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Constructing Music by Teresa Nakra. Book review.

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ABSTRACT

Nakra, T. M. (2024). *Constructing music: Musical explorations in creative coding*. Oxford University Press, Incorporated.

Technology is a crucial tool for enhancing music creativity and pedagogy, enriching learning rather than posing a threat to traditional educational means. The integration of computers into music pedagogy allows educators to access numerous resources, refining teaching methodologies and inspiring students' musical pursuits. Embracing technology in music education enables dynamic exploration of composition, production, and performance, fostering an interactive and engaging learning environment. Computers and AI offer opportunities for revitalizing music instruction and deepening students' appreciation for the art form.

Teresa M. Nakra's *Constructing Music* presents an innovative approach to music theory instruction by substituting traditional Western notation with principles of computer programming. Through illustrative examples, the book guides learners in studying and making music using Max, advancing from basic to complex structures. Nakra's fusion of music theory and programming offers a fresh perspective, encouraging lateral thinking and creative exploration. By bridging object-oriented programming in Max with music theory, the book provides an inclusive approach to music education, empowering students to engage deeply with music through technology.

Variego, Jorge. (2024) Review of Teresa M. Nakra's *Constructing Music*. *Journal of the Association for Technology in Music Instruction*, 4 (1).

BOOK REVIEW

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Technology serves as a crucial instrument for augmenting music creativity and pedagogy, offering tools to enhance learning experiences rather than posing a threat. Through the integration of computers, educators can access a plethora of resources to refine their teaching methodologies and inspire students' musical endeavors. Embracing technology in music education allows for dynamic exploration of composition, production, and performance, fostering an interactive and engaging learning environment. Computers are here to stay; AI is here to stay. Rather than fearing the rise of technology, educators can harness its potential to revitalize music instruction and cultivate a deeper appreciation for the art form among students. Paraphrasing Leonard Bernstein, music technology can help us communicate the unknowable.

Teresa M. Nakra's *Constructing Music* (2024) introduces an innovative approach to music theory instruction, substituting traditional Western notation with fundamental principles of computer programming. Through numerous illustrative examples, the book guides learners in constructing musical compositions using code (in Max), gradually progressing from basic concepts to more intricate structures. In the current landscape of music education, computers have seamlessly integrated themselves, serving as essential tools for learning, research, and instruction. Nakra's proposed fusion of music theory and programming offers students a fresh perspective, encouraging lateral thinking and creative exploration. By bridging the realms of object-oriented programming in Max with music theory, the book not only imparts knowledge but also invites readers on a journey of discovery.

Max is the main tool for the “constructing” portion of the book. This piece of software is an object-oriented programming language (OOP) that could be seen as a musical prolongation of Scratch (the MIT developed tool that focuses on programming concepts through creative projects and games). In a nutshell, OOP is a programming paradigm that organizes software design around objects and their interactions. In OOP, objects are instances of classes which encapsulate data and behaviors relevant to a particular concept or entity. These objects communicate with

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each other by sending messages, which invoke methods or functions associated with the receiving object (Griffiths & Cook 2014).

Scratch and Max are both OOP that have similarities despite being designed for different purposes. Both platforms utilize a visual programming paradigm, allowing users to create and manipulate code elements through graphical interfaces rather than traditional textual coding. This graphical approach enhances accessibility and facilitates rapid prototyping, making both Scratch and Max popular choices for beginners and experienced users alike. Additionally, both platforms prioritize real-time interaction and experimentation, enabling users to dynamically modify and observe the effects of their programming decisions. Both Scratch and Max offer a shared commitment to empowering users to express themselves through computational creativity.

Nakra's choice of Max is not random. Max is well supported and has a strong worldwide community of users. Additionally, the tools provided in the book plus the companion online resources give the student a myriad of options for further investigation and discovery. MSP (for digital sound processing), Jitter (video editing and manipulation in real time), and Max4Live (facilitates the integration with Ableton) are just a few of the resources that are included with the software.

With the aid of technology, *Constructing Music* aims to broaden the accessibility of music comprehension and inventive expression to a wider demographic of students. It tackles obstacles that, according to Nakra, limit the pursuit of music education beyond secondary school. It seeks to create a more inclusive environment that welcomes diverse musical perspectives, styles, and methodologies. Through this endeavor, it strives to democratize the process of musical learning and creativity, ensuring that a broader spectrum of individuals can engage meaningfully with music at a post-secondary level.

In an era of evolving pedagogical practices, there arises a pressing need to reassess music theory instruction, aiming for greater inclusivity and relevance to the upcoming generation of musicians. *Constructing Music* emerges as a meaningful contribution in this endeavor, prompting a reevaluation of traditional methodologies in music theory education centered around the study of musical notation. *Constructing Music* challenges this conventional approach by posing a fundamental inquiry: can music theory be effectively taught without relying on traditional musical notation?

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Music education has traditionally emphasized the importance of proficiency in music notation as a fundamental skill. However, while notation literacy is valued for its ability to communicate musical ideas, it can inadvertently deter the promotion of diversity and inclusivity within the classroom. Students are expected to be proficient in music notation, but few have access to music instruction besides the school curricula. This fact is at the crux of the motivations of the book. In the introduction, Nakra says: “Ethically, it is imperative that we develop alternative approaches and evaluate their effectiveness in recruiting and retaining new populations of students. It may likely remain a standard expectation that college music graduates be able to confidently read written music notation (depending upon the style of music in which they work), but whether they need to have that skill before they begin their studies should be thoughtfully reconsidered. (p. 22)”

The call for reconsideration of traditional expectations regarding music education, particularly the emphasis on proficiency in reading written music notation, reflects a growing awareness of the need for inclusivity and flexibility within the field. By acknowledging the importance of alternative approaches in recruiting and retaining diverse student populations, educators uphold ethical principles of fairness and accessibility. While proficiency in music notation may still be relevant in certain contexts, such as classical or orchestral settings, its necessity as a prerequisite for *all* music studies warrants critical examination. This reflection aligns with the evolving landscape of music education, which increasingly values diverse skill sets and perspectives. As music styles continue to diversify and technology shapes creative processes, educators must adapt their approaches to accommodate the changing needs and interests of students. Embracing alternative methods that prioritize creativity, collaboration, and innovation fosters a more inclusive environment where all aspiring musicians can thrive. As music educator and researcher Randall Allsup states, "Music education must engage and empower students, providing them with opportunities to express themselves in meaningful ways." (Allsup 2016).

In the 20th century, composers began to question the limitations of the Western system of musical notation. While Guido's contribution solidified the concept of representing music in a two-dimensional space, composers found that traditional staff notation was insufficient for capturing the intricacies perceived by their inner musical ear. As a result, they started developing

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their own systems to visually represent music and sound, aiming to better convey the nuances of their sonic imagination. British composer Cornelius Cardew's "Treatise" challenged conventional notions of accessibility while embracing inclusivity through its open-ended structure. Inspired by graphic notation, the piece eschews traditional musical notation in favor of a visual score filled with abstract symbols and shapes (Cardew 1967). This departure from standard notation offers a democratic platform for performers of varying skill levels and backgrounds to engage with the music on their own terms. In doing so, Cardew invites participants to co-create the musical experience, democratizing the act of composition and performance. This democratization aligns with Cardew's broader socio-political ideals, emphasizing accessibility and inclusion within the realm of experimental music. Through "Treatise," Cardew not only challenges hierarchical notions of musical authority but also fosters a sense of community and collaboration among performers and audiences alike, embodying the spirit of accessibility and inclusion in contemporary music. *Constructing Music* presents an alternative to the barriers created by western musical notation, not with another notational system (like Cardew) but simply by integrating music theory to technology and viewing music theory from a sound-centric tech-immersive perspective.

The connection between STEM disciplines and music lies in their shared principles of creativity, problem-solving, and innovation. Both require analytical thinking, precision, intuition, and attention to detail. Music composition often involves mathematical concepts such as rhythm, meter, and harmony while the development of musical instruments relies heavily on engineering (also involving digital means) and acoustics. Moreover, advancements in technology have revolutionized the way music is created, produced, distributed, and experienced. Digital Audio Processing, Acoustics and Instrument Design, and Music Information Retrieval are some of the fields in which the close intersection between science and music manifest. Nakra underscores the inherent synergy between creativity and scientific inquiry in the Introduction of *Constructing Music*. Subtitle I.4 of the Introduction, “Approach,” (p. 26) shares specific conceptual connections between the approach (and tools) offered in the book and those developed by STEM fields that can be applied toward understanding and creating music. At a meta-level, music and STEM coexist within the same abstraction layers, utilizing shared principles of statistical analysis, machine learning, and artificial intelligence. Both disciplines operate on complex data

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structures and pattern recognition. In music, these concepts manifest in sound wave analysis, algorithmic composition, and digital signal processing. Similarly, STEM fields leverage statistical methods to interpret data, apply machine learning for predictive modeling, and use AI for solving complex problems.

The book is structured in six chapters, each delving into essential aspects of music and programming within the framework of Max. Conceptually open and hands-on inviting, the book could be a valuable resource for high school students and college undergraduates in their first years of study. Depending on the instructor's vision, the examples provided in the book and in the companion website could be expanded (infinitely!) fulfilling the needs of a number of music theory, composition, and music technology courses.

The initial chapter, "Tutorials," serves as a foundational introduction, providing crucial insights into Max and object-oriented programming, particularly tailored for novices in the field. The select list of objects and programming concepts offered in this chapter open the door for the instructor to explore other worlds (not necessarily sonic) including infinite loops, arithmetic operations, routing, variables and arguments, including MIDI. The list is purposely select; a programming course based on MIDI could easily be developed upon these concepts.

The second chapter, "Building Blocks," explores the fundamental properties of sound, offering insights into rhythm, timbre, and concepts such as consonance and dissonance. Additionally, this section introduces basic sequencing and rhythmic patterns, shedding light on often overlooked matters in traditional music theory courses, such as noise and timbre.

The third chapter, "Pitch-based Structures," navigates the auditory landscape in the vertical domain, discussing intervals while concurrently introducing mapping and MIDI as indispensable tools for pitch manipulation within Max. Similarly, the fourth chapter, "Time-based Structures," further explores the temporal dimension of sound, delving into intricate rhythmic structures and their implementation within the software. Transitioning to the fifth chapter, "Finer Granularities," the focus shifts to the translation of frequency into pitch and the exploration of tuning systems.

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An example of how Max is implemented

In chapter six, “Reflections,” the author revisits the core concepts introduced in the book's introduction, drawing attention to the interdependent relationship between music technology and education. Employing a clever use of recursion, the author underscores the pivotal role played by music technology in fostering accessibility and inclusivity within music education. Through a thought-provoking exploration, the author ventures into a conceptualization of music as not merely a form of entertainment but as a quintessential human activity. As Nakra eloquently writes, "Music is the human activity of creative expression through sound" (p. 210), encapsulating the profound essence of music as a medium through which individuals express and understand the complexities of human experience. This exploration further elucidates how music serves as a channel for understanding the interconnectedness of various aspects of existence, including physical embodiment, cognitive perception, and emotional resonance. By delving into the patterns inherent in music, individuals gain invaluable insights into the essence of humanity itself, uncovering essential aspects of both the human condition and the limitations inherent in it. Ultimately, music emerges not only as a distinctive human endeavor but also as one of the most potent vehicles for learning about the intricacies of being human.

The book unfolds as a series of opportunities for discovery through interdisciplinary connections that stimulate lateral thinking. In discussing silence, the author references Cage's "4'33"" and Rauschenberg's "White Paintings," illustrating how absence of sound and visual emptiness can provoke thought. The exploration of noise vs. music incorporates Luigi Russolo’s futurist ideas and the Dadaists' avant-garde, framing sound as an artistic medium. By examining the use of traffic noise in Gershwin's "An American in Paris" and Antheil's "Ballet Mécanique," the book demonstrates how everyday sounds can be integrated into musical compositions. While offering technical information, it remains focused on teaching music theory and sound manipulation using computers. The book proposes a broad concept of music as a “human activity of creative expression through sound” (p. 210). Its introduction, tutorials, and reflective final chapter provide ample opportunities for learning and contemplation, encouraging readers to engage (and appropriate) the material in their own creative processes.

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The connection between music, sound and technology brings back Edgar Varese's reflections on Liberation of Sound (Varese, Wen-Chung 1966). Varese's preferred conceptualization of music as "the corporealization of the intelligence that is in sound,"[1] manifests his personal view of music as "organized sound." According to Varese, the benefits of using technology in music are numerous. Computers offer a liberation from the arbitrary constraints of the tempered system, enabling the creation of any number of cycles or subdivisions of the octave, and thus any desired scale. They also extend the range in both low and high registers and introduce new harmonic splendors through sub-harmonic combinations, impossible to achieve with acoustic instruments. They allow for any differentiation of timbre and sound combination, surpassing the dynamic range of traditional orchestras. Additionally, computers enable sound projection in space, allowing sound to emanate from any part of the hall as required by the score. They also facilitate the execution of cross-rhythms unrelated to each other, treated contrapuntally, as machines can handle any number of notes, subdivisions, omissions, or fractions within a given time unit, far beyond human capability. Nakra's book echoes Varèse's as it proposes the integration of technology in music making in an all-inclusive vision. *Constructing Music* is soaked with Varese's pioneer interdisciplinary thought in the arts.

Among the vast literature about making and studying music with computers, there are a few publications that share interests and points with *Constructing Music*. *Learning Music Theory with Logic, Max, and Finale* by Geoffrey Kidde (2020) proposes an integration of music theory with practical applications in Logic, Max, and Finale. This book offers recipes for Max patchers that demonstrate essential music theory concepts such as scales, chords, and progressions. The approach of this book follows a more-or-less traditional approach to teaching music theory; it talks about meter, tempo, pitch, scales, triads, triads with sevenths, melody and harmonic progressions. The integration of the computer proposed by Kidde lies within a traditional structure. *Composing Interactive Music* by Todd Winkler (2001) is a classic resource for learning Max. In *Composing Interactive Music*, Winkler presents both the technical and aesthetic potential of interactive music. Not intended to convey any topics related to music theory, this book remains as an extremely valuable resource. *Max/MSP/Jitter for Music: A Practical Guide*

[1] This all-inclusive concept was proposed by Polish mathematician and philosopher Hoene Wronsky (1778-1853).

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to Developing Interactive Music Systems for Education and More by V. J. Manzo (2020) provides step-by-step instructions and examples for developing interactive music systems using Max and Jitter. Through clear, step-by-step instructions, the book provides the tools needed to design and complete meaningful music projects in Max. This book is aimed at educators and music technologists and could be incorporated as an extension (e.g. with Jitter and interactive visuals) to *Constructing Music*. *Step by Step: Adventures in Sequencing with Max/MSP* by Gregory Taylor (2018) focuses on building and customizing step sequencers with Max/MSP. This book starts with simple patches and gradually introduces more complex variations, ideal for intermediate users. Focused on teaching sequencing, this book targets a specific audience and subject and could also be used as an extension to Nakra's title. The last one of this short list of books on the topic is *Electronic Music and Sound Design: Theory and Practice with Max 8* by Alessandro Cipriani and Maurizio Giri (2010). This book is structured for use in university courses and offers a thorough overview of Max 8. It includes a glossary, tests for students to evaluate their progress, and hundreds of sample patches and interactive exercises. Although intended for sound designers, the book by Cipriani and Giri offers unique features worth mentioning. One of them is that it provides tests for students to assess their progress. Assessment in music technology education is critical as it serves to evaluate students' understanding and application of new concepts, ensuring they acquire both theoretical knowledge and practical skills. Effective assessment methods include formative assessments, such as project-based tasks and real-time feedback during practice, and summative assessments, like exams and final projects. The approach of *Constructing Music* to assessment is somehow open, centered on the instructor's discretion. Nakra's book could help the instructor's assessment goals if it included a series of suggested 12-week course plans with expectations adjusted to different audiences, sequential course planning ideas (e.g. for a semester or a year), recommended projects with guidelines (Winkler and Cipriani's books come to mind here), exercises at the end of each new topic with clear guidelines and rubrics.

Some of the reflections from chapter six are worth revisiting. Constructionism, rooted in Jean Piaget's theory of constructivism, emphasizes learning through active engagement and personal knowledge construction. Piaget's idea that learners build understanding through experience and reflection is particularly relevant in music production, where creative technology

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plays a transformative role. Digital instruments and music production software embody constructionist principles by enabling users to experiment, create, and learn through doing. These tools are widely available (and cheap!), they democratize the access to music. Today, anyone with a computer can learn music making music. By lowering barriers to entry (not the expectations but the systemic hurdles that prevent students from studying music privately during K-12), digital tools allow individuals from diverse backgrounds to participate in music production, bringing new styles and genres into higher education curricula. Creative technology thus facilitates a more inclusive approach to music education, broadening the musical canon and enriching the educational landscape.

Students make music on computers from an early age; sounds created on computers naturally cohabitate with others created (and recorded in computers) made by "traditional" instruments. The computer is a natural companion for sonic creative activities and performances. Young musicians navigate the world of looping, sampling, DJ'ing and real time processing with inherent familiarity and ease. It seems only natural that the study of music (in the broad sense proposed by Nakra) involves computers in every stage. Constructionism in music education can transform passive learning into an active, creative process, empowering students to become composers and producers.

||: The world needs more musicians, performers, educators and scholars who integrate computers into their craft :|| Music education should offer balanced opportunities for young musicians specializing in computer music, free from the constraints of traditional Western musical notation. After all, computer coding is another type of music notation.

Constructing Music presents a fresh perspective on music theory by reinterpreting it as a *dynamic process of sound creation*. The author encourages readers to appropriate the power of code to actively explore, simulate, and manipulate sonic elements. By embracing creative coding, learners are empowered to interact with musical concepts in an engaging manner. Rather than relying solely on pre-recorded tracks or (given) static sheet music, students are encouraged to interact with code snippets, gaining insights into the sonic blocks that "make" music, actively participating in their recreation. In *Constructing Music* music (sound) and coding (notation) cohabitate in a world of endless possibilities for learning through making.

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Jorge Variego was born in Rosario, Argentina. He is a former Fulbright Scholar and is currently on the Music Theory/Composition faculty at the University of Tennessee, Knoxville and is the director of the composition program at the Sewanee Summer Music Festival. His music can be heard in the Parma, Albany Records, CMMAS, Centaur and Naxos libraries.

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In 2018 his book on algorithmic composition was released by the National University of Quilmes, in Argentina ISBN-10: 9875585025. During that same year he received the support of the Swedish Arts Grants Committee to be resident composer at the Visby Centre for Composers and was guest lecturer at the Universidad Autónoma de Madrid, in Spain. Among his recent research endeavors, his book "Composing with Constraints" was published by Oxford University Press in 2021. In 2023 he was a guest at many festivals, including the inaugural Festival de Música Algorítmica y Modular hosted by the Universidad Nacional de Musica de Perú, in Lima.

Jorge is the founder director of the Domino Ensemble a non-profit organization dedicated to the promotion, commission, and performance of new music with improvisation. The group released its first album "Purple Ego" (Centaur) in 2019 and "Recompensa" (Centaur) in 2023. In 2023 the ensemble performed at the Big Ears festival in collaboration with British author Geoff Dyer.

He is the founder director of the UT Electroacoustic Ensemble, a student group dedicated to free improvisation with electronic media and is member of the Society of Composers National Council.

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