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다성부 음악 학습에서의 인지적 부하 관리 전략
- 바흐 평균율 클라비어곡집 제1권 C장조 푸가를 중심으로 -

Strategies for Reducing Cognitive Load in Complex Polyphonic Music Learning: A Focus on Bach's C Major Fugue from *The Well-Tempered Clavier*, Book I

배수영*
Su-Young Bae

Abstract This study analyzed how piano instructors manage the cognitive load experienced by students when learning Bach's Fugue in C Major from *The Well-Tempered Clavier*, Book I, based on Cognitive Load Theory (CLT). In-depth interviews were conducted through Focus Group Interviews (FGI) with six instructors with over ten years of teaching experience, exploring various strategies to reduce cognitive load in complex polyphonic music learning. The results showed that students experienced a high cognitive load in maintaining independent voices, identifying the subject and counter-subject, analyzing the structure, managing rhythm and tempo, balancing voices, and memorizing. To address this, the instructors guided students to practice voices separately, visually mark the subject and counter-subject, and use recordings to enhance understanding. Additionally, students were assisted in mastering dynamics and articulation through diverse performance examples and encouraged to maintain tempo by tapping a steady beat. To reduce learning burdens, students were also allowed to explore freely without being constrained by fixed tempo, and sectional practice was used to effectively understand the structure and reduce cognitive load. This study suggests the applicability of CLT in complex polyphonic music learning and provides foundational material for developing effective instructional strategies in music education.

Key words: cognitive load theory, CLT, piano education, music learning strategies, music pedagogy, educational psychology, instructional design

초록 본 연구는 바흐 평균율 클라비어곡집 제1권 C장조 푸가 학습 시 학생들이 경험하는 인지적 부하를 피아노 교강사들이 어떻게 관리하는지 인지적 부하 이론(CLT)에 근거하여 분석하였다. 10년 이상의 지도 경력을 가진 6명의 교강사와 FGI를 통해 심층 인터뷰를 진행하였으며, 다성부 학습에서 발생하는 인지적 부하를 줄이기 위한 다양한 전략을 탐구하였다. 연구 결과, 학생들은 성부 독립 유지, 주제와 대주제 파악, 악곡 구조 이해, 리듬과 템포 조절, 성부 간 균형, 암기 과정에서 높은 인지적 부하를 경험하였다. 이를 해결하기 위해 교강사들은 성부를 분리하여 개별적으로 연습하도록 지도하고, 주제와 대주제를 시각적으로 표시하거나 녹음을 활용하여 학생들이 더 쉽게 인지할 수 있도록 하였다. 또한 학생들이 다양한 연주 예시를 통해 다이내믹과 아티큘레이션을 체득하도록 돕고, 발로 일정한 박을 치며 템포를 유지하는 방법을 활용하였다. 학생들이 고정된 템포에 얽매이지 않고 자유롭게 탐색하도록 하여 학습 부담을 줄였으며, 섹션별 연습을 통해 악곡의 구조를 효과적으로 파악하고 인지적 부담을 경감시켰다. 본 연구는 복잡한 다성부 음악 학습에서 인지적 부하 이론의 적용 가능성을 시사하며, 음악 교육에서 효과적인 지도 전략 개발의 기초 자료로 활용될 수 있다.

주제어: 인지적 부하 이론, 피아노 교육, 음악 학습 전략, 음악 교수법, 교육 심리학, 교육 설계

* Corresponding author, E-mail: sb2388@sungshin.ac.kr
Associate Professor, Sungshin Women's University, 2, 34 da-gil, Bomun-ro, Seongbuk-gu, Seoul, Korea

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Ⅰ. Introduction

J. S. Bach's *The Well-Tempered Clavier* is one of the most important works in Western music history, and due to its structural complexity and musical depth, it remains a crucial piece in piano education today. Among its compositions, Fugue No. 1 in C Major (BWV 846) from Book I is a complex polyphonic work composed of four voices, requiring a wide range of technical and cognitive abilities from students. This piece, which demands that students maintain the independence of each voice while achieving overall harmony, presents a significant cognitive load for piano learners due to its high level of difficulty.

Cognitive Load Theory (CLT) explores how to optimize learning outcomes by effectively managing the cognitive load that learners experience during the learning process (Sweller, 1988). CLT points out that a learner's working memory is extremely limited, and when the amount of information that needs to be processed simultaneously becomes excessive, learning performance can deteriorate (Sweller, Ayres, & Kalyuga, 2011). CLT categorizes the cognitive load experienced by learners into intrinsic load, extraneous load, and germane load, emphasizing the importance of reducing intrinsic load, minimizing unnecessary extraneous load, and increasing germane load to improve learning efficiency.

In piano education, students are required to simultaneously process various information such as sight-reading, score interpretation, maintaining accurate rhythm and tempo, technical control of fingers and body, and musical expression. In this process, they experience a high cognitive load. Particularly, complex polyphonic pieces like Bach's fugues can maximize this cognitive load, which can become a major obstacle to effectively learning and performing the piece. Therefore, it is essential for piano instructors to develop strategies to effectively manage the cognitive load experienced by students, thereby helping to maximize their learning outcomes.

This study aims to explore how piano instructors perceive and manage the cognitive load that students experience while learning Bach's Fugue in C Major from *The Well-Tempered Clavier*, Book I. Specifically, the study seeks to conduct an in-depth analysis of the instructional strategies used by instructors to help students understand and practice the complex structure of this piece. Through this, the study aims to propose effective methods for managing cognitive load in piano education and provide strategies that can be practically applied in educational settings.

The research questions for this study are as follows; First, what are the sources of cognitive load that students experience when learning Bach's C Major Fugue from *The Well-Tempered Clavier*, Book I? Second, what strategies do piano instructors use to manage students' cognitive load when teaching this piece? Third, What tools or materials do instructors utilize to support cognitive load management during instruction of this piece? Finally, how do instructors adjust their teaching methods for students at different proficiency levels?

Ⅱ. Literature Review

1. Cognitive load theory

Cognitive Load Theory (CLT), first introduced by J. Sweller, is a critical framework that explains how human cognitive architecture impacts the learning process. CLT focuses on the interaction between working memory and long-term memory, and it emphasizes how instructional design can help manage the cognitive load imposed on learners during complex tasks. The theory suggests that learners' working memory is limited and easily overwhelmed, which can hinder effective learning if cognitive load is not managed (Sweller et al., 2011; Sweller, van Merrienboer, & Paas, 2019).

1) Working memory and long-term memory

Working memory is the part of the cognitive system responsible for processing new information, but it has a highly limited capacity. Research indicates that working memory can handle only about 2~4 new pieces of information at a time, especially when those pieces require complex processing. This limitation makes it difficult for learners to handle complex tasks without experiencing cognitive overload (Sweller et al., 2011). In contrast, long-term memory has an almost unlimited capacity and stores information for extended periods. Once information is stored in long-term memory, learners can retrieve and apply it with minimal cognitive effort. The interplay between these two systems is central to learning, as effective instruction helps facilitate the transition of information from working memory to long-term memory (Sweller et al., 2019).

2) Intrinsic cognitive load

Intrinsic cognitive load refers to the inherent difficulty of the learning material itself. The complexity of the task—determined by the number of elements and their interactions—dictates the amount of cognitive load imposed on the learner. In music education, for example, learning a polyphonic composition like a fugue naturally imposes a high intrinsic cognitive load, as the student must process multiple independent voices simultaneously. The more complex the task, the greater the intrinsic load, making it essential for instructional strategies to account for this load in order to avoid overwhelming the learner (Sweller et al., 2019).

3) Extraneous cognitive load

Extraneous cognitive load is the unnecessary cognitive burden caused by poorly designed instructional materials or ineffective teaching methods. This type of load does not contribute to learning and can hinder the learner's ability to process essential information. In music education, for instance, confusing notation or unclear instructions may cause students to waste cognitive resources on irrelevant tasks—such as interpreting unclear scores—instead of focusing on mastering the musical content (Paas, Renkl, & Sweller, 2003). To reduce extraneous load, instructional materials should be clear, well-organized, and designed to help learners focus on the most important elements of the task (Sweller et al., 2019).

4) Germane cognitive load

Germane cognitive load refers to the mental effort directly related to learning and schema construction. This type of load is essential for understanding complex material and integrating new information into long-term memory (Sweller et al., 2011). In music education, germane load is critical when students are learning to understand how different voices in a polyphonic piece interact and when they are working to internalize the structure and patterns of a complex composition. Effective instructional strategies should aim to increase germane load by encouraging deep cognitive engagement with the material while managing intrinsic and extraneous loads (Sweller et al., 2019).

2. Key strategies of CLT

CLT provides a framework for instructional design that helps learners manage cognitive load during learning (Sweller, 1988). By optimizing cognitive resources, CLT enables learners to better process new information and integrate it into long-term memory. In the context of polyphonic music learning, where learners are required to process complex information, CLT strategies can be particularly effective. Below are key strategies from CLT and their application to music education.

1) Worked example effect

Providing learners with fully worked-out examples before asking them to solve similar problems helps reduce cognitive load. For instance, in music education, a teacher may demonstrate the interactions between voices in a fugue, allowing students to observe before attempting it themselves. This method shifts the focus from problem-solving to understanding structure, reducing cognitive strain (Sweller & Cooper, 1985).

2) Split-attention effect

Cognitive load increases when learners must process multiple, separate sources of information simultaneously, like sheet music and verbal instructions. Integrating these sources—for example, by using annotated scores that include instructions— helps learners process information as a single source, reducing unnecessary cognitive load (Ayres & Sweller, 2014).

3) Modality effect

Using both visual and auditory channels enhances learning. In music, this can mean having students listen to a piece while following the score. Engaging both senses allows them to process information more efficiently, lowering the cognitive load associated with using only one channel (Ginns, 2005; van Mierlo, Jarodzka, Kirschner, & Kirschner, 2012).

4) Transient information effect

Presenting complex information in a stable form, rather than transiently, helps learners manage cognitive load. In music, providing students with resources like annotated scores or recorded examples allows them to revisit essential information, thereby reducing the cognitive strain of recalling transient details (Chen, Castro-Alonso, Paas, & Sweller, 2018; Leahy & Sweller, 2011).

5) Isolated elements effect

Presenting each part of complex information separately at first helps reduce cognitive load. In music, this could involve practicing each voice independently before combining them. Once students master individual voices, managing the full complexity of the piece becomes easier (Pollock, Chandler, & Sweller, 2002).

6) Redundancy effect

Providing redundant or unnecessary information can increase cognitive load. For instance, if a student has already understood the annotations on the sheet music, repeatedly explaining the same information verbally may overburden the learner. In such cases, the additional explanation does not contribute to learning and instead increases extraneous cognitive load. Avoiding duplication and focusing on essential information helps streamline the learning process (Sweller et al., 2011; van Mierlo et al., 2012).

7) Goal-free effect

Encouraging learners to explore without a specific goal can reduce cognitive load. In music, allowing students to experiment with different interpretations without a set goal can foster creativity and exploration. This approach helps learners focus on the process rather than the end result, reducing cognitive demands (Sweller et al., 2011; van Mierlo et al., 2012).

8) Completion problem effect

Giving learners partially completed tasks to finish on their own reduces cognitive load while engaging them in active learning (Sweller et al., 2011). In music, this could mean providing partially annotated scores that students complete, enabling them to apply knowledge without feeling overwhelmed (van Merriënboer & Sweller, 2010).

9) Self-explanation effect

Encouraging learners to generate their own explanations for worked examples or learning materials enhances understanding and promotes deeper cognitive processing (van Merriënboer & Sweller, 2010). In music education, prompting students to self-explain the reasoning behind certain fingerings, articulations, or interpretative choices helps them internalize complex concepts more effectively.

10) Variability effect

Providing learners with varied practice situations helps them build generalized knowledge by identifying essential features and filtering out irrelevant ones (Paas & van Merrienboer, 1994). This is particularly useful in music education, as varied practice settings allow students to develop a more versatile understanding of music elements.

11) Human movement effect

Replacing static images with dynamic representations involving human movement enhances learning outcomes (Paas & Sweller, 2012). In music education, providing students with videos that show hand movements or actual playing demonstrations can help learners internalize techniques and structures more naturally.

12) Guidance-fading effect

Instructional guidance should decrease as learners gain proficiency. Beginners benefit from detailed examples, while more advanced learners can transition to independent problem-solving. This gradual reduction of guidance allows for more autonomy and supports a progression in skills (Renkl, 2012; Renkl & Atkinson, 2003; van Merriënboer & Kirschner, 2017).

13) Expertise reversal effect

Instructional methods effective for novices may become inefficient for experts. Beginners benefit from detailed guidance, while experts gain more from independent learning opportunities. Allowing advanced learners to engage in self-directed tasks reduces cognitive overload and supports deeper learning (Kalyuga, 2011).

3. CLT in music education

CLT has been increasingly applied to music education, particularly in areas like music reading and performance, where learners often experience high levels of cognitive load due to the complexity of musical tasks. Music reading and performing involve processing multiple layers of information simultaneously, such as pitch, rhythm, dynamics, and phrasing. CLT provides strategies to manage these demands by addressing intrinsic, extraneous, and germane cognitive loads in music learning environments.

1) Application of CLT to music reading

Music reading is a highly demanding cognitive task. Learners must simultaneously decode musical notation, interpret rhythm and dynamics, and translate this information into motor actions. Owens & Sweller (2007) emphasized the importance of managing both intrinsic and extraneous cognitive loads in music reading instruction by integrating visual and auditory information. Their study demonstrated that spatial integration of visual text and musical notation, as well as the dual-modal presentation of auditory explanations and musical notation, were superior to the spatially separated presentation of the same materials. This approach effectively reduced the *Split-Attention Effect*, which occurs when learners must divide their attention between disparate sources of information, thereby enhancing working memory efficiency.

Price (2010) explored reducing intrinsic cognitive load by simplifying music notation for beginners. She proposed using simplified notation at the start and gradually increasing complexity as learners build their cognitive schemas. This approach aligns with CLT principles by ensuring that learners' working memory is not overwhelmed during the initial stages of learning.

Han (2021) further expanded on the role of cognitive load management by examining whether visual support in the form of song lyrics could reduce cognitive load during aural learning of a complex song. In this study, learners who saw the lyrics while learning a difficult song experienced lower cognitive load compared to those who did not have visual support, even though recall accuracy was not directly affected by this condition. However, path analysis revealed that seeing the lyrics indirectly improved recall accuracy of lyrics and rhythm by reducing cognitive load. This suggests that providing targeted visual aids, such as lyrics during song learning, can effectively manage cognitive load and support learning processes, especially for young adults with low levels of musical expertise.

2) Additional cognitive load in music performance

Çorlu, Muller, Desmet, and Leman (2015) investigated the impact of additional cognitive load on musical performance under dual-task conditions. The hypothesis was that performance expressiveness would decline when cognitive resources were diverted, such as during exam situations or concert performances. Musicians were asked to perform a piece of music while simultaneously completing a secondary task, and the results showed that additional cognitive load negatively impacted the expressiveness of their performances.

The jury's evaluations indicated that when musicians experienced additional cognitive load, their performance expressiveness decreased. An analysis of audio recordings further revealed that the pauses between musical phrases were significantly shorter in dual-task conditions, while the durations of the musical phrases themselves were unaffected. The researchers attributed this to musicians relying on non-cognitive, corporeal references for timing during playing, but losing this reference during pauses between phrases.

These findings underscore essential educational implications. They suggest that teaching strategies should be developed to help musicians manage additional cognitive load during performances. By practicing under conditions that simulate the cognitive demands of exams or concerts, learners can develop techniques to cope with performance-related stress and external evaluative factors.

Ⅲ. Method

1. Research design

This study employed a qualitative research design using Focus Group Interviews (FGI) to investigate how piano instructors manage students' cognitive load while learning Bach's C Major Fugue from *The Well-Tempered Clavier*, Book I. FGI was chosen for its strengths in gathering in-depth perspectives, fostering open discussion, and allowing participants to interact and build on each other's insights (Krueger & Casey, 2014; Morgan, 1997). This interactive method was especially suitable for exploring the complex, multi-layered cognitive load management strategies that instructors apply within real-world educational settings.

2. Participants

The study included six piano instructors recruited from universities and professional music education institutions, selected through purposive sampling. Participants were chosen based on their substantial teaching experience—each with over ten years in the field—and expertise in advanced polyphonic music, specifically Bach's fugues. This ensured that participants had the practical and theoretical knowledge necessary to provide valuable insights into the cognitive demands and instructional strategies associated with teaching complex polyphonic works.

Each instructor held at least a master's degree in piano performance, with half also holding a doctoral degree. The instructors' primary teaching levels varied slightly, with most teaching advanced or undergraduate students, while others also instructed intermediate or graduate-level students. To maintain diversity in perspectives, the study included participants from varied age groups and genders.

All instructors voluntarily participated, providing informed consent after a briefing on the study's objectives, methodology, and ethical considerations. Confidentiality was ensured, with transcriptions securely stored, thereby fostering an environment conducive to honest and detailed contributions.

3. Procedure

To minimize bias and ensure data integrity, the researcher followed specific protocols during data collection. Each participant received an overview of the study objectives and provided informed consent, ensuring they were aware of the study's voluntary nature and confidentiality measures. The Henle Edition of Bach's Fugue No. 1 in C Major was provided in advance to align participant familiarity with the content under discussion.

Two focus groups were conducted, each with three instructors, to foster group dynamics that allow for a richer exchange of ideas while keeping the group size manageable (Kitzinger, 1995). This approach ensured that all participants had adequate opportunities to share and discuss their experiences. Each FGI session was conducted in a quiet, private setting conducive to open conversation. Interviews were audio-recorded, and strict confidentiality was maintained throughout. The researcher served as the moderator, adhering to ethical research practices by maintaining neutrality, avoiding suggestive feedback, and minimizing any unintentional influence on participants' responses. The FGI sessions lasted approximately 90 minutes each. The interviews were later transcribed verbatim to preserve the authenticity of participants' responses.

Semi-structured questions guided each session, as shown in <Table 1>. These questions were grounded in Cognitive Load Theory (CLT) principles, enabling instructors to reflect on specific cognitive load aspects in teaching the fugue.

<Table 1> Semi-structured questions

#	Questions
1	What challenges do students face when learning Bach's C major fugue?
2	What strategies do you use to help manage students' cognitive load with this piece?
3	What tools or materials do you use to support cognitive load management?
4	How do you adjust your teaching methods for different student levels?

4. Data analysis

A thematic analysis approach was used to organize and interpret the data systematically (Braun & Clarke, 2006). The analysis included the following stages.

First, the transcribed data were reviewed multiple times to gain familiarity. Initial codes were generated by examining responses line-by-line to identify recurring concepts related to cognitive load and instructional strategies.

Second, codes were grouped into categories based on similarity, leading to the identification of key sub-themes such as "voice independence challenges" and "tracking subject and counter-subject." These sub-themes were refined to represent specific instructional challenges and strategies relevant to cognitive load.

Third, final themes were developed, aligning with the study's primary research questions. Two main themes emerged from the analysis. The first was cognitive challenges in learning polyphonic music, encompassing difficulties in voice independence, tracking subjects, and managing overlapping rhythms. The second theme centered on instructional strategies for cognitive load management, incorporating methods like voice isolation, section-based practice, and metronome training.

Lastly, the final structure provided a comprehensive understanding of how CLT principles are applied in the context of piano instruction, with themes reflecting both participant experiences and instructional strategies linked to key strategies from previous CLT research.

To strengthen validity, preliminary findings were shared with participants for confirmation, enhancing alignment with their experiences and adding credibility to the results. Although investigator triangulation was not possible due to the single-researcher design, methodological triangulation was employed by corroborating data through multiple FGIs, which bolstered the study's reliability and validity.

Ⅳ. Results

1. Cognitive challenges in Bach's C major fugue

The four-voice polyphonic structure of Bach's C Major Fugue from *The Well-Tempered Clavier*, Book I introduces complex cognitive challenges. This fugue requires students to maintain independence in each voice while managing harmonic and rhythmic interactions, leading to a high intrinsic cognitive load. Instructors identified specific areas where students typically encounter these cognitive demands.

1) Voice independence

Maintaining the clarity of each voice as the subject moves between soprano, alto, tenor, and bass is often difficult. Students frequently allow one voice to dominate or lose track of voices entirely. Instructor B noted, "Students tend to drop the bass when focusing on the soprano's entry, shifting their attention and neglecting the bass's continuity. Practicing the bass line alone helps them maintain its flow with other voices."

2) Tracking subject and counter-subject

As the subject and counter-subject enter at various points and registers, students often face cognitive overload trying to follow these elements across multiple voices. Instructor E observed, "Students lose track of the subject in later sections, especially in the lower voices when faster-moving upper voices obscure it."

3) Understanding structure

Fugues differ from Classical pieces by flowing continuously with minimal cadences, making structural divisions less obvious. Recognizing these divisions based on harmonic progressions, such as exposition, episodes, middle entries, and coda, is challenging. Instructor F explained, “Fugues require a solid grasp of structure, but continuous flow and subtle cadences make recognition difficult.”

4) Maintaining rhythm and tempo

Different voices often feature contrasting rhythms, such as sustained notes against faster-moving patterns, creating difficulty in maintaining tempo and rhythm. Instructor D remarked, “Students struggle with maintaining rhythm in Bach’s polyphonic textures, where each voice follows its own rhythm, causing them to rush or slow down inconsistently.”

5) Balancing voices

Balancing the dynamics across four voices, particularly when the subject or counter-subject is present, poses a significant challenge. Instructor C emphasized, “Each voice must be distinct, especially the subject and counter-subject, requiring careful control of dynamics and tone color.”

6) Articulation

Students face challenges with articulation, especially when managing contrasting articulations across voices. In Bach’s music, articulation requires specific handling, with shorter notes typically played legato and longer notes non-legato. This C Major Fugue presents particular difficulty, as many performers play eighth notes legato and sixteenth notes non-legato. Due to these varying approaches, maintaining consistent articulation for the subject and counter-subject is essential, yet students often struggle to achieve the intended clarity and consistency in articulation across voices.

7) Memorization

Memorizing the fugue adds further cognitive demands, as students need to internalize the interactions of individual voices across the entire piece. Unlike homophonic music, polyphonic pieces require tracking of recurring subjects across voices. Instructor F noted, “In polyphonic works, students must keep track of subject entries in each voice, which complicates memorization and demands a stronger grasp of structure.”

2. Strategies for managing cognitive load in Bach’s C major fugue

Instructors employed a variety of strategies to manage the cognitive load imposed by the complexity of Bach’s four-voice C Major Fugue. The following section outlines these strategies based on insights gained from the focus group interviews with the instructors.

1) Maintaining voice independence

(1) Voice isolation and sequential practice

Instructors often guided students to practice each voice individually before combining them. This approach aligns with the *Isolated Elements Effect* by allowing students to master each voice separately, reducing the cognitive load from the complex polyphonic texture. Sequentially practicing each voice and then pairs, such as soprano with bass, enabled students to handle the fugue’s intricacy progressively and build towards managing all four voices simultaneously.

(2) Using notation software

Instructor A suggested using notation software to digitally isolate each voice, allowing students to print and practice one voice at a time. This visual separation reduced cognitive load, aligning with the *Isolated Elements Effect* as students could concentrate on mastering each voice independently without being overwhelmed by the entire polyphonic structure.

(3) Dividing parts with the teacher for duet practice

Instructors employed duet practice by dividing the voices, allowing students to focus on one part while hearing the entire piece’s harmonic structure. This approach aligns with the *Completion Problem Effect*, where instructors provide partial guidance. By hearing their voice within the full texture, students better understood harmonic and rhythmic relationships without full cognitive overload.

(4) Varying articulation for polyphonic control

For added control, instructors recommended varying articulations between voices, such as playing one voice legato and others staccato. This approach uses the *Variability Effect*, helping students recognize each voice's distinctive role and navigate various articulation patterns. This increase in variability, though momentarily raising cognitive load, enhances students' ability to navigate complex polyphonic textures more confidently.

2) Tracking subject and counter-subject

In managing cognitive load in Bach's C Major Fugue, instructors employed several strategies to help students accurately track and express the subject and counter-subject across multiple voices.

(1) Marking the subject and counter-subject

Instructors encouraged students to visually mark the subject and counter-subject in their scores, helping to consolidate these elements in a single reference. This approach leverages the *Split-Attention Effect*, reducing cognitive load by minimizing the mental effort needed to track these elements. By annotating their scores, students engage more easily and deeply, enhancing their recognition and retention of the subject and counter-subject without over-relying on external guidance.

(2) Listening to audio recordings while following the score

To improve their recognition of the subject and counter-subject, students were advised to listen to audio recordings while following along with the score. This method integrates visual (score) and auditory (recording) channels, aligning with the *Modality Effect.* By engaging these channels together, students process the material more effectively, making it easier to identify and articulate the subject and counter-subject in their own performances.

(3) Practicing the subject and counter-subject separately

Instructor D recommended isolating the subject and counter-subject for separate practice. This isolated approach allows students to fully understand each element's development and thematic role before integrating them. Reflecting the *Isolated Elements Effect*, this method simplifies the learning process by reducing cognitive load through focused practice on one element at a time, fostering a clearer understanding of their distinct roles in the fugue.

(4) Internalizing subject and counter-subject through vocalization

Another effective technique was having students vocalize the subject and counter-subject, using syllables like “la” or “da.” Instructor D often split the parts between student and teacher for this exercise. This strategy reinforces the polyphonic structure’s vocal roots, and by varying the modes of practice and engaging multiple senses, it leverages the *Variability Effect*, enhancing comprehension and skill transfer through auditory, vocal, and kinesthetic engagement.

(5) Instructor modeling to balance voices

For students struggling to adequately express prominent voices, some instructors played along to reinforce these voices’ presence. This approach, which uses the *Worked Example Effect*, allows students to observe and emulate a balanced expression in polyphonic music. By modeling the difficult passages, instructors help students manage cognitive load and achieve the structure and balance required in polyphonic performance.

3) Understanding structure

(1) Analyzing structure and identifying harmonic progression

Instructors agreed that analyzing the fugue’s structure and harmonic progression is essential for understanding the interactions between voices, especially during points of harmonic tension and modulation. Teacher C explained, “I ask students to analyze the harmonic structure, including areas of tension and resolution, so they can map out the broader architecture of the piece.” This type of analysis aids in organizing and internalizing the complex elements of the fugue, increasing germane cognitive load by fostering deeper engagement with the material. This process supports schema construction, helping students build a mental framework for understanding the fugue’s overarching structure and enhancing their interpretive accuracy.

(2) Sectional practice

To better understand the structure and manage the complexity of the fugue, Teacher B advocated breaking the piece into smaller, meaningful sections based on its structural components, rather than practicing it as a whole from start to finish. “I always tell students to divide the piece into sections and practice each section independently. Then, when they connect sections, I have them experiment by practicing different combinations of sections,” explained Teacher B. This method aligns with the *Isolated Elements Effect*, as it minimizes cognitive overload by allowing students to focus on smaller parts before integrating them. By segmenting the fugue according to its structural elements, students not only reduce cognitive strain but also enhance their structural understanding of the piece. This approach supports schema construction, helping students build a mental framework for the fugue's overarching architecture, and facilitates progressive mastery of its complexity.

4) Maintaining rhythm and tempo

(1) Setting tempo based on the smallest note value

Instructor C recommended setting the tempo according to the smallest rhythmic unit—here, the thirty-second note. By choosing a tempo that allows comfortable execution of these notes, students establish a stable rhythmic base for the entire piece. By not imposing a rigid tempo goal, this strategy leverages the *Goal-Free Effect*, reducing extraneous cognitive load by allowing students to set their own pace and approach the task without undue cognitive strain.

(2) Practicing with a metronome

Metronome practice was emphasized for its role in maintaining rhythm and tempo consistency. Instructor C noted that "Bach's music loses its effectiveness if the rhythm and tempo are unsteady," advocating for steady metronome use to highlight the polyphonic structure. This practice reduces extraneous cognitive load by providing a rhythmic framework, relieving students of the effort to maintain tempo and allowing focus on interpretation, such as expression and voice balance.

(3) Simplifying complex rhythms for practice

To assist with challenging rhythms, Instructor B recommended simplifying sections. For instance, students might replace complex patterns (e.g., dotted eighth notes followed by sixteenths) with more straightforward quarter notes, helping them focus on consistent rhythm across voices before tackling intricate patterns. This method corresponds with the *Isolated Elements Effect*, allowing students to process a simplified version of the rhythm initially, which reduces cognitive load and builds a foundation before reintroducing full complexity.

(4) Marking the beat physically

Instructor E suggested that students tap their foot or voice the beat, encouraging them to physically mark the rhythm. This kinesthetic technique enhances internal rhythm and tempo consistency, supporting the coordination needed for polyphonic texture. This approach aligns with the *Human Movement Effect*, as it integrates physical movement into learning, helping students internalize complex rhythms more intuitively and aiding their overall coordination in performance.

5) Balancing voices

(1) Listening to professional recordings

Instructors encouraged students to listen to professional recordings to grasp the balance and dynamics across voices, particularly to distinguish the subject and counter-subject within the polyphonic texture. This strategy is closely aligned with the *Worked Example Effect*, as students are provided with an expert model that showcases optimal balance and control. By listening to accomplished performances, students reduce cognitive load by focusing on a clear reference model before attempting to emulate it in their own practice.

(2) Defining dynamics for each voice

Instructors advised marking dynamics directly on the score to specify which voices should be emphasized or subdued. By marking each voice with distinct dynamic indicators (e.g., *f* for the subject, *mf* for the counter-subject, and *mp* for supporting voices), students gain a clear and visually organized guide to manage voice prominence accurately. This approach reduces ambiguity in dynamic control and reflects the *Modality Effect*, as it integrates visual cues (dynamic markings) with auditory cues (sound differentiation), enabling students to process these elements through multiple sensory channels, thereby enhancing learning.

(3) Exaggerating dynamics during practice to emphasize balance

Instructors suggested exaggerating dynamics for each voice during practice. For instance, students might play the subject with *ff* dynamics while rendering supporting voices with *pp*, even if final performance dynamics are intended to be more nuanced, such as *mf* and *mp*. This exaggerated practice aids students in mastering dynamic control and internalizing the prominence of each voice, promoting ease in refining subtle adjustments later. This strategy aligns with the

Variability Effect, as it introduces varied dynamic levels and interpretations, helping students identify key contrasts and improve their dynamic management.

(4) Using recordings and self-assessment for reflection

Instructors frequently encouraged students to record and review their performances as a form of self-assessment. Teacher F noted, "I have students record their performance and review it. Listening to themselves on a recording helps them identify issues they might not notice in real-time." This strategy leverages the *Self-Explanation Effect*, which enhance learning by encouraging students to actively engage with their own performance. By critically analyzing their recordings, students can more effectively evaluate and refine their skills, leading to deeper understanding and improved performance.

6) Articulation

(1) Comparison of editions and interpretations

Instructors advised students to compare various editions of the score to deepen their understanding of phrasing, articulation, and interpretative possibilities. Teacher B noted, "I have students compare multiple editions of the fugue, particularly for fingerings, phrasing, and articulation. By doing this, they learn to make their own decisions about how to interpret the music." This approach aligns with the *Worked Example Effect*, allowing students to observe different editorial interpretations and offering models for analysis and imitation. Through this comparison, students build a foundation of interpretive choices based on expert examples, facilitating informed decision-making in their own performances.

Teacher F added, "In Bach's music, each edition offers different fingerings, phrasing, dynamics, and articulation markings, yet the original scores lack these annotations since they were not standard in Bach's time. While modern editions add helpful interpretative markings, they can also clutter the score. I encourage students to selectively annotate necessary fingerings, phrasing, articulation, and dynamics on a facsimile score." This approach also highlights the *Redundancy Effect*. By marking only essential elements, students reduce visual clutter, avoiding cognitive overload and focusing on critical interpretive elements. This selective annotation strengthens their ability to apply dynamics, articulation, and other choices effectively.

(2) Referring to various recordings

Several instructors suggested listening to recordings by different performers, both professional and amateur. Teacher F emphasized, “I make sure students listen to different performances of the fugue and choose interpretations they like. Then, they try playing it in that style, which helps them develop their interpretation.” This strategy also utilizes the *Worked Example Effect*, as students encounter diverse interpretative approaches, giving them models to guide and inspire their stylistic development.

(3) Experimenting with diverse articulations

Instructors encouraged students to try various articulations throughout the piece, such as playing sections entirely staccato, legato, or with different slurs and accents. By experimenting, students identify articulations that best convey the fugue’s character and structure. Instructor A explained, “There’s no fixed articulation or tempo in Bach’s music, as he didn’t specify them. Bach’s pieces allow students to create their own style, so I have them play it staccato, legato, or with various slurs and even experiment with tempo.” This approach aligns with both the *Variability Effect* and the *Goal-Free Effect.*

The *Variability Effect* enables students to engage with multiple articulation options, enhancing flexibility and deepening interpretative understanding. Meanwhile, the *Goal-Free Effect* allows students to explore articulations without a predetermined goal, fostering open-ended experimentation. This strategy promotes autonomy and creativity, empowering students to build their unique interpretive style through exploration.

7) Memorization

(1) Memorizing by voice

Instructors recommended memorizing each voice independently to handle the complexity of polyphonic pieces more effectively. Instructor B noted, “I have students memorize the bass, soprano, and middle voices separately, then gradually combine them. This approach helps them clearly identify and remember each voice’s role.” This technique aligns with the *Isolated Elements Effect*, as it allows students to focus on each part separately, reducing cognitive load and enabling them to comprehend the unique function of each voice within the fugue.

(2) Memorizing by section

Dividing the piece into sections for incremental memorization was another suggested approach. Instructor F explained, "I guide students to memorize the piece section by section, then gradually link each part. Sometimes, I even have them start from the middle or memorize backward from the end." This method corresponds with the *Isolated Elements Effect*, as it allows students to focus on smaller, manageable sections, reducing cognitive strain and enabling clearer structural understanding.

(3) Memorizing through solfège

This strategy involves memorizing the melodic lines of each voice using solfège, which is particularly effective for polyphonic music where each voice follows its own melody. Practicing with solfège allows students to individually recognize and internalize each voice. This method reflects the *Variability Effect*, as it helps students memorize the unique melodies of each voice individually, allowing them to better internalize and recall the interactions between voices.

(4) Mental practice for memorization

Mental practice involves visualizing the score and rehearsing the music mentally. Instructor C remarked, "Students often rely on hand movements for memorization, which can cause issues on stage if they lose track of hand positions. Mental practice helps them retain the music visually (as an image) and aurally (through inner hearing)." This technique enhances germane cognitive load appropriately by promoting meaningful cognitive engagement beyond physical movements, encouraging students to internalize the piece fully through both visual and auditory imagery.

3. Application of tailored educational strategies

Instructors implemented a gradual, level-specific approach to adapt strategies to each student's skill level and readiness when learning Bach's C Major Fugue. Recognized as one of the more challenging four-voice fugues in *The Well-Tempered Clavier*, this piece presents students with significant technical and cognitive demands due to its frequent subject entries and use of stretto (where the subject overlaps closely with itself). To help students build essential polyphonic skills, instructors typically first assign three-voice fugues, where students can develop a solid foundation in managing polyphonic textures. Only after demonstrating proficiency in these simpler structures are students introduced to four-voice fugues, such as the C Major Fugue, to tackle additional complexity.

Many students choose this fugue due to the popularity of its Prelude, yet instructors assess each student's readiness for the fugue's demands. Teacher E noted, "This fugue is usually assigned to students who have already successfully mastered other three-voice or four-voice fugues. These students can manage multiple voices well. While I ensure they recognize the subject and counter-subject, I often focus more on musical interpretation, allowing them to isolate difficult passages or work on two voices at a time to deepen their expressive skills."

This method acknowledges the *Expertise Reversal Effect*, adapting instructional strategies as students progress. By building foundational skills first, instructors can modify their teaching approaches to suit the increasing expertise of the student, ensuring continuous development without unnecessary cognitive overload.

Ⅴ. Conclusion

This study demonstrates how targeted CLT-based strategies can effectively manage the cognitive load experienced by students in learning complex polyphonic pieces, such as Bach's C Major Fugue from *The Well-Tempered Clavier*, Book I. These strategies were particularly effective in addressing challenges related to voice independence, tracking the subject and counter-subject, understanding structural frameworks, managing overlapping rhythms and tempo, balancing voices, refining articulation, and memorization.

Among the strategies identified, the *Isolated Elements Effect* proved essential in managing voice independence, as students benefited from voice isolation and sequential practice. By focusing on individual voices before combining them, students were able to reduce cognitive load and master each component of the fugue's polyphonic structure. To aid in tracking the subject and counter-subject, visual annotation and the use of recordings were highly effective, leveraging the *Modality Effect* to engage both visual and auditory channels, which minimized cognitive strain while reinforcing thematic recognition.

The *Worked Example Effect* and *Completion Problem Effect* were successfully employed to model voicing and articulation practices. Instructors used professional recordings and partial guidance during duet practice to provide clear examples of how voices should interact, helping students internalize these interpretative elements without full cognitive overload. The *Split-Attention*

Effect was addressed by integrating relevant score annotations directly, allowing students to concentrate on critical details without having to mentally coordinate multiple information sources.

To maintain rhythm and tempo, instructors recommended kinesthetic methods, such as physical beat-marking, aligning with the *Human Movement Effect* by incorporating bodily engagement into rhythmic practice. Additionally, instructors utilized the *Goal-Free Effect* by removing rigid tempo goals, allowing students to explore tempo freely. This approach reduced extraneous cognitive load and enabled students to work at a pace that suited their individual needs.

By recording and reviewing their performances as a form of self-assessment, students benefited from the *Self-Explanation Effect*, which enhances learning by encouraging them to actively engage with their own performance. Through varied articulation exercises and exaggerated dynamics practice, the *Variability Effect* allowed students to explore a range of interpretations, deepening their understanding of expressive possibilities. These approaches raised germane cognitive load, encouraging meaningful processing that contributed to schema construction and interpretive flexibility. Finally, the *Redundancy Effect* was minimized by selectively annotating scores and limiting non-essential information, allowing students to focus exclusively on the critical elements of performance.

In conclusion, the findings of this study illustrate how the careful application of CLT principles can optimize instructional methods for complex polyphonic music. By reducing unnecessary cognitive load and promoting productive cognitive engagement, these strategies foster both technical and expressive growth, providing a robust framework for advanced music education.

Based on the findings of this study, several recommendations can be made for future research. First, exploring CLT-based instructional strategies across various musical genres and complexity levels could reveal how cognitive load management varies by style and task difficulty. Second, developing cognitive load measurement tools specifically for music learning would allow researchers and educators to assess and adjust instructional strategies more precisely. Third, examining the effectiveness of instructor-led adaptations of CLT strategies in improving student performance could provide valuable insights into optimizing these approaches. Finally, gathering student perspectives on CLT-based instruction could help refine these strategies, making them more student-centered and effective.

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