probe [15]. We then evaluated these features with the 17 initial participants through a web-based questionnaire combining videos of Tactus in action with Likert scales. Early feedback suggested that participants saw value in the approach.

Our contributions are the following:

- an empirical observation of musicians' learning process,
- the design and preliminary evaluation of features intended to support this process

2 Related Work

Research on musical practice reveals that musicians' needs are highly varied and often punctual, arising at specific moments in response to particular challenges [13, 19]. Longitudinal case studies have documented these needs in detail by tracking how musicians prepare pieces for performance over extended periods [6, 7, 18]. Grounded in expert memory theory [11], this research introduced the concept of *performance cues*: mental landmarks that musicians focus on during practice and use as retrieval anchors in performance [4, 9]. These cues serve different functional roles but also differ in temporal relevance. For instance, basic cues such as fingerings demand explicit attention early in learning, then fade as motor execution becomes automatic, while structural and expressive cues persist as long-term retrieval anchors [5, 8]. Yet, how digital score applications might leverage this variability to provide more targeted support remains underexplored.

3 Methodology

We recruited 17 musicians by word-of-mouth, playing strings, winds, or keyboard, with 5 to 20 years of study and varied preferences for paper or tablet scores. Participants first submitted videos of themselves practicing a new piece, which we analyzed to compile a table of frequent annotations. This table later informed the design of gestures to trigger features (see Appendix for detailed backgrounds and annotation table). From the 17 participants, 10 were available for follow-up interviews (1–2 hours, face-to-face or remote). Using the videos as prompts, we asked participants to explain the rationale behind specific annotations and to iterate on the annotation table by circling frequently used symbols and correcting or adding others. We selected five use-cases from their comments and iterated on feature design between Figma mock-ups and implementation in a web-based research probe. Finally, we conducted a preliminary evaluation with the 17 initial participants through a questionnaire combining videos of the probe in action with Likert scales.

4 Interview Findings

Two trends emerged from participants' comments: performance-oriented and practice-oriented strategies.

4.1 Performance-oriented Strategies

Participants unanimously cited dynamics such as crescendo signs as essential annotations when learning new pieces. String players particularly emphasized bowings, while wind players highlighted breathing points. These annotations serve as persistent reminders intended to remain relevant through performance. A flutist explained that she drew vertical lines at breathing points to ensure phrase endings matched her breathing rhythm (P_7), while others added brackets or textual prompts in Romantic passages to remind themselves of stylistic choices such as playing more aggressively or softer (P_4).

Half of the participants added warning signs to flag tonality issues or complex rhythms, while annotations such as ornamentation, chord structure, note insertions, and deletions served to personalize the score.

Color was often used to strengthen visual memory. Some participants highlighted dynamics (P_1, P_3, P_5, P_9), using red for *forte* and blue or green for *piano*, while others highlighted accidentals (P_2,P_3,P_5,P_{10}).

Several participants also wrote emotional prompts on their scores: motivational phrases (P_4), or images such as smiley faces and hearts to remind themselves to relax (P_7). Others transcribed their teacher's guidance directly, such as "emphasize here, play lighter there" (P_8). A few, however, insisted on making no additional markings, claiming that mental retention was sufficient (P_2, P_5).

4.2 Practice-oriented Strategies

Beyond performance reminders, participants described annotations serving temporary, practice-specific purposes. A clarinetist marked triangles in triple-meter passages to visualize rhythmic structure (P_2). Others used arrows, dashed lines, or stars to flag passages requiring additional work (P_2). Almost all participants added accidentals while deciphering passages, with some doing so preemptively in anticipation of known difficulties (P_4,P_7,P_{10}). Many strategies centered on external tools rather than on annotations themselves. When discussing challenges encountered during practice, participants most frequently cited difficulties with pitch, rhythm, and tempo control. On pitch, coping strategies included sliding fingers repeatedly along the fingerboard to strengthen relative pitch memory (P_1, P_3), checking notes against a tuner or piano (P_2, P_7), or singing along with accompaniment to train the ear (P_4, P_9, P_{10}). On rhythm, nearly all participants relied on the metronome for slow practice. A clarinetist explained, *"The rhythm is too messy; only the metronome keeps it steady"* (P_2). Some used body movements such as foot-tapping or singing rhythms aloud (P_3, P_6, P_8, P_9), while others drew shapes directly on the score to visualize rhythmic groupings. On tempo control, most participants admitted to unconsciously speeding up. A pianist noted, *"At fast tempos with large leaps, I easily hit wrong notes"* (P_5). Solutions included metronome use, self-monitoring through recordings, and written reminders such as *"don't rush"* in red pen (P_5).

For managing annotation clutter, strategies diverged. Half of the participants erased markings once they had internalized the relevant information (P_1, P_2, P_3, P_7, P_8), while others retained everything as a record of their learning process (P_4, P_{10}). A few maintained a clean backup copy (P_9). When modifying annotations, most used erasers, though some preferred overwriting in another color to preserve traces of their learning trajectory. P_2 used color to track learning progress: *"red means not memorized, yellow means needs more practice, green means mastered"*.

Overall, participants' coping strategies followed two tendencies: relying on external tools (metronomes, recordings, accompaniment, textual and color markings) and relying on embodied training (slow practice, muscle memory, singing, segmented practice).

5 Context-specific Annotations

The interview findings indicate that while context-agnostic annotations are well suited for leaving personalized, persistent visual reminders such as dynamics and ornaments, they are less adapted for practice-oriented strategies. Participants rely heavily on external tools and embodied training, revealing a need for specialized **feedback**; they add ranges of semantically-related information to the score as **feedforward**; and they often erase annotations manually once they have served their purpose, suggesting a need for **dynamic** manipulation. We propose to respond to these needs by transforming the score from a passive record into an interactive medium. Our approach integrates context-specific annotations directly into tablet-based digital scores, providing information just long enough to master passages. To accommodate varied workflows, musicians would leave context-agnostic annotations with the pen and access context-specific features through touch gestures on the score. This reduces attention switching between tools and avoids cluttering the score with drop-down menus. Rather than introducing a new vocabulary of gestures, we tap into musicians' existing repertoire of frequently used annotations collected during the interviews. For each feature, we selected from the annotation table one or more semantically related symbols that musicians draw anywhere on the score with their finger. The gesture disappears once completed, leaving only the system's response. Precision is not required, as users can refine their scope of interest with a simple drag. We present in this section the features we designed. Each description concludes with Likert scale scores (μ, σ) ranging from 1 to 7 collected from the 17 participants during the preliminary evaluation, assessing perceived usefulness, intuitiveness, ease of use, and memorability.

5.1 System-generated Feedback Annotations

Pitch Practice Mode. This feature addresses the intonation challenge reported by participants. The Pitch Practice Mode would act as a teacher by providing layered visual feedback directly on the score through system-generated annotations. Users would activate this mode by drawing a circle gesture (quasi-unanimously associated with tonality issues), then set practice parameters including pitch unit and bar range (section or full piece). For section practice, a diagonal gesture would indicate the target measures. The tool would record the user's sound and, upon completion, generate coarse pitch visualization: noteheads would change color according to deviation direction (purple for sharp, yellow for flat). Between each system, the score would make space for a gray rectangle and a central line representing the correct pitch. Large errors (greater than a semitone) would position the notehead above or below this line, connected by a vertical line proportional to the deviation. Small errors (less than a semitone) would keep the notehead on the line but vary its transparency to indicate magnitude. By drawing a circle on the gray rectangle, users would access fine-grained analysis. For large deviations, an animated loop would show the notehead sliding from correct to incorrect pitch. For small deviations, a scale covering ±100 cents would display the exact deviation in cents. The system would also preserve results across sessions, allowing learners to track improvement over time.
Scores: Usefulness (μ=5.6, σ=1.0), Intuitiveness (μ=4.2, σ=2.0), Ease of use (μ=6.5, σ=0.3), Memorability (μ=5.4, σ=1.2).

Rhythm Practice Mode. This feature addresses rhythm control, another challenge frequently emphasized by participants. The Rhythm Practice Mode would provide layered visual feedback through system-generated annotations that would help learners understand their timing errors. Users would activate this mode by drawing two vertical lines (in reference to the beat marks they usually add to delicate passages) (Figure 1b-5), then could set practice parameters including meter, tempo, and practice range. The system would generate a built-in metronome, and users would tap on the screen or play along. Upon completion, the system would generate coarse rhythm visualization: noteheads would change color depending on error direction (red for early, blue for late) (Figure 1b-6). Above each deviating note, a horizontal line ending with a small notehead would mark the user's actual timing, showing at a glance which notes were rushed or delayed. By drawing two vertical lines on the gray rectangle, users would access fine-grained analysis. In this

mode, a diagonal line would connect the correct beat (top) to the user's actual timing (bottom). Clicking this line would trigger a looping animation: the diagonal would tilt from vertical while the notehead would shift horizontally from its standard position to its performed timing. This dynamic feedback would strengthen the learner's intuitive sense of both direction and magnitude of timing errors.
Scores: Usefulness (μ=5.8, σ=0.9), Intuitiveness (μ=5.3, σ=1.4), Ease of use (μ=6.3, σ=0.8), Memorability (μ=5.6, σ=1.2).

Performance Practice Mode. This feature addresses the reality that pitch and rhythm challenges rarely occur in isolation. The Performance Practice Mode would provide integrated feedback on both dimensions within a single performance. Users would activate this mode by combining the two previous gestures (a circle and two vertical lines), then configure parameters including pitch range, meter, tempo, and practice scope. Upon completion, the system would generate an integrated visualization: notes with both pitch and rhythm errors would appear as triangles, where height encodes pitch deviation and base width encodes rhythm deviation. Notehead color would indicate pitch direction (yellow for flat, purple for sharp), while fill color would indicate timing direction (red for early, blue for late). This composite representation would allow learners to immediately recognize multi-dimensional errors such as "sharp and early" within a single symbol. Fine-grained analysis would remain available through the same gestures as the individual modes.
Scores: Usefulness (μ=5.8, σ=0.7), Intuitiveness (μ=5.3, σ=1.1), Ease of use (μ=5.9, σ=1.0), Memorability (μ=5.4, σ=1.0).

5.2 System-generated Feedforward Annotations

Revealing Accidentals. In the interviews, several participants emphasized the issue of missed accidentals. Since accidentals related to the key signature do not reappear within each measure, musicians often preemptively annotate each note that needs to be raised or lowered. This proposed feature would allow musicians to instantaneously reveal information that is otherwise implicit in the score, and to hide it again just as easily when it would cause visual clutter. Users would activate the mode by drawing a treble clef gesture (only associated with key signature issues) (Figure 1b-7). The system would then automatically highlight in red all noteheads that match the accidentals of the key signature, and generate a small widget in the top-right corner of the interface (for example, in E-flat major it would display E♭, A♭, and B♭) (Figure 1b-8). Users could selectively toggle which accidental categories to display through checkboxes. This approach would reduce the risk of overlooking accidentals during sight-reading without permanently adding markings that would need to be erased once the information has been internalized.
Scores: Usefulness (μ=5.1, σ=1.3), Intuitiveness (μ=3.8, σ=1.6), Ease of use (μ=6.0, σ=0.8), Memorability (μ=5.1, σ=1.5).

5.3 User-made Dynamic Annotations

Adding Symbols. This feature would allow musicians to add regular or personalized symbols to the score more efficiently than manual drawing and erasing. Any accidental-sign gesture (sharp, flat, natural) (Figure 1b-1) would bring up a symbol panel containing common accidentals (Figure 1b-2). For symbols not included in the library, a '+' button would open a drawing board where users could create custom symbols (Figure 1b-3); once saved, these would appear as thumbnails in the panel and could be reused across the score (Figure 1b-4). After selecting a symbol, the finger would become an instrument: the user would tap a target notehead, which would turn red during selection while the chosen symbol appears beside it. Double-tapping a blank area would exit the mode, and tapping an annotated note would revert it to normal. By combining a standard symbol library with freehand customization, this feature would reduce the overhead of repeated annotation while preserving flexibility for personalized expression.
Scores: Usefulness (μ=5.8, σ=0.9), Intuitiveness (μ=5.1, σ=1.7), Ease of use (μ=5.8, σ=1.1), Memorability (μ=5.0, σ=1.6).

6 Discussion and Future Work

Context-specific annotations represent a conceptual shift from treating the digital score as a passive record toward conceiving it as an interactive medium that participates in the learning process. This carries implications for how musicians engage with notation: rather than merely reading static symbols, they interact with a responsive system capable of displaying and generating information tailored to their immediate practice needs. Preliminary evaluation results suggest that musicians would be receptive to this shift. A potential limitation lies in file format requirements: instead of PDF files, musicians must locate MusicXML versions of their scores for the system to render them interactive. However, such files are readily available on public digital libraries such as IMSLP [17], mitigating this barrier for most standard repertoire.

The proposed framework opens avenues for AI-driven enhancements. Machine learning models trained on performance data could extend integrated feedback by generating localized comments and corrective symbols, approximating the personalized guidance a human teacher might provide. Similarly, AI systems capable of learning from a user's error history and practice patterns could generate personalized feedforward annotations that anticipate difficulties before they arise, encoding a predictive model of individual weaknesses into the score itself. Such extensions would further blur the boundary between passive notation and active pedagogical support.

The primary next step involves implementing these features into a fully functional prototype and conducting longitudinal evaluations to assess how musicians integrate context-specific annotations into established workflows. We view this work as an invitation to the community: articulating a comprehensive feature set will require the perspectives of musicians with varied practice routines and pedagogical backgrounds. Understanding how context-specific annotations might best support the diversity of musical practice remains an open challenge.

References

[1] Shota Asahi, Satoshi Tamura, Yuko Sugiyama, and Satoru Hayamizu. 2018. Toward a High Performance Piano Practice Support System for Beginners. In *2018 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC)*. 73–79. https://doi.org/10.23919/APSIPA.2018.8659463
[2] Vincent Cavez, Catherine Letondal, Caroline Appert, and Emmanuel Pietriga. 2025. EuterPen: Unleashing Creative Expression in Music Score Writing. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25)*. Association for Computing Machinery, New York, NY, USA, Article 760, 16 pages. https://doi.org/10.1145/3706598.3713488

[3] Vincent Cavez, Catherine Letondal, Emmanuel Pietriga, and Caroline Appert. 2024. Challenges of Music Score Writing and the Potentials of Interactive Surfaces. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 728, 16 pages. https://doi.org/10.1145/3613904.3642079

[4] R. Chaffin. 2007. Learning Clair de Lune: Retrieval Practice and Expert Memorization. (2007). https://doi.org/10.1525/mp.2007.24.4.377

[5] R. Chaffin, C. Gerling, and Alexander P. Demos. 2024. How secure memorization promotes expression: A longitudinal case study of performing Chopin's Barcarolle, Op. 60. *Music Science* (2024). https://doi.org/10.1177/10298649241241405

[6] R. Chaffin and G. Imreh. 2002. Practicing Perfection: Piano Performance as Expert Memory. *Psychology Science* (2002). https://doi.org/10.1111/j.0956-7976.2002.00462.x

[7] R. Chaffin, G. Imreh, A. Lemieux, and Colleen Chen. 2003. Seeing the Big Picture: Piano Practice as Expert Problem Solving. (2003). https://doi.org/10.1525/mp.2003.20.4.465

[8] R. Chaffin, T. Lisboa, T. Logan, and Kristen T. Begosh. 2010. Preparing for memorized cello performance: the role of performance cues. (2010). https://doi.org/10.1177/0305735608100377

[9] R. Chaffin and T. Logan. 2009. Practicing perfection: How concert soloists prepare for performance. (2009). https://doi.org/10.2478/v10053-008-0050-z

[10] Andy Clark and David Chalmers. 1998. The Extended Mind. *Analysis* 58, 1 (1998), 7–19. http://www.jstor.org/stable/3328150

[11] K. A. Ericsson and W. Kintsch. 1995. Long-term working memory. *Psychological review* (1995). https://doi.org/10.1037/0033-295x.102.2.211

[12] LLC. FORSCORE. 2026. forScore. https://forscore.co/. Last accessed: 2026-01-17.

[13] S. Hallam. 1995. Professional Musicians' Approaches to the Learning and Interpretation of Music. (1995). https://doi.org/10.1177/0305735695232001

[14] Matsuto Hori, Christoph M. Wilk, and Shigeki Sagayama. 2019. Piano Practice Evaluation and Visualization by HMM for Arbitrary Jumps and Mistakes. In *2019 53rd Annual Conference on Information Sciences and Systems (CISS)*. 1–5. https://doi.org/10.1109/CISS.2019.8692813

[15] Hilary Hutchinson, Wendy Mackay, Bo Westerlund, Benjamin B. Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, Nicolas Roussel, and Björn Eiderbäck. 2003. Technology probes: inspiring design for and with families. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Ft. Lauderdale, Florida, USA) *(CHI '03)*. Association for Computing Machinery, New York, NY, USA, 17–24. https://doi.org/10.1145/642611.642616

[16] David Kirsh. 2010. Thinking with external representations. *AI & SOCIETY* 25, 4 (2010), 441–454. https://doi.org/10.1007/s00146-010-0272-8

[17] MediaWiki. 2026. IMSLP. https://imslp.org/. Last accessed: 2026-01-22.

[18] Kacper Miklaszewski. 1989. A Case Study of a Pianist Preparing a Musical Performance. (1989). https://doi.org/10.1177/0305735689172001

[19] Peter Miksza. 2011. A Review of Research on Practicing: Summary and Synthesis of the Extant Research with Implications for a New Theoretical Orientation. (2011). https://doi.org/10.5406/bulcouresmusedu.190.0051

[20] Eun Park. 2025. Music dynamics visualization for music practice and education. *Multimedia Tools and Applications* 84 (01 2025), 36145–36161. https://doi.org/10.1007/s11042-025-20637-0

[21] Piascore. 2026. Piascore. https://piascore.com/. Last accessed: 2026-01-17.

[22] Symphonic Hub SL. 2026. digitalScore. https://digitalscore.app/. Last accessed: 2026-01-17.

A Participant Background

Participant	Instrument(s) + years	Practice medium	Software + years	Performance context
P_1	Violin (20)	Tablet or paper	forScore (1+)	Group and solo
P_2	Clarinet (10)	Tablet or paper	Piascore (1+)	Group, mainly solo
P_3	Cello (5) & Piano (16)	Tablet	IMSLP (10)	Group and solo
P_4	Tuba (6.5)	Tablet	Digitalscore (7+)	Mainly solo
P_5	Piano (15) & Pipa (15)	Tablet	Goodnotes(7+)	Group and Solo
P_5	Piano (10+)	Tablet	ChongChong Piano (3+)	Group and Solo
P_7	Flute (10)	Tablet or paper	forScore (7+)	Group and Solo
P_8	Clarinet (13)	Paper	-	Group and Solo
P_9	Double bass (5)	Paper	-	Group and Solo
P_{10}	Violin (8)	Paper	-	Group and Solo
P_{11}	Cello (18)	Paper	-	Group and Solo
P_{12}	French horn (14)	Paper	-	Group and Solo
P_{13}	Violin (4)	Paper	-	Group and Solo
P_{14}	Cello (14)	Paper	-	Group and Solo
P_{15}	Flute (14)	Paper	-	Group and Solo
P_{16}	Piano (9)	Paper	-	Solo
P_{17}	Piano (4)	Paper	-	Solo

Table 1: Profile of the 17 musicians we worked with. All of them provided video recordings of a practice session for the formative study, and participated in the evaluation questionnaire. P_1 to P_{10} additionally participated in the interviews.

B Table of Annotations

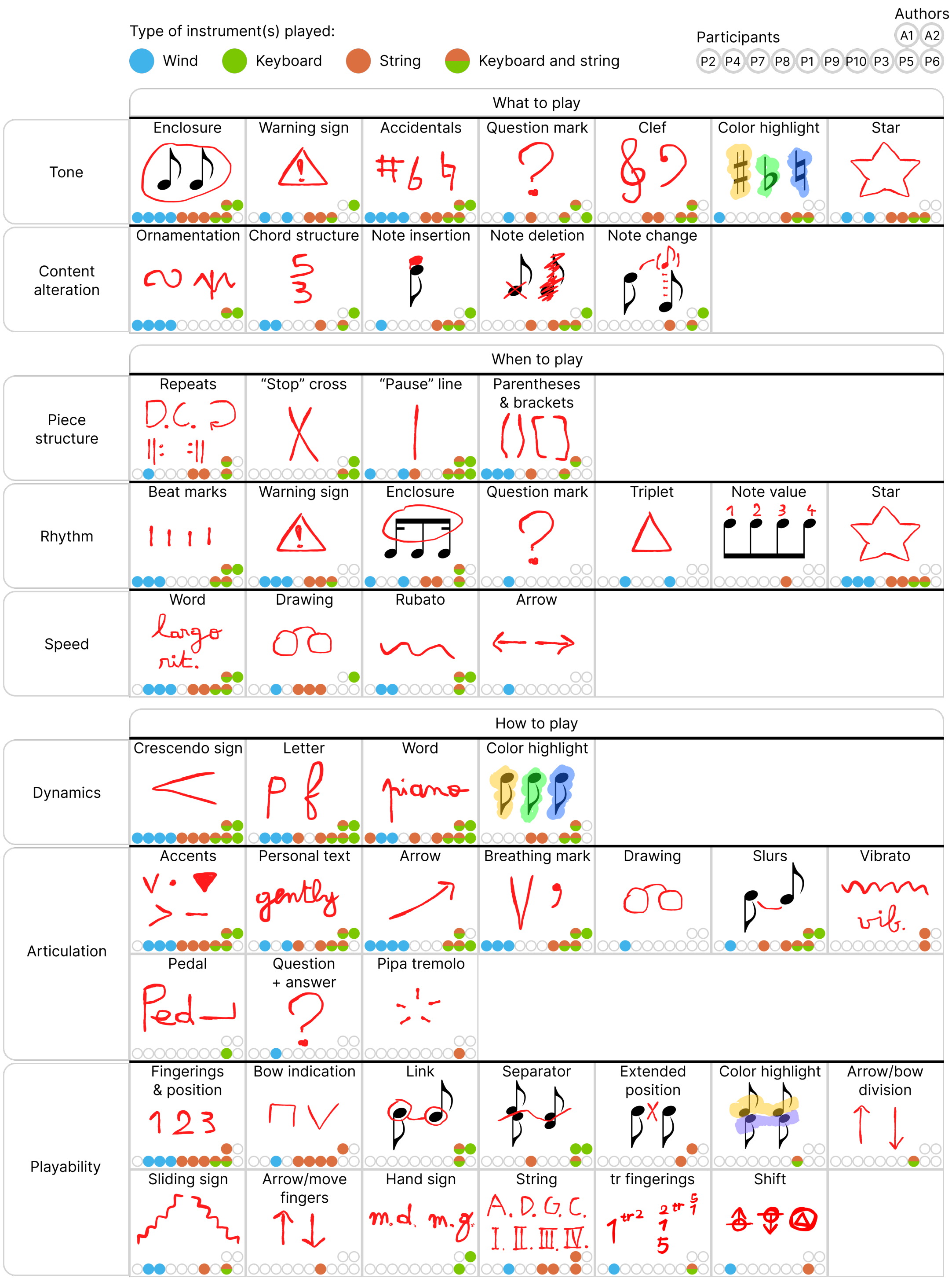

Figure 2: Table of the annotations used by the participants interviewed (P1-P10) and the authors (A1, A2).