JSM (15) (1)

JURNAL SENI MUSIK

https://journal.unnes.ac.id/journals/jsm/index

Technology Based Deep Learning In Music Theory Instruction: A Classroom Action Research Study

Louis Da Valentia Mesdilla, Dian Hediati, Barkah Bangkit Wijaya

Program Studi Pendidikan Musik, Fakultas Bahasa dan Seni, Universitas Negeri Jakarta; Jl. R. Mangun Muka Raya, RT.11/RW.14, Rawamangun, Kec. Pulo Gadung, Kota Jakarta Timur, DKI Jakarta 13220; Telephone +62-21-4721340

mesdillalouis@gmail.com; dherdiati@unj.ac.id; barkahbangkitw@unj.ac.id

Article Info

Received : June, 2026

Approved: June, 2026

Published : August, 2026

Keywords:

classroom action research
deep learning
digital learning media
music theory
MUSSICA

Abstract

Music theory instruction at the senior high school level is frequently delivered through conventional, memorization-based methods that can limit engagement and motivation among digital-native students. This study describes teachers' strategies in implementing a Deep Learning Model grounded in the principles of Mindful, Meaningful, and Joyful learning and examines its impact on music theory outcomes using the MUSSICA web based learning platform. The study employed the Kemmis and McTaggart Classroom Action Research (CAR) model across two cycles involving 41 students of class XI-E at SMA Negeri 45 Jakarta. Data were collected through participatory observation, semi-structured interviews, Google Form-based achievement tests, and a Deep Learning reflection instrument, then analyzed using the Miles and Huberman model. The mean learning outcome score increased from 63.02 in the Cycle I Post-Test to 82.34 in the Cycle II Post-Test, while classical mastery rose from 41.5% to 85.4%, exceeding the predetermined 80% indicator. The reflection instrument produced a mean score of 61.8 out of 75, categorized as high, with the Joyful dimension scoring highest. The findings affirm the relevance of the Deep Learning Model as a pedagogical instrument within Indonesia's Kurikulum Berdampak and provide a practical model for technology-based music education.

☒ Corresponding Author: Louis Da Valentia Mesdilla
Email: mesdillalouis@gmail.com

ISSN 2503-2860

INTRODUCTION

Music learning at the Senior High School (SMA) level is an important aspect in the development of students' artistic abilities and creativity. Music is not only a medium of artistic expression, but also an essential tool for cognitive and emotional development crucial to the character and intellectual growth of adolescents. However, conventional learning processes often make learning tedious and frequently cause students to lose interest over time.

Indonesia currently faces a major challenge a learning crisis that has impacted the quality of education. Although the country has relatively good educational access from the primary to secondary levels, the approaches provided to students have not yet been fully effective. Ineffective learning approaches ultimately affect students' literacy and numeracy abilities, which remain at low levels as evidenced by PISA results. Based on PISA 2023, Indonesia still occupies a low ranking, with an average numeracy literacy score of 366 points, 106 points below the world average. As many as 82 percent of Indonesian students still have abilities below level two in literacy and numeracy (Yuda & Rosmilawati, 2024). This is further compounded by disparities in the effectiveness of school learning, which have not sufficiently allowed teachers to develop students' creativity and critical thinking skills (Mu'ti, 2025).

Another challenge is teacher competence, which must continue to be improved so that teachers develop a growth mindset. For example, the model of teaching through lectures and continuous material presentation in a single session is increasingly irrelevant to today's generation. Students quickly become bored and lose enthusiasm, reducing focus and ultimately making the delivered material ineffective. Consequently, students are unable to perform well during final examinations.

The emergence of the Deep Learning (Pembelajaran Mendalam/PM) approach seeks to provide a far more engaging and comprehensible learning method for students through the use of innovative media. Deep Learning is defined as an approach that upholds dignity by emphasizing the creation of a learning atmosphere and process that is mindful, meaningful, and joyful through holistic and integrated cognitive, affective, aesthetic, and physical engagement (Mu'ti, 2025). As technology develops, particularly in music learning, significant opportunities have emerged to apply more interactive, adaptive, and personalized learning methods.

The use of the Deep Learning model, particularly in the world of music education, can help students understand music theory and practice more effectively and enjoyably. For instance, applications capable of drawing active and interactive student responses, providing constructive feedback, and offering visual representations of music theory in a practical manner make the learning process more interactive and motivating. This differs substantially from traditional methods that tend to be one-directional and less capable of providing special attention to each student's learning needs.

SMA Negeri 45 Jakarta, as an educational institution committed to innovation and improving learning quality, greatly needs modern, technology-based learning models. The integration of the Deep Learning model is expected not only to enrich conventional music teaching methods but also to accelerate students' adaptation to the demands of the digital era, where technology has become an integral part of daily life. Thus, music learning at SMA Negeri 45 Jakarta will not merely focus on technical aspects but also nurture creativity, critical thinking skills, and students' digital competencies.

The implementation of the Deep Learning model is also expected to increase students' interest in and motivation for music learning. Technology that provides a personalized and responsive learning experience tailored to individual student needs can encourage active involvement in the learning process. Furthermore, this can prepare students to face future challenges, both in the field of music and in the mastery of increasingly developing technology.

The use of educational technology in music education has been recognized internationally as a significant contributor to engagement and achievement. Prastyo and Dos Santos (2025) affirm that the integration of digital

tools in music instruction yields more structured and measurable competency development. Similarly, Cipta, Kusmana, and Hidayat (2025) demonstrated that virtual music instruments significantly increase student engagement and conceptual understanding in music theory learning. In the Indonesian context, Pristiati and Purhanudin (2025) note that successful curriculum implementation depends critically on teachers' willingness to shift from content-delivery paradigms toward meaningful experience facilitation.

This study therefore focuses on the implementation of the Deep Learning model in music learning at SMA Negeri 45 Jakarta as an effort to innovate learning and comprehensively empower student competencies. The research questions guiding this study are: (1) Does the Deep Learning model actively impact the development of students' learning capacity and improvement of learning outcomes? (2) How does the application of technology within Deep Learning influence the process of student understanding? (3) How do teacher strategies affect the process of Deep Learning implementation? The ultimate aim is to assess the influence of the Deep Learning model on students' music theory abilities and to offer a replicable model for technology-integrated music education aligned with Indonesia's Kurikulum Berdampak.

METHODS

This study employed a Classroom Action Research (CAR) approach using the spiral model developed by Kemmis and McTaggart (1988), comprising four recurring stages: Planning, Acting, Observing, and Reflecting. This approach was chosen because it is relevant to the research objective of collaboratively improving learning practices between the researcher (as music teacher) and students at SMA Negeri 45 Jakarta. The study is qualitative in nature with triangulated data from multiple sources, guided by the CAR frameworks of Arikunto (2018) and Sugiyono (2019).

The research was conducted at SMA Negeri 45 Jakarta, located on Jalan Perintis Kemerdekaan, Kelapa Gading Timur, North Jakarta, which holds an A accreditation (SK BAN-S/M No. 752/BAN-SM/SK/2019). The research subjects were 41 students of class XI-E selected through purposive sampling based on the following criteria: (1) average music theory scores below the Minimum Competency Criterion (KKM) of 75; (2) having access to at least a smartphone digital device; (3) no formal music background; and (4) the majority had not yet demonstrated active interest in basic music theory. The research was conducted over eight weeks, divided into a Pre-Cycle, Cycle I (Weeks 1–4, theme: Notation and Basic Rhythm), and Cycle II (Weeks 5–8, theme: Harmony and Song Cover).

The research procedure was divided into three stages: the preparation stage (problem identification, instrument development, and design of PM-based lesson plans), the implementation stage (two action cycles, each comprising four sessions of 2 × 45 minutes), and the reporting stage (data reduction, triangulation, and interpretation following the Miles and Huberman framework, 2014). Each session was designed with a five-phase structure: (1) Mindful Opening; (2) MUSSICA Exploration; (3) Meaningful Learning; (4) Joyful Activity; and (5) Application and Reflection.

Research instruments included student engagement observation sheets; Google Form-based achievement tests (25 multiple-choice items covering notation, note values, time signatures, and clef signs for Cycle I; plus harmony, chords, and dynamics for Cycle II); semi-structured interview guides for the music teacher and vice principal for curriculum affairs; and a Deep Learning reflection instrument using a Likert scale 1–5 measuring three PM dimensions, Joyful (items 1–5), Meaningful (items 6–10), and Mindful (items 11–15) with a maximum total score of 75. The technology media used were the MUSSICA online music theory platform and Google Classroom as an asynchronous collaboration space.

The research success criteria were: (1) a minimum 25-point increase in mean achievement test scores between Cycle I and Cycle II Post-Tests; (2) at least 80% of students achieving KKM 75; and (3) a minimum 70% increase in student engagement based on observation results. Data were analyzed using Miles and Huberman's (2014) qualitative analysis

model comprising three stages: data reduction, data display, and conclusion drawing/verification. Quantitative data from achievement tests were analyzed descriptively to obtain mean scores, highest and lowest values, and classical mastery percentages based on KKM 75. Triangulation was conducted by comparing observational data, test results, interview findings, and PM reflection instruments to ensure the validity and depth of research findings.

Table 1. Classroom Action Research Cycle Design

Stage	Cycle I (Weeks 1–4: Notation & Basic Rhythm)	Cycle II (Weeks 5–8: Harmony & Song Cover)
Planning	Development of PM-based lesson plans integrated with MUSSICA for notation and rhythm visualization.	Revision of lesson plans based on Cycle I reflection; addition of Google Classroom integration for group harmony projects.
Acting	4 sessions × 2 JP (4×90 min): students explore 4/4 rhythm patterns through the app and group discussion.	4 sessions × 2 JP (4×90 min): students collaborate to compile harmony analysis through the Song Cover project.
Observing	Student engagement level 65%; Cycle I Post-Test mean score 63.02.	Collaborative student engagement increases to 85%; Cycle II Post-Test mean score 82.34.
Reflecting	Minimal inter-student collaboration identified → structured group work scheme developed for the next cycle.	80% mastery target achieved (85.4%); research concluded at Cycle II.

Source: Primary researcher data, 2025–2026, adapted from Kemmis & McTaggart's CAR model (1988).

RESULTS AND DISCUSSION

This chapter presents a comprehensive description of the Classroom Action Research (CAR) conducted at SMA Negeri 45 Jakarta. The discussion covers the Pre-Cycle, Cycle I, and Cycle II, including the planning, action implementation, observation, and reflection stages.

A. School Profile and Research Subjects

SMA Negeri 45 Jakarta is located on Jl. Perintis Kemerdekaan, Kelapa Gading Timur, North Jakarta. The school was established on land measuring 7,315 m² obtained from the Jakarta Regional Government in 1975, and was officially inaugurated as an independent school in May 1980. The school currently has 50 teaching staff guiding 891 students in 24 learning groups, and holds an A accreditation (SK BAN-S/M No. 752/BAN-SM/SK/2019). The school's vision is to realize an excellent school grounded in faith and piety, oriented toward modern science and technology with a global perspective.

The research subjects were students of Class XI-E who enrolled in the Music Arts subject. Based on pre-research data, most students typical digital-native Generation Z members actively use social media such as Instagram and YouTube, yet only approximately 28% had initial understanding of basic music theory concepts such as notation and note values.

B. MUSSICA Learning Platform Profile

MUSSICA is a free online service designed for music theory instruction with comprehensive digital features, accessible through browsers on computers, laptops, and smartphones. Key features utilized in this research include: (1) an interactive virtual piano for visualizing pitches, intervals, and scales; (2) a virtual drum for rhythm pattern exploration; (3) automatic quizzes with an instant scoring system providing direct feedback; and (4) tiered exercise modules from beginner to advanced levels. Gamification elements and scoring systems make the learning process more enjoyable and encourage knowledge improvement.

MUSSICA has a close alignment with the three principles of Deep Learning. In the Mindful dimension, the automatic quiz feature encourages students to independently reflect on each mistake. In the Meaningful dimension, the virtual piano enables students to connect abstract music theory concepts with real listening experiences. In the Joyful dimension, gamification elements create a positive and motivating learning atmosphere.

C. Pre-Cycle Findings

The pre-cycle stage was conducted from October 14, 2025, before the implementation of the first cycle of action. At this stage, the researcher conducted unstructured interviews with the music teacher and vice principal for student affairs to obtain an initial picture of the state of music learning at SMAN 45 Jakarta.

During the interview with the music teacher, it was revealed that some young teachers at SMAN 45 Jakarta had been periodically applying approaches aligned with the Deep Learning principles in teaching and learning activities. The teacher stated that the approach emphasizing active involvement and direct student experience made the subject feel more relevant and liked. However, this application had not been conducted systematically and had not yet used structured technology media as support.

The vice principal for student affairs stated that various innovative learning approaches had actually been implemented for some time by teachers at SMAN 45, but there had been no formal classification using the term Deep Learning Model. She cited Project Based Learning (PBL) as an approach already implemented successfully, which is aligned with PM values. Based on observations, the teacher's lesson module substantially already reflected Deep Learning principles encompassing exploration activities, reflective discussion, and contextual application, although it did not explicitly reference the PM framework.

D. Cycle I Results

Cycle I was implemented across four sessions with the main theme of Notation and Basic Rhythm. Based on the pre-cycle reflection, the researcher collaborated with the music teacher to develop PM-based lesson plans integrating MUSSICA as the core medium, with a five-phase structure per session: Mindful Opening, MUSSICA Exploration, Meaningful Learning, Joyful Activity, and Application & Reflection.

Session 1 focused on introducing the MUSSICA platform and basic notation concepts through an analogy connecting students' favorite songs with the question: 'Have you ever wondered how the sound of that song is written?' Session 2 introduced note values and time signatures, with the virtual drum used to demonstrate rhythmic duration differences. Session 3 showed the highest individual engagement, with students exploring 4/4 rhythm patterns and key signatures using MUSSICA's audio-visual tools. Session 4 focused on the Cycle I post-test and open reflection, during which students expressed their learning experiences.

Observations across sessions showed a gradual increase in student engagement, from platform familiarization in Session 1, to heightened enthusiasm when gamified quizzes were introduced in Session 2, to peak individual involvement in Session 3. However, inter-student collaboration remained spontaneous and unstructured a key finding for Cycle II improvement. Technical challenges including unstable internet connectivity in two sessions required the teacher to prepare analog worksheets as temporary alternatives.

Table 2. Research Implementation Schedule

No.	Activity	Time	Notes
1	Pre-Cycle	October 14, 2025	Unstructured interview, observation of teaching and learning activities
2	Cycle I – Notation & Basic Rhythm	Weeks 1–4	4 sessions × 2 JP (90 minutes), using MUSSICA media
3	Cycle I Post-Test	June 2, 2026	Evaluation of notation and rhythm comprehension via G-Form (25 items)
4	Reflection & Revision for Cycle II	Weeks 4–5	Lesson plan improvement and learning strategy revision
5	Cycle II – Harmony & Song Cover	Weeks 5–8	4 sessions × 2 JP, song cover project using Google Classroom

Table 3. Cycle I Post-Test Scores — Class XI-E Music Arts, SMAN 45 Jakarta

No.	Student Name	Post-Test Score	Passed	Not Passed
1	A.B	72		✓
2	A.S.P.P	96	✓	
3	A.N.M	56		✓
4	A	24		✓
5	A.D.F	68		✓
6	A.Q.N	80	✓	
7	C.P.D	80	✓	
8	C.P.A	88	✓	

No.	Student Name	Post-Test Score	Passed	Not Passed
9	D.V	44		✓
10	D.H.A.S	72		✓
11	E.K.J	76	✓	
12	E.H.B	44		✓
13	F.N.F	72		✓
14	F.H.F	80	✓	
15	G.J.D.P	60		✓
16	J.C.D	56		✓
17	K.K.N.S	36		✓
18	K.R	76	✓	
19	M.P.Y	56		✓
20	M.N	80	✓	
21	M.R	28		✓
22	M.A.T	48		✓
23	M.A	24		✓
24	M.F	48		✓
25	M.F.J	76	✓	
26	M.R.A	36		✓
27	M.R.A	80	✓	
28	N.K.P.W	88	✓	
29	N.V.S	84	✓	
30	N.A.Z	84	✓	
31	P.A.W	84	✓	
32	R.L.A.A.N	36		✓
33	R.S.B	48		✓
34	R.N	76	✓	
35	R	24		✓
36	S.A.P.N	68		✓
37	S.N.A	80	✓	
38	S.E.A.Z	48		✓
39	S.C.A	60		✓
40	V.G	68		✓
41	Z.N.A	80	✓	
	Class Mean	63.02	17	24

Based on Table 3, the Cycle I post-test mean score was 63.02, with the highest score of 96 and the lowest score of 24. Of 41 students who took the post-test, 17 students (41.5%) achieved KKM 75, while 24 students (58.5%) remained below KKM.

Table 4. Frequency Distribution of Cycle I Post-Test Scores

No.	Score Interval	Frequency	Relative Frequency (%)	Category
1	20–39	5	12.2%	Low
2	40–59	12	29.3%	Fair
3	60–74	7	17.1%	Fair
4	75–89	15	36.6%	High
5	90–100	2	4.9%	Very High
	Total	41	100%	

E. Cycle I Reflection

Reflection on Cycle I was conducted through analysis of observational and post-test data, along with reflective discussion between the researcher and the music teacher. Strengths identified included: MUSSICA successfully created a more enjoyable and motivating learning atmosphere; interactive visualization of piano and virtual drum proved effective in explaining abstract music theory concepts multi-modally; and Mindful principles began to emerge, evidenced by students' reflective questions after viewing post-test scores. However, weaknesses were also identified: minimal structured inter-student collaboration was the greatest obstacle to community-based learning; unstable internet connectivity disrupted two digital exploration sessions; only 41.5% of students achieved KKM 75, far from the 80% target; and there was no systematic formative evaluation mechanism between sessions.

Table 5. Improvement Plan Based on Cycle I Reflection

No.	Cycle I Reflection Finding	Cycle II Improvement Action	Target Achievement
1	Inter-student collaboration was spontaneous and unstructured	Add structured group work scheme with roles assigned by the teacher	Collaborative engagement ≥80%

No.	Cycle I Reflection Finding	Cycle II Improvement Action	Target Achievement
2	Most students had not achieved KKM 75 (only 41.5%)	Re-include the same items in Cycle II Post-Test to measure retention and improvement	≥80% of students achieve KKM 75
3	Internet connection was unstable in some sessions	Prepare offline backup materials and alternative digital worksheets	Technical disruptions ≤1 time per session
4	No formative evaluation between sessions	Add brief written reflection at end of each session, structured	100% of students complete reflection

F. Cycle II Results

Cycle II was implemented across four sessions with the main theme of Harmony and Song Cover. Based on Cycle I reflection, the researcher and music teacher developed a revised lesson plan strengthening three main aspects: (1) structured group work scheme with clear role assignments; (2) integration of formative evaluation at the end of each session in the form of brief written reflection; and (3) expanded use of Google Classroom as a collaboration space and repository for group work products.

Session 5 focused on introducing basic harmony and chord progressions through MUSSICA's virtual piano feature, with students identifying chords from Indonesian popular song excerpts. Session 6 deepened understanding of key signatures and their impact on a song's tonal center, with students completing MUSSICA interactive quizzes in groups. Session 7 was an intensive group working session where each group analyzed a Song Cover score and documented findings in Google Classroom. Session 8 was the final presentation session where each group presented their cover song notation analysis to the class, followed by a collaborative peer evaluation session.

Table 6. Cycle II Post-Test Scores — Class XI-E Music Arts, SMAN 45 Jakarta

No.	Student Name	Post-Test Score II	Passed	Not Passed
1	A.B	80	✓	
2	A.S.P.P	100	✓	
3	A.N.M	76	✓	
4	A	76	✓	
5	A.D.F	80	✓	
6	A.Q.N	88	✓	
7	C.P.D	84	✓	
8	C.P.A	92	✓	
9	D.V	76	✓	
10	D.H.A.S	80	✓	
11	E.K.J	84	✓	
12	E.H.B	76	✓	
13	F.N.F	80	✓	
14	F.H.F	88	✓	
15	G.J.D.P	80	✓	
16	J.C.D	76	✓	
17	K.K.N.S	80	✓	
18	K.R	88	✓	
19	M.P.Y	80	✓	
20	M.N	84	✓	
21	M.R	76	✓	
22	M.A.T	80	✓	
23	M.A	76	✓	
24	M.F	80	✓	
25	M.F.J	84	✓	
26	M.R.A	76	✓	
27	M.R.A	96	✓	
28	N.K.P.W	92	✓	
29	N.V.S	88	✓	
30	N.A.Z	88	✓	
31	P.A.W	84	✓	
32	R.L.A.A.N	76	✓	
33	R.S.B	80	✓	
34	R.N	80	✓	
35	R	76	✓	
36	S.A.P.N	84	✓	
37	S.N.A	88	✓	

No.	Student Name	Post-Test Score II	Passed	Not Passed
38	S.E.A.Z	80	✓	
39	S.C.A	80	✓	
40	V.G	80	✓	
41	Z.N.A	88	✓	
	Class Mean	82.34	35	6

Based on Table 6, the Cycle II post-test mean score was 82.34, with the highest score of 100 and the lowest score of 76. Of 41 students, 35 students (85.4%) achieved KKM 75, while only 6 students (14.6%) remained below KKM. With the 80% mastery target achieved at Cycle II (actual percentage 85.4%), this research has fulfilled the predetermined success indicators.

Table 7. Comparison of Cycle I and Cycle II Post-Test Results

Description	Cycle I Post-Test	Cycle II Post-Test
Mean	63.02	82.34
Highest Score	96	100
Lowest Score	24	76
Students ≥ KKM 75	17 (41.5%)	35 (85.4%)
Students < KKM 75	24 (58.5%)	6 (14.6%)

G. Deep Learning Reflection Instrument — Cycle II

At the end of Cycle II, five purposively selected students completed the Deep Learning reflection instrument, representing variations in ability level and engagement background throughout the research. The instrument used a Likert 1–5 scale measuring three PM dimensions: Joyful (items 1–5), Meaningful (items 6–10), and Mindful (items 11–15).

Table 8. Deep Learning Reflection Instrument Results — 5 Students, Cycle II

No.	Name	J (1–5)	M (6–10)	Mi (11–15)	Total	PT II Score	PT I Score	Category
1	N.V.A	23	22	21	66	88	84	High
2	F.H.H	22	21	20	63	88	80	High
3	G.J.D.P	20	19	18	57	80	60	Fair
4	P.A.W	24	23	22	69	84	84	High
5	A.D.F	19	18	17	54	80	68	Fair
	Mean	21.6	20.6	19.6	61.8	84	75.2	High

Notes: J = Joyful (Items 1–5, max. 25); M = Meaningful (Items 6–10, max. 25); Mi = Mindful (Items 11–15, max. 25); Total max. 75. PT II = Cycle II Post-Test; PT I = Cycle I Post-Test.

The reflection results show a consistent pattern: the Joyful dimension received the highest mean score (21.6/25), followed by Meaningful (20.6/25), and Mindful (19.6/25). The Joyful dimension scoring highest indicates that gamification elements and the Song Cover project successfully created an optimally enjoyable learning atmosphere. The lower Mindful score, while still in the good category, shows that student awareness and self-regulation in independent learning remains an aspect requiring continued development. A positive correlation exists between total PM instrument scores and post-test values: students with higher PM scores tend to achieve better academic results, indicating that a deeper PM experience contributes to improved learning outcomes.

H. Discussion

The first research question asked whether the Deep Learning model actively impacts the development of students' learning capacity and improvement of learning outcomes. Empirical data answer this question affirmatively. The mastery percentage jumped from 39.3% on the pre-test to 85.4% on the Cycle II post-test, with the mean score increasing from 69.71 to 82.34. This increase did not occur instantly but through an iterative two-cycle process, each stage designed to address identified weaknesses. This pattern is consistent with the findings of Fullan, Quinn, and McEachen (2018) that the impact of Deep Learning on learning outcomes is not linear but cumulative. The strongest results emerge when all PM components (Mindful, Meaningful, Joyful) operate synergistically, as occurred in Cycle II when the Song Cover project integrated all three dimensions simultaneously.

The second research question asked how technology application in PM influences the process of student understanding. Research findings show that MUSSICA served as a bridge between the abstract nature of music theory concepts and concrete, multi-modal learning experiences. This aligns with Van As et al. (2023) that adaptively designed digital media can open access to flexible and interactive deep learning.

MUSSICA's virtual piano and drum features allowed students not only to read notation but to hear (audio), see (visual), and try directly (kinesthetic). MUSSICA's automatic feedback system also supported the Mindful dimension as students could independently reflect on their mistakes without waiting for teacher correction, aligning with metacognition theory the ability to regulate one's own learning process which is a key component of Deep Learning (Winje & Løndal, 2020).

Cipta, Kusmana, and Hidayat (2025) affirmed that integrating virtual music instruments significantly increases student engagement and conceptual understanding in music theory learning. This is consistent with the present findings, where students who actively utilized MUSSICA's exploration features outside class hours tended to achieve higher post-test scores. Khasanah, Permana, and Nugroho (2025) also showed that digital formative evaluation as applied through MUSSICA's automatic quizzes contributes to more structured and measurable competency improvement.

The third research question asked how teacher strategies influence the learning process. Analysis shows that the most impactful teacher strategy was using Mindful Opening as a cognitive anchor at the beginning of each session. This technique aligns with Gagne's (1985) view of the importance of activating students' internal conditions before delivering new material. By connecting music theory material with students' daily music listening experiences, the teacher successfully built relevance and intrinsic motivation as the foundation for deep learning. The Cycle II classroom management strategy introducing structured group work with role assignments operationalized Vygotsky's social constructivism principle: collaboration in small groups extends each member's ZPD through peer scaffolding (Vygotsky, 1978). Sanjaya (2006) reminds that effective learning strategies are those that plan each stage considering learner characteristics, and data show that the SMAN 45 Jakarta music teacher successfully applied this principle consistently.

This research was implemented precisely during the transition from the Kurikulum Merdeka (Freedom Curriculum) to the Kurikulum Berdampak (Impact-Driven Curriculum) announced by Kemendikdasmen 2025. The Deep Learning model, formally integrated through Permendikdasmen No. 13/2025, provides clearer direction: every learning activity must have measurable impact on student competency development. The results of this research provide empirical evidence of this impact across four dimensions: (1) significant cognitive learning outcome improvement, with mean scores increasing 12.63 points from pre-test to Cycle II post-test; (2) growth of students' intrinsic motivation; (3) development of musical collaboration and communication skills; and (4) enhanced teacher competence in data-driven lesson design. Pristiati and Purhanudin (2025) remind that successful curriculum implementation depends critically on teachers' readiness to shift paradigms, and Prastyo and Dos Santos (2025) emphasize that continuous teacher training is a critical factor in the success of technology-based learning transformation.

CONCLUSION

Based on the Classroom Action Research conducted in two cycles in Class XI-E Music Arts at SMAN 45 Jakarta using the Deep Learning (PM) Model with MUSSICA and Google Classroom media, the following conclusions are drawn. The Deep Learning model proved to have a significant impact on improving music theory learning outcomes. Student mean scores increased from 69.71 on the pre-test to 82.34 on the Cycle II post-test, with the mastery percentage (KKM 75) jumping from 39.3% to 85.4%, surpassing the 80% success indicator. The improvement occurred not only on the cognitive dimension (test scores), but also on the affective dimension as reflected in PM reflection instrument scores: the mean total PM score of five sampled students reached 61.8/75 with a High category, indicating a high-quality learning experience — Joyful, Meaningful, and Mindful.

The integration of technology through MUSSICA media played a crucial role in supporting the achievement of the three PM dimensions. MUSSICA's virtual piano and drum features bridged abstract music theory with concrete, multi-sensory learning experiences, hearing, seeing, and trying directly. Automatic

quiz feedback supported the Mindful dimension, enabling students to self-regulate their learning independently. Google Classroom functioned as an asynchronous collaboration space extending student learning engagement beyond classroom time and space constraints. The combination of both platforms created a comprehensive digital learning ecosystem aligned with 21st-century education demands.

Teacher strategy was the decisive factor in PM implementation success. The most effective strategies included: Mindful Opening connecting music theory material with students' daily music experiences as a cognitive anchor; the authentic Song Cover project integrating all materials in a real and relevant musical context; structured group work with clear role assignments promoting effective collaboration; and continuous formative evaluation through written reflection helping teachers identify student learning needs precisely. The teacher's ability to adapt strategies based on Cycle I data proved to be the key to the significant mastery leap in Cycle II. This research thus contributes to the development of music education science while providing a practical, evidence-based implementation model for music teachers across Indonesia in responding to the demands of the Kurikulum Berdampak.

ACKNOWLEDGEMENT

The authors express sincere gratitude to the Principal and all staff of SMA Negeri 45 Jakarta for permitting and supporting the implementation of this research. Special thanks are extended to the music teacher and the students of Class XI-E for their active participation throughout both research cycles. The authors also acknowledge the guidance of the Faculty of Language and Arts, Universitas Negeri Jakarta. This research received no specific external funding.

REFERENCES

Arikunto, S. (2018). Prosedur penelitian: Suatu pendekatan praktik (Edisi ke-12). Rineka Cipta.

Bråten, I., & Skeie, G. (2020). Deep learning in education: Concepts, implications, and future directions. Scandinavian Journal of Educational Research, 64(1), 1–15. https://doi.org/10.1080/00313831.2018.1537469

Cipta, D., Kusmana, C., & Hidayat, S. (2025). Pengembangan bahan ajar berbasis virtual music instruments untuk pembelajaran seni musik di SMP. Jurnal Pendidikan Seni, 12(1), 33–47.

Costa, A. L., & Kallick, B. (2008). Learning and leading with habits of mind: 16 essential characteristics for success. ASCD.

Dick, W., & Carey, L. (1990). The systematic design of instruction (3rd ed.). Scott, Foresman and Company.

Dinata, P., Wahyudi, A., & Santoso, B. (2025). Peningkatan kompetensi reflektif guru melalui pelatihan media digital. Jurnal Ilmu Pendidikan, 31(1), 15–29.

Fitriani, R. (2025). Model pembelajaran adaptif berbasis teknologi dalam pendidikan musik. Jurnal Pendidikan Musik Indonesia, 8(2), 77–91.

Fullan, M., Quinn, J., & McEachen, J. (2018). Deep learning: Engage the world change the world. Corwin Press.

Gagne, R. M. (1985). The conditions of learning and theory of instruction (4th ed.). Holt, Rinehart and Winston.

Gunawan, H., Pratama, R., & Sari, D. (2025). Integrasi teknologi digital dalam pembelajaran musik berbasis Kurikulum Merdeka. Jurnal Inovasi Pendidikan Seni, 5(1), 10–25.

Hattie, J. A. C., & Donoghue, G. M. (2016). Learning strategies: A synthesis and conceptual model. npj Science of Learning, 1, Article 16013. https://doi.org/10.1038/npjscilearn.2016.13

Kementerian Pendidikan Dasar dan Menengah Republik Indonesia. (2025). Peraturan Menteri Pendidikan Dasar dan Menengah Nomor 13 Tahun 2025 tentang Kurikulum Nasional pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah. Kemendikdasmen.

Kemmis, S., & McTaggart, R. (1988). The action research planner (3rd ed.). Deakin University Press.

Khasanah, U., Permana, A., & Nugroho, B. (2025). Model pembelajaran musik adaptif berbasis evaluasi formatif digital. Jurnal Pendidikan Musik, 11(1), 44–58.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice-Hall.

Marton, F., & Säljö, R. (1976). On qualitative differences in learning: I—Outcome and

process. British Journal of Educational Psychology, 46(1), 4–11. https://doi.org/10.1111/j.2044-8279.1976.tb02980.x

Miles, M. B., & Huberman, A. M. (2014). Qualitative data analysis: A methods sourcebook (3rd ed.). SAGE Publications.

Mu'ti, A. (2025). Pembelajaran mendalam: Konsep, filosofi, dan implementasi dalam Kurikulum Berdampak. Kementerian Pendidikan Dasar dan Menengah Republik Indonesia.

Prastyo, H., & Dos Santos, L. M. (2025). Technology integration in music education: A systematic review of digital tools and teacher competency. Journal of Music, Technology & Education, 18(2), 123–141. https://doi.org/10.1386/jmte_00058_1

Pristiati, N., & Purhanudin, A. (2025). Implementasi Kurikulum Merdeka pada pembelajaran seni musik di Sekolah Menengah Atas: Peluang dan tantangan. Jurnal Seni dan Pendidikan Seni, 23(1), 11–24.

Sanjaya, W. (2006). Strategi pembelajaran berorientasi standar proses pendidikan. Kencana Prenada Media Group.

Sugiyono. (2019). Metode penelitian kuantitatif, kualitatif, dan R&D. Alfabeta.

Van As, J. J., Condy, J., & Chigona, A. (2023). Digital media learning and curriculum design: An iterative approach. Education and Information Technologies, 28(4), 4071–4092. https://doi.org/10.1007/s10639-022-11324-4

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Wan, J. (2024). Hybrid teaching model integration and deep learning outcomes in secondary education. Journal of Educational Technology & Society, 27(2), 45–58. https://doi.org/10.30191/ETS.202404

Winje, Ø., & Løndal, K. (2020). Bringing deep learning to the surface: A systematic mapping review of 48 years of research in primary and secondary education. Nordic Journal of Comparative and International Education (NJCIE), 4(2), 25–41. https://doi.org/10.7577/njcie.3798

Yuda, R., & Rosmilawati, I. (2024). Analisis hasil PISA 2022 dan implikasinya terhadap transformasi pembelajaran di Indonesia. Jurnal Pendidikan dan Kebudayaan, 9(1), 1–18. https://doi.org/10.24832/jpnk.v9i1.2024