



DAW-Based Beatmaking Creative Process: Literature Review with Guilford Indicators

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Abstract: This study aims to map rhythmic creativity in Digital Audio Workstation (DAW)-based beatmaking using Guilford's indicators of creativity—fluency, flexibility, originality, and elaboration—as the primary analytical framework. In higher education in music arts, these indicators are employed as an analytical lens to examine how rhythmic ideas are generated, varied, refined, and expanded during the DAW-based beatmaking process. The study adopted a directed literature review method with thematic synthesis, analyzing 40 open-access sources published between 2017 and 2025 and retrieved through database searches (e.g., DOAJ and Google Scholar) and manual reference list screening. All included sources were peer-reviewed and assigned Digital Object Identifiers (DOIs). The literature was organized into thematic clusters, including DAW pedagogy, beatmaking practices, divergent thinking and musical creativity, digital collaboration, and critiques of technology and artificial intelligence in music production. Rhythmic elements—such as patterns, grooves, accents, subdivisions, swing, microtiming, transitions, arrangement, and energy automation—were subsequently mapped onto the four creativity indicators. The findings indicate that DAWs strongly facilitate rapid idea prototyping and iterative refinement, making fluency and elaboration the most prominent creativity indicators. In contrast, flexibility and originality appear to be more contingent on task design, learners' willingness to shift compositional strategies, negotiation with genre conventions, and the broader collaborative and technological ecosystem, including templates, presets, and AI-assisted tools. This study provides a conceptual mapping framework and illustrative assessment directions to assist lecturers in interpreting DAW project artifacts as evidence of rhythmic creative processes. In the context of music arts higher education, the proposed mapping offers a reference for designing DAW-based composition tasks and developing more consistent and transparent assessment criteria for rhythmic creativity across the four Guilford indicators. Future research is recommended to empirically test this framework through the analysis of student-produced DAW artifacts.

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Introduction

Rhythm can be considered the “heartbeat” of beatmaking because it organizes time, drives groove, and shapes the listener's sense of movement and energy. While melodic and harmonic elements are often supported by MIDI tools and preset libraries, rhythmic decisions—such as groove, swing, and microtiming—still require nuanced human judgment. In this sense, rhythm becomes the primary site where human-digital negotiation occurs during DAW-based beatmaking. In this context, the development of digital music technology is changing the way students learn, create, and evaluate musical works, not only in terms of the final product but also in terms of the creative process. Because digital technology provides a fast, flexible, and easily revised production environment, the music learning process is



shifting towards the practice of exploration, trial and error, and the iterative development of ideas, thus impacting the development of students' creative thinking that is more divergent and experimental (Song & Chen, 2017). In music education, Digital Audio Workstations (DAWs) are increasingly being used not only as recording tools, but also as composition and learning spaces (Cipta, 2021; Pierard & Lines, 2022).

In the context of higher education in music arts, studies show that DAWs support students' competencies and production practices, including decision-making in structure, track processing, and artistic choices (Andriyanto, 2020, 2021; Jaohari et al., 2025). In Indonesia itself, students' interest in DAWs and their relationship to aesthetic styles is also starting to be discussed, indicating that DAWs are no longer an additional tool, but rather part of the identity of students' musical practices (Jaohari et al., 2025). In general, the literature on music composition or production devices emphasizes the existence of affordances (possible actions) that make exploration easier, for example pattern manipulation, layering, loops, and rapid revision (Laato et al., 2019; Palioura & Dimoulas, 2022).

However, rhythmic creativity in DAW-based beatmaking needs to be discussed specifically within arts higher education, not only as a creative practice but also as a teachable and assessable learning outcome. Unlike hobbyist 'bedroom producers' who often learn informally through participation in beatmaking communities and events, arts university students work under curricular targets, structured feedback, and assessment criteria that require lecturers to justify task design and evaluate creative processes transparently (Andriyanto, 2020, 2021; Crooke, 2018; Ng & Gamble, 2022). Therefore, understanding how rhythmic creativity is manifested through students' DAW project artifacts is crucial for developing meaningful assignments and more consistent assessment in music arts higher education.

One practice closely associated with DAWs is beatmaking, particularly in the traditions of hip-hop and urban popular music. Beatmaking is not just a technical activity, but a creative tradition with its own tools, customs, and aesthetic logic. In the digital space, practices such as beat battles demonstrate that beatmaking is also a social learning space, with participants learning through participation, competition, and a culture of sharing (Ng & Gamble, 2022). In hip-hop education, the learning process often emphasizes how to flip sound material into something personal so that creativity emerges not from scratch, but from negotiations with conventions (Deluxe & Kautny, 2024). Therefore, to understand creativity in beatmaking, we need a framework that captures the process of idea emergence, as well as the shifting strategies and novelties of detailed exploration.

On the theoretical side, musical creativity is understood broadly and multidisciplinary, starting from the perspective of psychology, education, to musician practice (Huovinen, 2021; Schiavio et al., 2021). However, one fairly operational way to read the creative process is through divergent thinking indicators (fluency, flexibility, originality, elaboration). Several studies related to creativity and divergent thinking show that music can be related to strengthening the divergent process (Fritz et al., 2020; Ritter & Ferguson, 2017), and the discussion about creative flexibility also emphasizes that flexibility is not just about having lots of ideas, but rather the ability to change approaches (Weiss & Wilhelm, 2022). In the context of a creative thinking model that considers the spectrum of conventionality, the courage to break out of the usual pattern becomes an important aspect that can be read in compositional or popular practice (Lansing-Stoeffler & Daley, 2023).

However, many digital music studies tend to discuss creativity in general (e.g., digital music creativity, compositional creativity, or technology-based creativity), without



specifically placing rhythmic creativity as the main focus in DAW-based beatmaking practices. Different from previous studies that examine digital music creativity in general, this study specifically focuses on rhythmic creativity in DAW-based beatmaking by using the Guilford indicator framework as the main analysis. The focus is not to explain the Guilford indicators, but rather to use the indicators as a reading tool to map how rhythmic creativity emerges in beatmaking activities such as creating grooves, processing accents, microtiming, pattern variations, and structure (arrangement).

In addition, the digital ecosystem also has two sides, namely facilitating creativity while also normalizing certain habits (for example templates, presets, platform standards), so that creativity can be more focused or even locked (Benedict & O’Leary, 2019). AI discourse in music adds context, AI can help ideation, but also risks shifting creative decisions from students to systems (Avdeeff, 2019; Merchán Sánchez-Jara et al., 2024). On the other hand, digital collaboration provides opportunities for joint creativity, both in the collaborative format of urban popular music compositions (Merchán-Sánchez-Jara & González-Gutiérrez, 2023), a DAW-based collaborative platform (Baratè et al., 2022), as well as collaborative learning practices through music applications (Sembiring et al., 2025). Therefore, this study also positions rhythmic creativity in beatmaking as a process influenced by tools, cultural practices, and digital ecosystems.

Although the literature on DAW and beatmaking spans general education, professional practice, and informal learning communities, this review focuses specifically on music arts higher education because university courses require explicit learning outcomes, task design, and assessment criteria. The aims of this study are: (1) to map the concept of rhythmic creativity in DAW-based beatmaking using Guilford indicators as a reading tool, (2) to synthesize literature findings related to the creative process of beatmaking or digital music production that are relevant to these indicators, and (3) to formulate learning implications for higher education in music arts, especially in task design and how to read student work based on DAW project data.

However, rhythmic creativity in DAW-based beatmaking needs to be discussed specifically within arts higher education, not only as a creative practice but also as a teachable and assessable learning outcome. Unlike hobbyist ‘bedroom producers’ who learn informally and follow personal goals, arts university students work under curricular targets, structured feedback, and assessment criteria that require lecturers to justify task design and evaluate creative processes transparently. Therefore, understanding how rhythmic creativity is manifested through students’ DAW project artifacts is crucial for developing meaningful assignments and more consistent assessment in music arts higher education. This higher-education perspective also clarifies why the study formulates learning implications based on task design and student project data.

Research Method

The study employed a directed literature review with thematic synthesis (Thomas & Harden, 2008). It also drew on scoping-style guidance to support concept mapping and clarify the review approach (Munn et al., 2018). The literature corpus was determined from 40 curated open-access references with DOIs (ranging from 2017 to 2025). Searches were conducted in Google Scholar, and DOAJ, complemented by manual screening of reference lists. The search used Boolean combinations such as (‘digital audio workstation’ OR ‘DAW’) AND (beatmaking OR ‘music production’) AND (rhythm OR groove OR swing OR microtiming) AND (creativity OR ‘divergent thinking’). The final corpus covers themes of



technology-based music education on DAW, digital production and composition, hip-hop beatmaking and online learning, musical creativity and divergent thinking, digital collaboration, and critical issues of technology and AI in music.

Forty articles were selected through a targeted search using keywords relevant to the focus of the study, such as Digital Audio Workstation (DAW), beatmaking, music production, digital composition, music education, musical creativity, divergent thinking, and Guilford. The selection stage was carried out in stages by screening titles and abstracts to ensure relevance to the context of learning or digital music production, followed by reading the full text to ensure that the article contained concepts or findings that could be used to examine aspects of rhythmic creativity (e.g., pattern, groove, accent, subdivision, swing, microtiming, fill/transition, arrangement, and energy automation). Articles were excluded if they did not fall within the specified time frame, were not open access, did not have a DOI, or were not relevant to the focus on rhythmic creativity in DAW-based beatmaking. The final corpus that met these criteria was then synthesized thematically and mapped using Guilford's indicators. To organize the findings into a thematic synthesis, this study follows the following stages of analysis. The unit of analysis in this study is various concepts and findings from articles discussing the process of rhythmic creativity in digital music production. Since this study did not collect data directly in the field, the results presented are a summary and synthesis of the literature reviewed, not empirical findings from participants. Next, to organize the findings into a thematic synthesis, this study followed the following analytical steps.

- 1) Grouping the literature into clusters: (a) DAW & digital composition pedagogy; (b) hip-hop beatmaking and learning ecosystems; (c) musical creativity & divergent thinking; (d) digital collaboration; (e) AI & technology critique.
- 2) Extraction of rhythmic issues: rhythmic markers in production practices (pattern, groove, accent, subdivision, swing, microtiming, fill/transition, arrangement, energy automation). This theme is aligned with the broader discussion of musical creativity (Podlipniak, 2021; Schiavio et al., 2023) as well as examples of musical creativity across contexts (Addessi, 2020; Alkaei & Küssner, 2021).
- 3) Indicator mapping: Guilford's indicators are used as thematic codes (fluency, flexibility, originality, elaboration) to analyze literature findings and organize conclusions. This indicator approach aligns with the practice of formulating creative indicators through consensus or expert judgment, although the context is different (López Martínez et al., 2024).
- 4) Thematic synthesis: the results are presented in the form of conceptual mapping and synthesis tables (Tables 1–2), then their implications for beatmaking learning in higher education are discussed.

Results and Discussion

This section presents two main results: (1) a mapping of Guilford's indicators as a means of reading rhythmic creativity in DAW-based beatmaking artifacts, and (2) a synthesis of literature findings that show how the DAW environment can strengthen or limit these indicators.



Table 1. Mapping of Guilford indicators on beatmaking practices in DAW

Guilford Indicator	Focus On Reading Rhythmic Creativity	The Form in DAW Beatmaking	Possible Evidence/Data	Synthesis Note (From Literature)
Fluency	Many alternative rhythmic ideas	Create lots of pattern variations, lots of groove versions, try out different tempos or feels.	Number of clips or patterns, project version, alternative tracks	The composition tools in DAWs facilitate rapid ideation and trial and error, so fluency is often strong in the early phases of production (Laato et al., 2019; Pierard & Lines, 2022; Cipta, 2021).
Flexibility	Rhythmic strategy shift	Switch from straight to swing/shuffle, change subdivisions, change accents, and change layering strategies.	Comparison of versions (A/B), grid or swing changes, revision notes	Flexibility needs to be understood separately from fluency; it occurs when students change their approach, rather than simply adding variations (Weiss & Wilhelm, 2022; Lansing-Stoeffler & Daley, 2023).
Originality	New patterns or accents	<i>Off-beat</i> , characterful, playful (silence), unusual yet musical accent combinations	Accent analysis, short transcriptions, comparisons between works	<i>Beatmaking</i> has conventions; originality emerges when understanding common patterns and then making meaningful deviations from them (Crooke, 2018; Ng & Gamble, 2022; Huovinen, 2021).
Elaboration	Depth of idea development	Detailed velocity, microtiming, fill/transition, section structure (intro-drop-break), energy automation	MIDI parameters, automation, arrangement view, composition structure	Project-based production activities encourage elaboration: basic loops develop into mature structures (Andriyanto, 2021; Palioura & Dimoulas, 2022; Cuenca-Rodríguez et al., 2025).

This table is designed to analyze student beatwork data (e.g., DAW projects, arrangement screenshots, MIDI/clips, revision notes), not to define Guilford's theory. Strengthening divergent thinking through music and the distinction between flexibility and fluency are important points here (Fritz et al., 2020; Gerwig et al., 2021; Weiss & Wilhelm, 2022). In summary, Table 1 shows that Guilford's indicators can be operationalized on DAW artifacts through version traces, rhythmic parameter changes, and structural development. To prevent the mapping from stopping as categories, Table 2 summarizes the supports and barriers for each indicator based on a synthesis of the literature.



Table 2. Synthesis of literature findings related to rhythmic creativity in DAW-based production and beatmaking

Focus of findings	Thematic summary	Supporting references
DAW as an idea prototyping space	DAWs make it easy to try–delete–redo (iteration), so students can generate many rhythmic options and quickly compare versions.	Laato et al., 2019; Cipta, 2021; Pierard & Lines, 2022; Andriyanto, 2020
Creativity in DAW learning design	Creativity thrives when DAW is used in meaningful tasks (projects). based), including cross-media (transmedia) and classroom contexts	Palioura & Dimoulas, 2022; Macrides & Angeli, 2020; Song & Chen, 2017
<i>Beatmaking</i> as a learning culture	Beatmaking has its own aesthetic norms and traditions; online arenas (beat battles) make learning participatory and social.	Crooke, 2018; Ng & Gamble, 2022; Deluxe & Kautny, 2024
Digital collaboration expands rhythmic strategies	Collaboration (ensemble/digital) gives rise to negotiation of ideas, division of roles, and response to others' ideas, this can trigger flexibility and elaboration.	Bishop, 2018; Merchán-Sánchez-Jara & González-Gutiérrez, 2023; Baratè et al., 2022; Sembiring et al., 2025
Creativity as rhythmic “sense-making”	Musical creativity is understood as a process of constructing meaning; entrainment and the experience of time or groove can influence rhythmic decisions.	Schiavio et al., 2021; Schiavio et al., 2023; Podlipniak, 2021
Platform ecosystem and AI issues	Technology can both liberate and normalize habits (presets/templates); AI aids ideation but risks displacing creative decisions.	Benedict & O’Leary, 2019; Avdeeff, 2019; Merchán Sánchez-Jara, et al., 2024
Long-term support and learning context	Online learning and ongoing interventions can impact creativity and achievement, but require appropriate evaluation design.	Yang & Li, 2025; Després & Dubé, 2020

To ensure that the mapping does not stop at categories, Table 2 summarizes how the literature describes the conditions that support or restrain each indicator when applied to DAW practice, including collaboration and digital ecosystem factors.

Based on these two tables, the indicators that most often appear strong in a DAW environment are fluency and elaboration because DAWs support rapid iteration and the development of detail and structure. Conversely, flexibility and originality tend to require additional triggers, such as demands for changing strategies, collaborative contexts, or challenging tasks that encourage deviation from established patterns. A summary of these



patterns is then discussed further to illustrate the implications for beatmaking instruction in higher education.

This discussion links the mapping results (Tables 1–2) with pedagogical consequences, namely how lecturers can read students' beatwork as data from the rhythmic creative process, and how DAW assignment design can stimulate specific indicators. Next, the discussion is outlined based on Guilford's four indicators (fluency, flexibility, originality, elaboration) to further clarify the link between the findings and pedagogical implications:

1) Fluency

The literature on composition or production tools confirms that composition software provides affordances for rapid exploration (Laato et al., 2019). In the context of learning, DAW is also often understood as a constructivist space where students learn through trial and error and reflection on the sound results (Pierard & Lines, 2022). DBR-based studies on DAW self-paced learning show that appropriate learning design can facilitate a step-by-step exploration process (Cipta, 2021). In higher education, strengthening student competencies through DAW learning shows that DAW is effective as a means of production training and technical-musical decision-making (Andriyanto, 2020). However, when viewed through the Guilford indicator, fluency isn't simply measured by the number of patterns, but by the ability to generate alternatives that truly offer artistic choices. Here, instructors need to distinguish between mechanical variations (e.g., minor copy-pastes) and variations that alter the feel or groove.

2) Flexibility

Creative flexibility is understood as the ability to change strategies, not simply increase the number of ideas (Weiss & Wilhelm, 2022). The model of the spectrum of conventionality also emphasizes the courage to move from conventional patterns to other approaches that still make musical sense (Lansing-Stoeffler & Daley, 2023). In DAW practice, flexibility is evident when students change grids or swings, change subdivisions, or overhaul accents and layering. DAW practice, flexibility is often visible when students decide whether to preserve human microtiming or to tighten timing using manual-to-grid quantization. This choice reflects strategic adaptation: quantization can increase clarity and alignment, while leaving timing slightly off-grid can maintain groove and stylistic feel that are central to hip-hop and urban popular music traditions (Crooke, 2018). Local context is also important, as students' DAW preferences and aesthetic styles demonstrate that tools and tastes influence each other (Jaohari et al., 2025). That is, flexibility does not stand neutral; it occurs in a negotiation between DAW features, the intended genre, and the student's habits.

3) Originality

Beatmaking is a creative tradition that has a history of tools and typologies (Crooke, 2018). In online cultures like beat battles, learning occurs as participants learn the rules and styles of play, then try to twist those styles to sound unique (Ng & Gamble, 2022). Hip-hop education also emphasizes that learning often emerges from the practice of flipping and building a musical identity (Deluxe & Kautny, 2024). From the perspective of musical creativity theory, students also bring personal theories about creativity and how they argue about what is considered creative can influence artistic decisions (Huovinen, 2021). Thus, reading originality in beatmaking ideally involves: (a) simple comparisons between student works, (b) identification of



characteristic accents or grooves, and (c) assessment of whether the rhythmic deviations have a musical function.

4) Elaboration

Elaboration is an indicator typically seen when a basic idea is developed into a more mature structure. Production practices for virtual concerts demand precise production details and structure. This is relevant to see how elaboration emerges in the arrangement of sections (intro-build-drop-break) and detailed decisions (Andriyanto, 2021). Studies on digital technology in music education also show that DAWs can be used to foster classroom creativity through more complex development strategies, not just creating loops (Palioura & Dimoulas, 2022).

In the context of music learning involving the use of DAW, the integration of technology and tradition also shows how DAW can be an elaboration medium to maintain musical form while processing it in a new format (Saputra et al., 2024). Even the discussion of the use of recording devices in learning traditional instruments can provide context that audio technical skills also influence the quality of the sound details produced (Pambayun, 2022). Beyond that, international literature on the use of DAW in music education also discusses the use of digital technology for the development of learning structures and creativity (Cuenca-Rodríguez et al., 2025).

5) Digital ecosystem

Critical literature reminds us that music technology can promise freedom, but it also normalizes certain habits (presets, templates, platform standards), so that creativity can lead to uniform tastes (Benedict & O’Leary, 2019). The discussion of AI in popular music suggests that AI could emerge as a new creative agent that influences the way musical decisions are made (Avdeeff, 2019). In the realm of education, a critical synthesis of AI-assisted music education emphasizes opportunities and challenges, particularly regarding the role of humans, evaluation, and the ethics of creative decisions (Merchán Sánchez-Jara et al., 2024).

On the other hand, the digital ecosystem also strengthens collaboration. Musical collaboration (including spontaneous coordination) is related to shared creativity (Bishop, 2018). In music classes, a collaborative composition approach based on urban music demonstrates the potential of DAWs to encourage negotiation of ideas (Merchán-Sánchez-Jara & González-Gutiérrez, 2023). Even collaborative DAW platforms and the use of music apps in private lessons add to the evidence that creativity can emerge from interaction and role-sharing (Baratè et al., 2022; Sembiring et al., 2025). The implication for reading the Guilford indicator: when students use templates or presets, fluency can be high, but originality can be low. When students are collaborative, flexibility tends to increase because there is an incentive to adapt and when AI is involved, elaboration can increase (due to technical assistance), but creative decisions need to be traced to which are truly student decisions.

So that the indicator mapping in Tables 1–2 does not stop as an analysis category, this section summarizes examples of beatmaking task designs that lecturers can use to stimulate each Guilford indicator in a more targeted manner:

1) Fluency task: Create eight groove variations from the same accent motif.

Judging criteria: Number of options plus differences in feel or groove, not just minor changes.



- 2) Flexibility task: Change the same beat into three different feels, namely straight, swing, and half-time.
Assessment criteria: changes in rhythmic strategy such as subdivisions, accents, and swing, not just surface variations.
- 3) Originality task: Create an accent deviation that is still pleasing and then explain the aesthetic reasons.
Assessment criteria: meaningful deviation plus sound musical argumentation.
- 4) Elaboration task: develop the loop into a one-minute composition with transitions/fills, and energy automation.
Judging criteria: microtiming or velocity details plus clear part structure.

The series of tasks above is in line with the idea that music technology-based learning design needs to consider the cognitive, affective, and experiential aspects of student learning so that production activities are not only technical but also meaningful (Macrides & Angeli, 2020). In addition, it is important for lecturers to hear the voices of learners so that assignments feel relevant to students' musical practices and learning contexts (Després & Dubé, 2020).

In the context of online learning, the effectiveness of increasing creativity is also greatly influenced by the design of the intervention and how it is evaluated, especially if you want to see the long-term impact (Yang & Li, 2025). More broadly, digital music production can also intersect with the development of other thinking skills, so that beatmaking activities need not be positioned as narrow exercises, but rather as part of a more comprehensive creative literacy (Fanchamps et al., 2024). To organize students' learning experiences and musical identities, the narrative mapping approach can also be a complementary inspiration in writing the process (Livingston, 2024). Ultimately, digital composition learning supports DAW's position as a learning medium, not just a technical tool, especially when assignments are structured in stages and supported by the development of ICT-based teaching materials (Asplund, 2022; Cipta et al., 2024).

Conclusion

This literature review offers a conceptual mapping of rhythmic creativity in DAW-based beatmaking using Guilford's indicators as a reading tool (fluency, flexibility, originality, elaboration). The synthesis shows that DAWs tend to strengthen the ideation and iteration phases (fluency), open up opportunities for strategy changes through rhythmic parameter manipulation (flexibility), place originality as a negotiation with beatmaking conventions (originality), and encourage deepening details and maturing structures from loops to compositions (elaboration). However, the digital ecosystem also has a normalization side (templates/presets) and new dynamics (AI) that can change the direction of students' creative decisions, so the reading of rhythmic creativity needs to consider the context of tools, practice culture, and learning task design. Moving forward, research can be expanded with field data in the form of analysis of students' DAW projects (revised versions, arrangement screenshots, process notes) so that this indicator mapping can be tested as an instrument for analyzing beatmaking learning in higher education in music arts.

Recommendation

Based on the conceptual mapping of rhythmic creativity in DAW-based beatmaking using Guilford's indicators (fluency, flexibility, originality, elaboration), further research is recommended to test these findings using process data. Such data can be collected through a



think-aloud protocol, in which students verbalize their decision-making while producing beats in a DAW. Additionally, screen-recording analysis (screen capture of the DAW session) can be used to trace editing actions, quantization choices, revisions, and time-stamped creative decisions across the draft to final process. Subsequent studies can analyze student work artifacts in DAW, such as project files, revision versions (draft-final), arrangement screenshots, and reflection notes, so that Guilford's indicators can be used more operationally in reading the development of rhythmic ideas in higher education in music.

In learning practice, lecturers are advised to design step-by-step assignments that balance exploration and the risk of normalization from templates/presets, as well as assess products and processes through rubrics and process evidence. However, implementation may be affected by limitations in device/license access, variations in rhythmic ability and DAW literacy, and the use of presets/AI that have the potential to standardize results. Therefore, learning needs to be supported by adequate facilities and guidelines for the use of templates/presets/AI so that students' creative decisions can still be traced and assessed fairly.

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