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Improvisation in music education: empirical evidence, classroom practice, and teacher preparation

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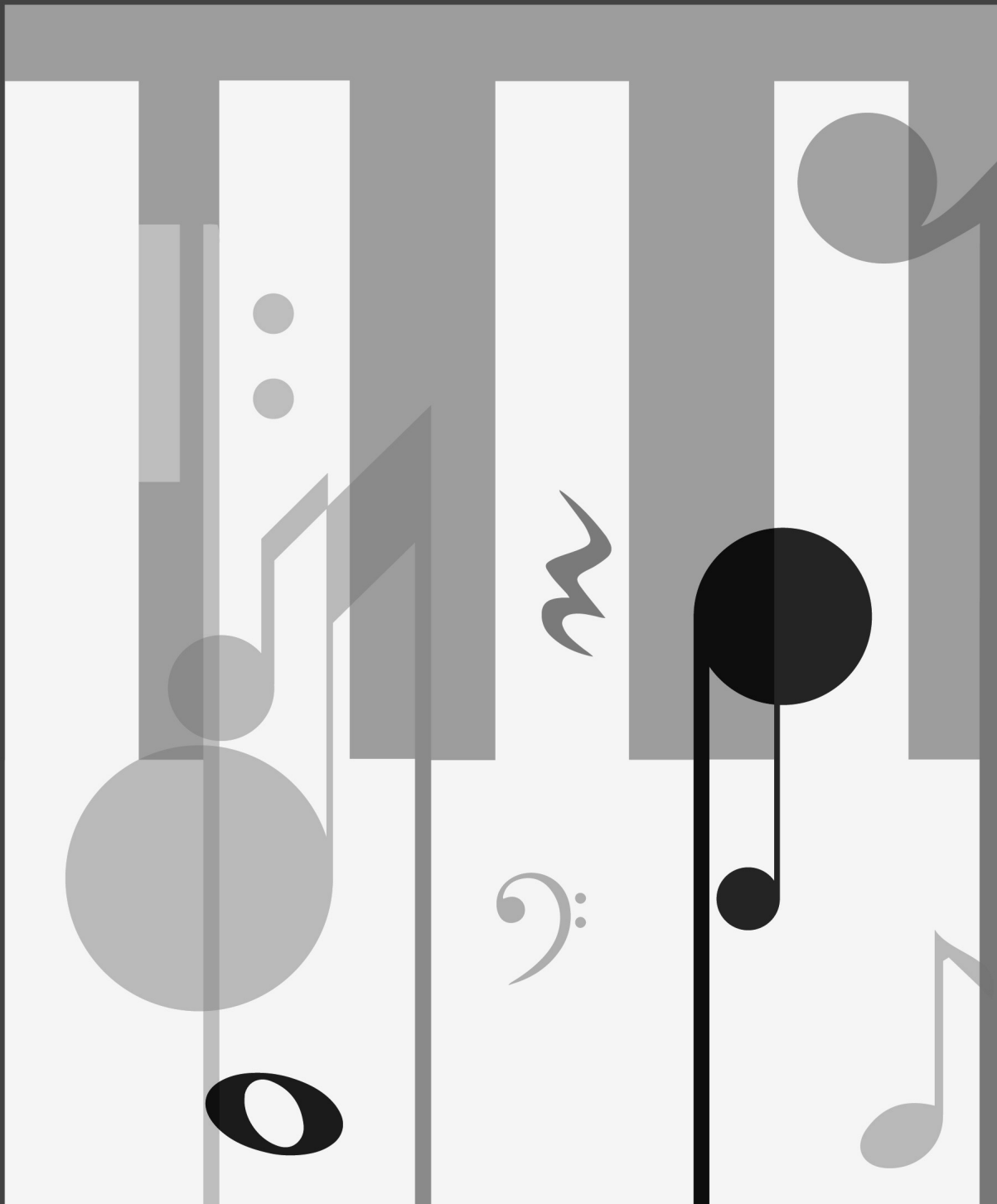
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Appendices

Appendices

Appendix A Abbreviations

Abbr.	Full term
AI	Attitude toward inclusion of improvisation
AS	Attitude toward studying improvisation
AT	Attitude toward teaching improvisation
AVE	Average variance extracted
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CR	Composite reliability
EFA	Exploratory factor analysis
HTMT	Heterotrait–Monotrait ratio
IMBP	Integrative model of behavior prediction
M	Mean
MCTM	Measure of creative thinking in music
MG-SEM	Multigroup structural equation modeling
PCK	Pedagogical content knowledge
PLS-SEM	Partial least squares structural equation modeling
PMT	Pre-service music teacher
PRISMA	Preferred reporting items of systematic reviews and meta-analyses
RMSEA	Root mean square error of approximation
RQ	Research question
R ²	Explained variance
SD	Standard deviation
SDT	Self-determination theory
SEI	Self-efficacy for improvisation
SEM	Structural equation modeling
SETI	Self-efficacy for teaching improvisation
SRMR	Standardized root mean square residual
TLI	Tucker–Lewis index
TPB	Theory of planned behavior
TRA	Theory of reasoned action
VIF	Variance inflation factor

Appendix B-1 Characteristics of included publications.

	Authors (year)	Region	Educational level	Participants group	N	Methodology	Data collection method
1	Augustyniak (2015)	Australia	Secondary	Student	40	Qualitative	<ul style="list-style-type: none"> • Questionnaire • Video • Interview
2	Bernhard and Stringham (2016)	US	Higher	Pre-service music teacher	397	Quantitative	Questionnaire
3	Black (2017)	Scotland	Secondary	Student	8	Qualitative	<ul style="list-style-type: none"> • Observation • Interview
4	Corcoran (2021)	Canda & UK	Primary and community	Teacher	8	Qualitative	<ul style="list-style-type: none"> • Observation • Interview • Field notes • Reflective journal
5	Cossey (2024)	UK	Multiple levels	Piano teacher	117	Mixed	Questionnaire
6	Cremades-Andreu and Lage-Gómez (2024)	Spain	Secondary	Student	267	Mixed	<ul style="list-style-type: none"> • Observation • Interview • Class diary • Questionnaire
7	Cuervo and Campayo (2024)	Spain	Secondary	Student	63	Quantitative	<ul style="list-style-type: none"> • Questionnaire • Pre–post test
8	de Bruin (2018a)	Australia	Higher	Teacher and student	4 teacher-student pairs	Qualitative	<ul style="list-style-type: none"> Case study • Video • Interview
9	de Bruin (2018b)	Australia	Higher	Teacher and student	5 teacher-student pairs	Qualitative	<ul style="list-style-type: none"> • Video • Interview
10	de Bruin (2019a)	Australia	Higher	Teacher / Expert improviser	6	Qualitative	Interview
11	de Bruin (2019b)	Australia	Higher	Teacher and student	3 teacher-student pairs	Qualitative	<ul style="list-style-type: none"> • Video observation • Interview
12	de Bruin (2022)	Australia	Higher	Student	3 projects	Qualitative	<ul style="list-style-type: none"> • Pre/post-questionnaire (open-ended) • Diary

13	Hanson (2023)	US	Higher	Pre-service music teacher	5	Qualitative	<ul style="list-style-type: none"> • Interview • Field notes • Classroom observations • Researcher journal
14	Healy and Albert (2025)	US	Higher	Student	4	Qualitative	<ul style="list-style-type: none"> • Interview • Focus group • Student reflections on readings • Interview • Reflective journal • Observation • Field notes
15	Hedden (2017)	Lithuania	Higher	Teacher	1	Qualitative	<ul style="list-style-type: none"> • Interview • Informal conversations • Classroom observation • Field notes
16	Hickey et al. (2016)	US	Higher	Student	19	Quantitative	Questionnaire
17	Ho (2022)	China	Secondary	Student	1083 (questionnaire); 53 (interview)	Mixed	<ul style="list-style-type: none"> • Questionnaire • Focus group interview
18	Huovinen and Keipi (2022)	Finland	Higher	Student	16	Mixed	<ul style="list-style-type: none"> • Retrospective verbal protocol • Expert ratings • Observation • Questionnaire
19	Johansen (2018)	Norway and Sweden	Higher	Student	13	Qualitative	<ul style="list-style-type: none"> • Interview • Practice session video • Practice diaries
20	Juntunen et al. (2015)	Finland	Primary and secondary in the conservatoire	Student	10	Mixed	<ul style="list-style-type: none"> • Qual: case study • Video observation • Quasi-experimental tests
21	Lage-Gómez and Cremades-Andreu (2019)	Spain	Secondary	Student	Not mention	Qualitative	<ul style="list-style-type: none"> • Expert rating • Observation • Interview • Questionnaire • Video recording • Classroom diary
22	Langley (2018)	US	Secondary	Student and teacher	314 students, 11 teachers	Mixed	<ul style="list-style-type: none"> • Explanatory Sequential Design • Questionnaire

23	Larsson and Öhman (2018)	Sweden	Primary	Student	Not mention	Qualitative	<ul style="list-style-type: none"> • Focus group • Interview • Video • Classroom observation
24	Liu (2025)	China	Higher	Student and audience	183 students, 315 audience members	Mixed	<ul style="list-style-type: none"> • Expert rating • Audience survey • Video observation • App-based performance tracking
25	Lukács et al. (2022)	Hungary	Primary	Student	40	Quantitative	<ul style="list-style-type: none"> • Questionnaire • Tests
26	MacGlone and Gravem Johansen (2024)	Europe	Higher	Teacher	12	Qualitative	Interview
27	MacGlone et al. (2021a)	UK	Pre-school	Student	14	Mixed	<ul style="list-style-type: none"> • Interview • Video recording • Field notes • Rating sessions
28	MacGlone et al. (2021b)	UK	Pre-school	Parents and teachers	13 children (in improvisation workshop), 11 parents, 4 teachers	Qualitative	<ul style="list-style-type: none"> • Interview • Field notes
29	Marino and Chinn (2023)	US	Secondary	Student	43	Quantitative	<ul style="list-style-type: none"> • Pre-, mid-, post-instruction testing • Questionnaire • Audio recordings of improvisation
30	Mateos-Moreno and Erlanson (2022)	Sweden & Spain	Not mention	Teacher and student	3 teachers, 11 students	Qualitative	<ul style="list-style-type: none"> • Interview • Focus group • Teaching journals
31	Ng (2021)	Singapore	Higher	Pre-service music teacher	9	Qualitative	<ul style="list-style-type: none"> • Interview • Video recording • Field notes
32	Ng (2022)	Singapore	Higher	Pre-service music teacher	9	Qualitative	<ul style="list-style-type: none"> • Video recording • Field notes • Interview • Surveys • Focus group discussions • Performance observations

33	Ng (2023)	Singapore	Higher	Pre-service music teacher	9	Qualitative	<ul style="list-style-type: none"> • Interview • Video recording • Surveys • Field notes
34	Nikolaou (2023)	Greece	Higher	Pre-service generalist teacher	40	Qualitative	<ul style="list-style-type: none"> • Observation • Diary • Questionnaire (open- and closed-ended)
35	Norgaard (2017)	US	Secondary	Student	6	Qualitative	<ul style="list-style-type: none"> • Interview • Audio recording
36	Norgaard et al. (2019)	US	Secondary	Student	155	Quantitative	Test
37	Palaigeorgiou and Pouloulis (2018)	Greece	Primary	Student	30	Mixed	<ul style="list-style-type: none"> • Questionnaire • Observation • Focus group • Field Note • Interview
38	Palmer (2016)	US	High school & College	Student	70	Quantitative	<ul style="list-style-type: none"> • Questionnaire • Test • Recording
39	Pellegrino et al. (2019)	US	Higher	Teacher	3	Mixed	<ul style="list-style-type: none"> • Researcher journals • Interview • Survey • Observations • Written communications
40	Piazza and Talbot (2021)	US	Higher	Pre-service music teacher (PMT) & Music teacher educator (MTE)	331 (236 PMTs, 95 MTEs)	Quantitative	Questionnaire
41	Navarro Ramón and Chacón-López (2021)	Spain	Primary	Student	17	Mixed	<ul style="list-style-type: none"> • Pre-post test • Video analysis • Observation
42	Regier (2022)	US	Secondary	Teacher	264	Quantitative	Questionnaire

43	Rowe et al. (2015)	UK & Greece	Music school	Student	19	Qualitative	<ul style="list-style-type: none"> • Interview • Recording • Field notes • Questionnaire
44	Russell and Woodward (2024)	Australia	Higher	Student	11	Qualitative	<ul style="list-style-type: none"> • Interview • Recording
45	Savage and Harry (2024)	US	Secondary	Teacher	42	Qualitative	<ul style="list-style-type: none"> • Questionnaire • Interview
46	Smith (2024)	US	Higher	Pre-service music teacher	6	Qualitative	<ul style="list-style-type: none"> • Diary • Interview • Recording • Questionnaire • Group discussion
47	Snell and Azzara (2015)	US	Higher	Student	4	Qualitative	<ul style="list-style-type: none"> • Survey • Interview • Improvisation course assignment
48	Sutela et al. (2020)	Finland	Secondary special education	Student	13	Qualitative	<ul style="list-style-type: none"> • Interview • Recording • Research diary
49	Sutela et al. (2021)	Finland	Secondary special education	Student	13	Qualitative	<ul style="list-style-type: none"> • Interview • Recording • Research diary
50	Sutherland and Smith (2022)	Australia & HongKong	Higher	Student	8	Qualitative	<ul style="list-style-type: none"> • Interview
51	Terauchi (2022)	Japan	Primary	Student	61	Qualitative	<ul style="list-style-type: none"> • Recording • Questionnaire • Observation
52	Tomlinson2015)	Australia	Pre-school	Student	21	Qualitative	<ul style="list-style-type: none"> • Recording • Interview • Observation
53	Tomlinson (2018)	Australia	Primary	Student	16	Qualitative	<ul style="list-style-type: none"> • Field note • Recording • Field note • Interview • Observation

54	Varvarigou (2017a)	UK	Higher	Student	46	Qualitative	<ul style="list-style-type: none"> • Reflective log • Feedback form
55	Varvarigou (2017b)	UK	Higher	Student	46	Qualitative	<ul style="list-style-type: none"> • Interview • Recording • Reflective log • Feedback form
56	Veloso (2017)	Portugal	Primary	Student	24	Qualitative	<ul style="list-style-type: none"> • Interview • Recording • Participant observation • Field note • Photographs and artefacts by children
57	Verneert et al. (2024)	Belgium	Secondary	Student and teacher	Student (n = 1282) Teacher (n = 14)	Mixed	Questionnaire
58	Wall (2018)	US	Primary	Student	6	Qualitative	<ul style="list-style-type: none"> • Observation • Interview • Video recording • Personal reflective notes
59	Wang (2023)	China	Higher	Student	122	Quantitative	Test
60	West (2019)	US	Kindergarten and adult	Teacher	2	Qualitative	<ul style="list-style-type: none"> • Observation • Interview • Field note
61	Yao and Qin (2024)	China	Higher	Student	187	Quantitative	<ul style="list-style-type: none"> • Pre-/post-test test • Expert rating • Self-report questionnaire
62	Zalar et al. (2015)	Slovenia	Primary	Student	18	Qualitative	<ul style="list-style-type: none"> • Observation • Recording • Field note
63	Zhang (2023)	China	Higher	Student	421 (Control = 221; Experimental = 200)	Quantitative	<ul style="list-style-type: none"> • Reflective protocol Pre-/post-test with control group test

Appendix B-2 Improvisation Activity

Category	Abbr.	Sub-category	Description	Example	Frequency (N)	Reference
Improvisation forms and techniques	COL	Collective improvisation	Multi-performer spontaneous music making.	The teacher-students' carried out music improvisations individually, as responses to visual, verbal, or musical stimuli, in pairs when they improvised using the call and response or the binary form (AB), and in groups when they improvised rhythmically or melodically using specific notes, on a melody or a song or when they had to work as a team to make decisions with their teammates to carry out the music improvisation (Nikolaou, 2023).	48	Augustyniak (2015); Bernhard and Stringham (2016); Black (2017); Corcoran (2021); Cremades-Andreu and Lage-Gómez (2024); Cuervo and Campayo (2024); de Bruin (2019a, 2022); Hanson (2023); Hedden (2017); Hickey et al. (2016); Ho (2022); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Langley (2018); Larsson and Öhman (2018); MacGlone et al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Marino and Chinn (2023); Ng (2021, 2022, 2023); Nikolaou (2023); Norgaard et al. (2019); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Pellegrino et al. (2019); Piazza and Talbot (2021); Navarro Ramón and Chacón-López (2021); Russell and Woodward (2024); Savage and Harry (2024); Snell and Azzara (2015); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017a, 2017b); Veloso (2017); Verneert et al. (2024); Wall (2018); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)
	IND	Individual improvisation	Individual spontaneous music making.	Each session consisted of the performance of an improvised jazz solo followed by an interview (Norgaard, 2016).	15	Black (2017); de Bruin (2018a, 2018b, 2019b); Hickey et al. (2016); Ho (2022); MacGlone and Gravem Johansen (2024); Mateos-Moreno and Erlanson (2022); Nikolaou (2023); Norgaard et al. (2019); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Veloso (2017); Wall (2018); Yao and Qin (2024)
	FRE	Free improvisation	Improvising without structure, norms, or limits for spontaneity and creativity.	He starts by improvising freely on the guitar, playing all along the neck and looking for different timbres and approaches to the guitar (Veloso, 2017).	38	Augustyniak (2015); Black (2017); de Bruin (2018a, 2018b, 2022); Healy and Albert (2025); Hedden (2017); Hickey et al. (2016); Huovinen and Keipi (2022); Johansen (2018); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Lukács et al. (2022); MacGlone et

IWC	Improvisation with boundaries	Creating spontaneously within set limits to spark creativity and focus.	This activity constituted a short group improvisation with simple rules without using Sanka Play (Terauchi, 2022).	38	al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Ng (2021, 2022, 2023); Nikolaou (2023); Norgaard (2016); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Pellegrino et al. (2019); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Smith (2024); Snell and Azzara (2015); Sutela et al. (2020); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017b); Veloso (2017); Verneert et al. (2024); Wall (2018); West (2019) Augustyniak (2015); Bernhard and Stringham (2016); Black (2017); Cossey (2024); de Bruin (2018a, 2018b); Hanson (2023); Healy and Albert (2025); Ho (2022); Huovinen and Keipi (2022); Johansen (2018); Liu (2025); MacGlone et al. (2021b); MacGlone and Gravem Johansen (2024); Marino and Chinn (2023); Ng (2021, 2023); Nikolaou (2023); Norgaard (2016); Norgaard et al. (2019); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Pellegrino et al. (2019); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Russell and Woodward (2024); Snell and Azzara (2015); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015); Varvarigou (2017a, 2017b); Verneert et al. (2024); Wall (2018); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)
MRV	Melodic or rhythmic variation	Improvise variations based on the familiar melody or songs.	Improvise simple rhythmic variations and simple melodic embellishments on familiar melodies (Bernhard & Stringham, 2016).	23	Bernhard and Stringham (2016); Corcoran (2021); Cossey (2024); Johansen (2018); Larsson and Öhman (2018); Liu (2025); MacGlone and Gravem Johansen (2024); Ng (2022, 2023); Palmer (2016); Pellegrino et al. (2019); Piazza and Talbot (2021); Rowe et al. (2015); Terauchi (2022); Tomlinson (2018); Varvarigou (2017a, 2017b); Wall (2018); Wang (2023); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)
JCB	Jazz Combo / Blues improvisation	Improvisation based on jazz or blues	An improvised solo over a modal tune's form (John Coltrane's "Impressions") and another over	17	Black (2017); Corcoran (2021); de Bruin (2018b); Healy and Albert (2025); Hickey et al. (2016); Johansen (2018); Lage-Gómez and Cremades-Andreu

			traditions, as well as harmonic structures.	a 12-bar blues form (Sonny Rollins's "Sonnymoon for Two") (Marino & Chinn, 2023).		(2019); Marino and Chinn (2023); Ng (2022); Norgaard (2016); Norgaard et al. (2019); Palmer (2016); Pellegrino et al. (2019); Regier (2022); Russell and Woodward (2024); Snell and Azzara (2015); Wall (2018)
	CAR	Call and response	A dialogue-like interaction between two performers or groups who play a musical phrase and react with a complementary phrase.	To converse musically, improvisers need to tap into a wide repertoire of personalized musical vocabulary (e.g., musical motifs, rhythmic patterns, harmonic progressions) to express themselves freely and respond appropriately to fellow players' musical stimuli (Ng, 2023).	16	Augustyniak (2015); Bernhard and Stringham (2016); Cossey (2024); de Bruin (2018a, 2018b); Hickey et al. (2016); Ng (2021, 2022, 2023); Nikolaou (2023); Norgaard et al. (2019); Pellegrino et al. (2019); Snell and Azzara (2015); Sutela et al. (2021); Verneert et al. (2024); Wall (2018)
	RR	Repetitive riffs	Building and changing improvisational concepts on repeating melodic patterns or motifs.	For example, at one point, the students developed a riff they enjoyed, so I asked them to return to the next session with another riff to play for the group (Wall, 2018).	12	Augustyniak (2015); Bernhard and Stringham (2016); Corcoran (2021); Hedden (2017); Hickey et al. (2016); Liu (2025); Ng (2021, 2022, 2023); Rowe et al. (2015); Varvarigou (2017a); Wall (2018)
Tools & Mediums-Specific improvisation	INS	Instrument improvisation	Using the acoustic instrument as the primary medium for spontaneous musical creation.	For example, when Jared began his group performance with a 12-bar blues harmonic groove on his electric guitar in the first CFMI session, fellow players entered the performance by filling in musical roles common to the style—Megan with a bassline on the piano, Valerie with a melodic line on the same piano, and Adrienne with a rhythmic ostinato on a drum (Ng, 2022).	52	Augustyniak (2015); Bernhard and Stringham (2016); Corcoran (2021); Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); Cuervo and Campayo (2024); de Bruin (2018a, 2018b, 2019b, 2022); Hanson (2023); Healy and Albert (2025); Hedden (2017); Huovinen and Keipi (2022); Johansen (2018); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Liu (2025); MacGlone et al. (2021b); MacGlone and Gravem Johansen (2024); Marino and Chinn (2023); Mateos-Moreno and Erlanson (2022); Ng (2021, 2022, 2023); Nikolaou (2023); Norgaard (2016); Norgaard et al. (2019); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Russell and Woodward (2024); Savage and Harry (2024); Smith

					(2024); Snell and Azzara (2015); Sutela et al. (2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017a, 2017b); Veloso (2017); Wall (2018); Wang (2023); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)	
	VOC	Vocal Improvisation	Using the human voice as the primary medium for spontaneous musical creation.	Improvisation began with the children singing long mf notes (MacGlone et al., 2021a).	19	Augustyniak (2015); Bernhard and Stringham (2016); Cuervo and Campayo (2024); de Bruin (2018b); Hedden (2017); Ho (2022); Lage-Gómez and Cremades-Andreu (2019); Lukács et al. (2022); MacGlone et al. (2021a); Ng (2022); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Russell and Woodward (2024); Terauchi (2022); Tomlinson (2015, 2018); Verneert et al. (2024); Zhang (2023)
	PER	Percussion-based improvisation	Using percussion as the primary medium for spontaneous musical creation.	Students played xylophones (tuned to the pentatonic scale), box drum, and bongo drums, while the teacher/ researcher accompanied them on piano (Transcript 1) (Tomlinson, 2018).	15	Cremades-Andreu and Lage-Gómez (2024); Hedden (2017); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); MacGlone et al. (2021a); Ng (2021, 2022); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Terauchi (2022); Tomlinson (2015, 2018); Veloso (2017); Verneert et al. (2024); West (2019)
	E&D	Electronic / Digital Tools	Using technology such as software or digital devices to create spontaneous music.	Uses Sibelius in a formal situation in class as well as Acid Studio as a loop-based product in class (Augustyniak, 2015).	10	Augustyniak (2015); Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); Hickey et al. (2016); Ho (2022); Juntunen et al. (2015); Liu (2025); Palaigeorgiou and Pouloulis (2018); Rowe et al. (2015); Tomlinson (2015)
Reflection on Learning & Creating	CMS	Coaching & Mentorship & Scaffolding	Providing systematic advice and assistance to facilitate the development of improvisational abilities through training.	Teaching to an advanced improvisation student is a dynamic, fluid, and reflexive interplay of pedagogical applications of modelling, scaffolding, coaching, and reflective processes (de Bruin, 2019b).	23	Bernhard and Stringham (2016); de Bruin (2018a, 2018b, 2019a, 2019b); Hedden (2017); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Lukács et al. (2022); MacGlone et al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Ng (2022, 2023); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Snell and Azzara (2015); Sutherland and Smith (2022); Terauchi (2022); Verneert et al. (2024); Wall (2018); West (2019)

	IM	Imitation & Modeling	Learning musical expression or strategies by observing and imitating the way teachers or others do.	Trills first initiated by Valerie on the piano are soon imitated by Megan at a higher register on another piano, followed by Jared on the electric guitar (Ng, 2022).	20	Augustyniak (2015); Corcoran (2021); de Bruin (2018a, 2018b); Hedden (2017); Hickey et al. (2016); Larsson and Öhman (2018); Liu (2025); MacGlone et al. (2021a); Mateos-Moreno and Erlanson (2022); Ng (2022, 2023); Pellegrino et al. (2019); Rowe et al. (2015); Snell and Azzara (2015); Terauchi (2022); Varvarigou (2017a, 2017b); Veloso (2017); Wall (2018)
	EXR	Exploring & Experimenting	Trying out musical ideas in different ways to see what works, manipulating musical material to explore possibilities.	Exploration/experimentation is key—there are no errors or bad sounds; each note is simply a stepping stone to the next (Ng, 2023).	19	Augustyniak (2015); Black (2017); de Bruin (2018a, 2018b, 2019a, 2019b); Huovinen and Keipi (2022); Lage-Gómez and Cremades-Andreu (2019); MacGlone et al. (2021b); Ng (2022, 2023); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Rowe et al. (2015); Varvarigou (2017a, 2017b); Veloso (2017); Wall (2018); West (2019)
	LP	Listening & Personalizing	Actively listening and adapting to others to create one's own improvisational style (e.g., play by ear).	The tutor clarified that the task was not to produce an accurate imitation of the copied material. Instead, the students were free to make any changes they wished to the pieces copied, for example, changes in the dynamics, tempo, rhythm, harmony, and even the melody, as long as they kept the flow of the music (Varvarigou, 2017b).	18	Augustyniak (2015); Corcoran (2021); de Bruin (2018a, 2019a); Healy and Albert (2025); Mateos-Moreno and Erlanson (2022); Ng (2021, 2023); Nikolaou (2023); Pellegrino et al. (2019); Rowe et al. (2015); Russell and Woodward (2024); Savage and Harry (2024); Snell and Azzara (2015); Varvarigou (2017a, 2017b); Wall (2018); West (2019)
Interdisciplinary Improvisation	MOV	Improvised movement	Spontaneous physical movements or dance in response to the music.	In the first illustration, Sebastian, improvises movements in the moment recalling and reactualising specific disco dance moves (Larsson & Öhman, 2018).	22	Bernhard and Stringham (2016); Cuervo and Campayo (2024); Hedden (2017); Ho (2022); Larsson and Öhman (2018); Lukács et al. (2022); MacGlone et al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Ng (2023); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Sutela et al. (2020, 2021); Terauchi (2022); Tomlinson (2015, 2018); Veloso (2017); Verneert et al. (2024); West (2019); Yao and Qin (2024); Zalar et al. (2015)

	FUS	Fusion with other art forms	Improvisation based on other art forms, for instance, painting, sculpture, or other visual stimuli.	For instance, he showed the class a picture or a short video, then asked them to create an interpretation as a group (Hedden, 2017).	22	Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); Cuervo and Campayo (2024); Hedden (2017); Hickey et al. (2016); Ho (2022); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); MacGlone et al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Navarro and Chacón-López (2021); Rowe et al. (2015); Smith (2024); Terauchi (2022); Tomlinson (2018); Veloso (2017); Verneert et al. (2024); West (2019); Zhang (2023)
Improvisation Games	STO	Story or role-based improvisation	Improvisation directed by a narrative, poem, or text, offering a contextual foundation.	Exercises emphasizing contrast between free and organized improvisations, improvisation inspired by poetry (Hickey et al., 2016).	19	Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); de Bruin (2019b); Hedden (2017); Hickey et al. (2016); Huovinen and Keipi (2022); Juntunen et al. (2015); Larsson and Öhman (2018); MacGlone et al. (2021a, 2021b); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Navarro Ramón and Chacón-López (2021); Sutela et al. (2021); Tomlinson (2015, 2018); Veloso (2017); West (2019); Zalar et al. (2015)
	GAM	Improvisation games	Structured, playful activities are intended to enhance and cultivate improvisation enjoyably and engagingly.	Secondly, the teacher created in the classroom a place inspired by Egypt and later, by India, conducting activities such as talking about countries, dressing up and games to improvise (Navarro Ramón & Chacón-López, 2021).	9	de Bruin (2018a, 2019a); Hedden (2017); Lukács et al. (2022); MacGlone et al. (2021a); Nikolaou (2023); Navarro Ramón and Chacón-López (2021); West (2019); Zalar et al. (2015)

Appendix B-3 Learning Outcome

Category	Abbr	Sub-category	Description	Example	Frequency (N)	Reference
Affective outcome	CON	Confidence	Developing a belief in one's abilities to perform and create music.	'I can't imagine that our first gig at [...] was particularly good, but it boosted our confidence.' (Black, 2017)	43	Bernhard and Stringham (2016); Black (2017); Corcoran (2021); de Bruin (2018a, 2018b, 2019b, 2022); Healy and Albert (2025); Hedden (2017); Hickey et al. (2016); Juntunen et al. (2015); Langley (2018); Liu (2025); MacGlone et al. (2021a, 2021b); MacGlone and Gravem Johansen (2024); Marino and Chinn (2023); Ng (2021, 2022, 2023); Nikolaou (2023); Norgaard (2016); Norgaard et al. (2019); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Pellegrino et al. (2019); Piazza and Talbot (2021); Navarro Ramón and Chacón-López (2021); Regier (2022); Rowe et al. (2015); Russell and Woodward (2024); Smith (2024); Snell and Azzara (2015); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2018); Varvarigou (2017a, 2017b); Verneert et al. (2024); West (2019); Yao and Qin (2024)
	EMO	Emotional Express	Exploring and expressing emotions using musical improvisation.	The results point toward a view according to which the expressive content of improvisation gets specified and personalized during the very act of improvisation itself. (Huovinen & Keipi, 2022)	28	Augustyniak (2015); Cremades-Andreu and Lage-Gómez (2024); Cuervo and Campayo (2024); de Bruin (2022); Hedden (2017); Ho (2022); Huovinen and Keipi (2022); Johansen (2018); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Liu (2025); MacGlone et al. (2021b); MacGlone and Gravem Johansen (2024); Ng (2021); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Rowe et al. (2015); Russell and Woodward (2024); Smith (2024); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015); Varvarigou (2017a); West (2019); Zalar et al. (2015)
	ENJ	Enjoyment / Joy	Achieving pleasure and satisfaction from engaging in improvisational activities.	According to one teacher, it was noticeable that students who do not take instrument lessons especially enjoyed the lesson (T1). (Verneert et al., 2024)	24	Black (2017); Corcoran (2021); Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); Hanson (2023); Healy and Albert (2025); Hedden (2017); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Mateos-Moreno and Erlanson (2022); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017a); Verneert et al. (2024); Wall (2018); West (2019)

	MOT	Motivation	Increasing the desire to engage in and persist with musical activities.	Surveys at the end of the first year showed that the majority of the students grew to enjoy improvisation well enough that half of the students were improvising during their personal practice sessions, and every student expressed an intent to use improvisation in their future teaching. (Pellegrino et al., 2019)	24	Black (2017); Cossey (2024); Cremades-Andreu and Lage-Gómez (2024); de Bruin (2019a); Healy and Albert (2025); Hedden (2017); Lage-Gómez and Cremades-Andreu (2019); Marino and Chinn (2023); Mateos-Moreno and Erlanson (2022); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Piazza and Talbot (2021); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Snell and Azzara (2015); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015); Varvarigou (2017b); Verneert et al. (2024); Wang (2023); Yao and Qin (2024); Zhang (2023)
	SEL	Self-awareness	Acquiring understanding of one's emotions, strengths, and developmental areas through improvisation.	This manifested in the students' identity and confidence, but also a profound liminality and learning triggered by the new ensemble dynamic (de Bruin, 2022)	23	Black (2017); Corcoran (2021); Cuervo and Campayo (2024); de Bruin (2018a, 2019a, 2019b, 2022); Healy and Albert (2025); Huovinen and Keipi (2022); Lage-Gómez and Cremades-Andreu (2019); Ng (2021, 2022); Smith (2024); Snell and Azzara (2015); Sutela et al. (2021); Sutherland and Smith (2022); Terauchi (2022); Varvarigou (2017a); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)
	REF	Reflection / Meaning Making	Reflecting on own learning, expression, or experience during improvisation and construct personal understanding and meaning from it.	In PEA, the pupils' previous experiences and the present situation are considered in order to understand the meaning-making process (Larsson & Öhman, 2018).	15	Black (2017); de Bruin (2018a, 2018b, 2019a, 2019b); Johansen (2018); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Ng (2023); Rowe et al. (2015); Russell and Woodward (2024); Smith (2024); Sutela et al. (2020); Sutherland and Smith (2022); Tomlinson (2018)
	FLO	Flow	A state of effortless immersion, creative liberty, or intrinsic reward during improvisation. It involves emotional engagement and a sense of fluency in real-time creative processes.	S1: (More attempts for 1 minute, finally stops). Wow that felt great, I just lost sense of time and indulged myself (de Bruin, 2018b).	9	Augustyniak (2015); de Bruin (2018b, 2019b); Johansen (2018); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Mateos-Moreno and Erlanson (2022); Veloso (2017); Verneert et al. (2024)
Behavioral outcome	ENG	Engagement	Actively participating and, being involved in, or	We worked on jazz improv stuff and stuff	25	Black (2017); Corcoran (2021); Cremades-Andreu and Lage-Gómez (2024); de Bruin (2018b); Healy and Albert (2025);

		interested in the improvisational activities.	outside of what I was playing in school... stuff that was not the boring band parts that you get used to as trombone players (Healy & Albert, 2025).		Hedden (2017); Ho (2022); Lage-Gómez and Cremades-Andreu (2019); MacGlone et al. (2021a, 2021b); Marino and Chinn (2023); Nikolaou (2023); Norgaard et al. (2019); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Piazza and Talbot (2021); Snell and Azzara (2015); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Tomlinson (2015); Varvarigou (2017a, 2017b); Verneert et al. (2024); West (2019)	
	RIS	Risk-Taking	Willingness to experiment and try new ideas without fear of mistakes.	As PMTs grew confident improvising collaboratively, they began to take more risks by breaking away from behavioral conventions established in earlier CFMI sessions to venture into unfamiliar territory (Ng, 2022).	15	Black (2017); de Bruin (2018a, 2018b, 2019a, 2022); Hanson (2023); Hedden (2017); Hickey et al. (2016); Ng (2021, 2022); Snell and Azzara (2015); Tomlinson (2015); Varvarigou (2017a); Veloso (2017); Verneert et al. (2024)
	AUT	Autonomy	Applying initiative and making independent decisions in musical improvisation reflects learners' self-regulation, creative choices, and reduced reliance on external guidance.	Students with a few touches felt the ownership of attractive musical effects, and that fascinated them (Palaigeorgiou & Pouloulis, 2018).	12	Black (2017); Corcoran (2021); Lage-Gómez and Cremades-Andreu (2019); Ng (2023); Palaigeorgiou and Pouloulis (2018); Rowe et al. (2015); Savage and Harry (2024); Smith (2024); Snell and Azzara (2015); Sutela et al. (2020, 2021); Wall (2018)
	ADA	Adaptive Skills	Adjusting one's approach in response to changing musical contexts or challenges.	They could also adopt, adapt, or discard the strategies at will based on their learning needs and preferences (Ng, 2023).	7	Black (2017); de Bruin (2019a); Lage-Gómez and Cremades-Andreu (2019); Ng (2022, 2023); Sutela et al. (2021); Sutherland and Smith (2022)
Cognitive outcome	KNO	Musical Knowledge / Technical Skills	Improving knowledge of music theory and instrumental techniques. (e.g., aural skills, note reading, technique, and theory knowledge)	Seven participants mentioned an improved ability to recognize musical elements when listening to music, enabling them to better understand how these musical elements work together to create a	42	Augustyniak (2015); Black (2017); Cossey (2024); de Bruin (2018b, 2019a, 2019b, 2022); Hanson (2023); Healy and Albert (2025); Hedden (2017); Hickey et al. (2016); Johansen (2018); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); Liu (2025); Lukács et al. (2022); MacGlone and Gravem Johansen (2024); Marino and Chinn (2023); Mateos-Moreno and Erlanson (2022); Ng (2023); Norgaard (2016); Palaigeorgiou and Pouloulis (2018); Palmer (2016); Pellegrino et al. (2019); Navarro Ramón and Chacón-López (2021); Rowe et al. (2015); Russell and Woodward (2024); Savage and Harry (2024); Snell

CRE	Creativity	Generating innovative musical ideas and solutions during improvisation.	whole (Russell & Woodward, 2024). The posttest data demonstrate that a considerable increase in the level of creativity after the musical combinatorics course is noted in the category of “improvisation, composition, and theory,” which confirms the influence of musical improvisations on creative skills; however, an increase in this indicator was expected (S. Wang, 2023).	36	and Azzara (2015); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017a, 2017b); Wall (2018); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023) Augustyniak (2015); Black (2017); Cremades-Andreu and Lage-Gómez (2024); de Bruin (2018a, 2018b, 2019a, 2019b, 2022); Hanson (2023); Hedden (2017); Ho (2022); Huovinen and Keipi (2022); Johansen (2018); Juntunen et al. (2015); Lage-Gómez and Cremades-Andreu (2019); Langley (2018); Larsson and Öhman (2018); MacGlone et al. (2021a, 2021b); Ng (2021, 2023); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Navarro Ramón and Chacón-López (2021); Savage and Harry (2024); Snell and Azzara (2015); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2018); Varvarigou (2017a, 2017b); Wang (2023); West (2019); Yao and Qin (2024); Zalar et al. (2015); Zhang (2023)
CRI	Critical Thinking / Decision Making	Evaluating situations and making educated decisions when improvising.	Both teachers were observed to nurture the social nature of learning, responding in the moment, consciously directing the music curriculum toward the students’ experience, and engendering creative and critical thinking while exploring collaborative construction of knowledge (J. M. West, 2019).	25	Augustyniak (2015); Black (2017); Cossey (2024); de Bruin (2018a, 2018b, 2019a, 2019b, 2022); Hanson (2023); Hedden (2017); Huovinen and Keipi (2022); Johansen (2018); Larsson and Öhman (2018); MacGlone and Gravem Johansen (2024); Nikolaou (2023); Norgaard (2016); Palaigeorgiou and Pouloulis (2018); Russell and Woodward (2024); Sutela et al. (2021); Terauchi (2022); Tomlinson (2018); Varvarigou (2017a); Wall (2018); West (2019); Yao and Qin (2024)
PRO	Problem-solving	Developing strategies to overcome musical challenges and achieve desired outcomes.	Music improvisation was a way to solve problems by the transmodal redesign of diverse experiences brought into the	10	Cossey (2024); de Bruin (2018a, 2018b, 2019b); Pellegrino et al. (2019); Tomlinson (2015, 2018); Veloso (2017); Wall (2018); Wang (2023)

Social outcome	COL	Collaboration	Working together in musical activities to achieve shared goals, foster mutual support, and strengthen communal bonds and a shared sense of belonging.	classroom (Tomlinson, 2015). It is also interesting that students highlighted the value of teamwork since ImproviSchool inherently requires the constant collaboration and coordination of all class members. (Palaigeorgiou & Pouloulis, 2018)	34	Augustyniak (2015); Black (2017); Corcoran (2021); Cremades-Andreu and Lage-Gómez (2024); Cuervo and Campayo (2024); de Bruin (2018a, 2019a); Hanson (2023); Healy and Albert (2025); Ho (2022); Lage-Gómez and Cremades-Andreu (2019); Larsson and Öhman (2018); MacGlone et al. (2021a); MacGlone and Gravem Johansen (2024); Ng (2021, 2022, 2023); Nikolaou (2023); Palaigeorgiou and Pouloulis (2018); Pellegrino et al. (2019); Savage and Harry (2024); Sutela et al. (2020, 2021); Sutherland and Smith (2022); Terauchi (2022); Tomlinson (2015, 2018); Varvarigou (2017a, 2017b); Veloso (2017); Verneert et al. (2024); Wall (2018); West (2019); Zalar et al. (2015)
	COM	Communication skill	Effectively conveying ideas and listening to others in both musical and verbal forms.	They also emphasized how, through this group interaction, they developed interpersonal and leadership skills such as taking others' opinions on board, communicating within a group, and building awareness in playing with others (Varvarigou, 2017a).	21	(Black, 2017; Hedden, 2017; Huovinen & Keipi, 2022; P. Juntunen et al., 2015; Lage-Gómez & Cremades-Andreu, 2019; Larsson & Öhman, 2018; Lukács et al., 2022; MacGlone et al., 2021a; Ng, 2021, 2022, 2023; Sutela et al., 2021; Sutherland & Smith, 2022; Terauchi, 2022; Tomlinson, 2015, 2018; Varvarigou, 2017a, 2017b; Veloso, 2017; Wall, 2018; Zalar et al., 2015)
	EMP	Empathy	The ability to perceive, interpret, and respond sensitively to the emotions, intentions, and expressions of others through shared musical interaction.	From these comments, it is evident that this activity provided an opportunity to nurture empathy, respect for others, and self-understanding. (Terauchi, 2022)	8	Corcoran (2021); Cuervo and Campayo (2024); Huovinen and Keipi (2022); MacGlone and Gravem Johansen (2024); Ng (2021, 2022); Sutela et al. (2021); Terauchi (2022)

Appendix B-4 Improvisation Activity

	Authors (year)	Level of study	Improvisation forms and techniques	Tools & Mediums-Specific improvisation & Physical response	Reflection on Learning & Creating	Interdisciplinary Improvisation	Improvisation Games
1	Augustyniak (2015)	Secondary	COI; FRE; IWC; CAR; RR	INS; VOC; E&D	IM; EXR; LP		
2	Bernhard and Stringham (2016)	Higher	COI; IWC; MRV; CAR; RR	INS; VOC	CMS	MOV	
3	Black (2017)	Secondary	COI; IND; FRE; IWC; JCB		EXR		
4	Corcoran (2021)	Primary and community	COI; MRV; JCB; RR	INS	IM; LP		
5	Cossey (2024)	Multiple levels	IWC; MRV; CAR	INS; E&D		FUS	STO
6	Cremades-Andreu and Lage-Gómez (2024)	Secondary	COI	INS; PER; E&D		FUS	STO
7	Cuervo and Campayo (2024)	Secondary	COI	INS; VOC		MOV; FUS	
8	de Bruin (2018a)	Higher	IND; FRE; IWC; CAR	INS	CMS; IM; EXR; LP		GAM
9	de Bruin (2018b)	Higher	IND; FRE; IWC; CAR; JCB	INS; VOC	CMS; IM; EXR		
10	de Bruin (2019a)	Higher	COI		CMS; EXR; LP		GAM
11	de Bruin (2019b)	Higher	IND	INS	CMS; EXR		STO
12	de Bruin (2022)	Higher	COI; FRE	INS			
13	Hanson (2023)	Higher	COI; IWC	INS			
14	Healy and Albert (2025)	Higher	COI; FRE; IWC; JCB	INS	LP		
15	Hedden (2017)	Higher	COI; FRE; RR	INS; VOC; PER	CMS; IM	MOV; FUS	STO; GAM
16	Hickey et al. (2016)	Higher	COI; IND; FRE; CAR; JCB; RR	E&D	IM	FUS	STO
17	Ho (2022)	Secondary	COI; IND; IWC	VOC; E&D		MOV; FUS	
18	Huovinen and Keipi (2022)	Higher	FRE; IWC	INS	EXR		STO
19	Johansen (2018)	Higher	FRE; IWC; MRV; JCB	INS			
20	Juntunen et al. (2015)	Primary and secondary in conservatoire	COI; FRE	INS; E&D			STO

21	Lage-Gómez and Cremades-Andreu (2019)	Secondary	COI; FRE; JCB	INS; VOC; PER	CMS; EXR	FUS	
22	Langley (2018)	Secondary	COI				
23	Larsson and Öhman (2018)	Primary	COI; FRE; MRV	INS; PER	CMS; IM	MOV; FUS	STO
24	Liu (2025)	Higher	IWC; MRV; RR	INS; E&D	IM		
25	Lukács et al. (2022)	Primary	FRE	VOC	CMS	MOV	GAM
26	MacGlone and Gravem Johansen (2024)	Higher	COI; IND; FRE; IWC; MRV	INS	CMS	MOV; FUS	
27	MacGlone et al. (2021a)	Pre-school	COI; FRE	VOC; PER	CMS; IM	MOV; FUS	STO; GAM
28	MacGlone et al. (2021b)	Pre-school	COI; FRE; IWC	INS	CMS; EXR	MOV; FUS	STO
29	Marino and Chinn (2023)	Secondary	COI; IWC; JCB	INS			
30	Mateos-Moreno and Erlanson (2022)	Not mention	IND	INS	IM; LP		
31	Ng (2021)	Higher	COI; FRE; IWC; CAR; RR	INS; PER	LP		
32	Ng (2022)	Higher	COI; FRE; MRV; CAR; JCB; RR	INS; VOC; PER	CMS; IM; EXR		
33	Ng (2023)	Higher	COI; FRE; IWC; MRV; CAR; RR	INS	CMS; IM; EXR; LP	MOV	
34	Nikolaou (2023)	Higher	COI; IND; FRE; IWC; CAR	INS; VOC; PER	CMS; EXR; LP	MOV; FUS	STO; GAM
35	Norgaard (2017)	Secondary	IND; FRE; IWC; JCB	INS			
36	Norgaard et al. (2019)	Secondary	COI; IWC; CAR; JCB	INS			
37	Palaigeorgiou and Pouloulis (2018)	Primary	COI; FRE; IWC	INS; VOC; PER; E&D	CMS; EXR	MOV; FUS	STO
38	Palmer (2016)	High school & College	COI; FRE; IWC; MRV; JCB	INS			
39	Pellegrino et al. (2019)	Higher	COI; FRE; IWC; MRV; CAR; JCB	VOC	CMS; IM; LP		
40	Piazza and Talbot (2021)	Higher	COI; MRV				
41	Navarro Ramón and Chacón-López (2021)	Primary	COI; IND; FRE; IWC	INS		FUS	STO; GAM

42	Regier (2022)	Secondary	JCB					
43	Rowe et al. (2015)	Music school	IND; FRE; IWC; MRV; RR	INS; E&D	IM; EXR; LP	FUS		
44	Russell and Woodward (2024)	Higher	COI; IWC; JCB	INS; VOC	LP			
45	Savage and Harry (2024)	Secondary	COI	INS	LP			
46	Smith (2024)	Higher	FRE	INS		FUS		
47	Snell and Azzara (2015)	Higher	COI; FRE; IWC; CAR; JCB	INS	CMS; IM; LP			
48	Sutela et al. (2020)	Secondary special education	COI; FRE			MOV		
49	Sutela et al. (2021)	Secondary special education	COI; CAR	INS		MOV	STO	
50	Sutherland and Smith (2022)	Higher	COI; IWC	INS	CMS			
51	Terauchi (2022)	Primary	COI; FRE; IWC; MRV	INS; VOC; PER; E&D	CMS; IM	MOV; FUS		
52	Tomlinson2015)	Pre-school	COI; FRE; IWC	INS; VOC; PER		MOV; FUS	STO	
53	Tomlinson (2018)	Primary	COI; FRE; MRV	INS; VOC; PER		MOV	STO	
54	Varvarigou (2017a)	Higher	COI; IWC; MRV; RR	INS	IM; EXR; LP			
55	Varvarigou (2017b)	Higher	COI; FRE; IWC; MRV	INS	IM; EXR; LP			
56	Veloso (2017)	Primary	COI; IND; FRE	INS; PER	IM; EXR	MOV; FUS	STO	
57	Verneert et al. (2024)	Secondary	COI; FRE; IWC; CAR	INS; VOC; PER	CMS	MOV; FUS		
58	Wall (2018)	Primary	COI; IND; FRE; IWC; MRV; CAR; JCB; RR	INS	CMS; IM; EXR; LP			
59	Wang (2023)	Higher	MRV	INS				
60	West (2019)	Kindergarten and adult	FRE; IWC; MRV	INS; PER	CMS; EXR; LP	MOV; FUS	STO; GAM	
61	Yao and Qin (2024)	Higher	COI; IND; IWC; MRV	INS		MOV		
62	Zalar et al. (2015)	Primary	COI; IWC; MRV	INS		MOV	STO; GAM	
63	Zhang (2023)	Higher	COI; IWC; MRV	INS; VOC		FUS		

Note: COL = Collective improvisation, IND = Individual improvisation, FRE = Free improvisation, IWC = Improvisation with constraints, MRV = Melodic or rhythmic variation, CAR = Call and response, JCB = Jazz Combo / Blues improvisation, RR = Repetitive riffs, INS = Instrument improvisation, VOC = Vocal improvisation, PER = Percussion-based improvisation, DIT = Electronic / Digital Tools, CMS = Coaching & Mentorship & Scaffolding, EXR = Exploring & experimenting & Reflecting, IM = Imitation & Modeling, LP = Listening & Personalizing, BIM = Body-based improvisation, FUA = Fusion with other art forms, STO = Story or role-based improvisation, GAM = Improvisation games, Empty cell = no specific information in the article about the topic.

Appendix B-5 Learning Outcome

	Authors (year)	Affective outcomes	Behavioral outcomes	Cognitive outcomes	Social outcomes
1	Augustyniak (2015)	EMO; FLO		KNO; CRE; CRI	COL
2	Bernhard and Stringham (2016)	CON			
3	Black (2017)	CON; ENJ; MOT; SEL; REF	ENG; RIS; AUT; ADA	KNO; CRE; CRI	COL; COM
4	Corcoran (2021)	CON; ENJ; SEL	ENG; AUT		COL; EMP
5	Cossey (2024)	ENJ; MOT		KNO; PRO; CRI	
6	Cremades-Andreu and Lage-Gómez (2024)	EMO; ENJ; MOT	ENG	CRE	COL
7	Cuervo and Campayo (2024)	EMO; SEL			COL; EMP
8	de Bruin (2018a)	CON; SEL; REF	RIS	CRE; PRO; CRI	COL
9	de Bruin (2018b)	CON; REF; FLO	ENG; RIS	KNO; CRE; PRO; CRI	
10	de Bruin (2019a)	MOT; SEL; REF	RIS; ADA	KNO; CRE; CRI	COL
11	de Bruin (2019b)	CON; SEL; REF; FLO		KNO; CRE; PRO; CRI	
12	de Bruin (2022)	CON; EMO; SEL	RIS	KNO; CRE; CRI	
13	Hanson (2023)	ENJ	RIS	KNO; CRE; CRI	COL
14	Healy and Albert (2025)	CON; ENJ; MOT; SEL	ENG	KNO	COL
15	Hedden (2017)	CON; EMO; ENJ; MOT	ENG; RIS	KNO; CRE; CRI	COM
16	Hickey et al. (2016)	CON	RIS	KNO	
17	Ho (2022)	EMO	ENG	CRE	COL
18	Huovinen and Keipi (2022)	EMO; SEL		CRE; CRI	COM; EMP
19	Johansen (2018)	EMO; REF; FLO		KNO; CRE; CRI	
20	Juntunen et al. (2015)	CON; EMO; ENJ; FLO		CRE	COM
21	Lage-Gómez and Cremades-Andreu (2019)	EMO; ENJ; MOT; SEL; REF; FLO	ENG; AUT; ADA	KNO; CRE	COL; COM
22	Langley (2018)	CON		CRE	
23	Larsson and Öhman (2018)	EMO; ENJ; REF		KNO; CRE; CRI	COL; COM
24	Liu (2025)	CON; EMO		KNO	
25	Lukács et al. (2022)			KNO	COM
26	MacGlone and Gravem Johansen (2024)	CON; EMO		KNO; CRI	COL; EMP
27	MacGlone et al. (2021a)	CON	ENG	CRE	COL; COM
28	MacGlone et al. (2021b)	CON; EMO	ENG	CRE	
29	Marino and Chinn (2023)	CON; MOT	ENG	KNO	
30	Mateos-Moreno and Erlanson (2022)	ENJ; MOT; FLO		KNO	
31	Ng (2021)	CON; EMO; SEL	RIS	CRE	COL; COM; EMP
32	Ng (2022)	CON; SEL	RIS; ADA		COL; COM; EMP

33	Ng (2023)	CON; REF	AUT; ADA	KNO; CRE	COL; COM
34	Nikolaou (2023)	CON; EMO; ENJ; MOT	ENG	CRE; CRI	COL
35	Norgaard (2017)	CON		KNO; CRI	
36	Norgaard et al. (2019)	CON	ENG		
37	Palaigeorgiou and Pouloulis (2018)	CON; EMO; ENJ; MOT	ENG; AUT	KNO; CRE; CRI	COL
38	Palmer (2016)	CON		KNO	
39	Pellegrino et al. (2019)	CON; ENJ; MOT	ENG	KNO; PRO	COL
40	Piazza and Talbot (2021)	CON; MOT	ENG		
41	Navarro Ramón and Chacón-López (2021)	CON; ENJ; MOT		KNO; CRE	
42	Regier (2022)	CON			
43	Rowe et al. (2015)	CON; EMO; ENJ; MOT; REF	AUT	KNO	
44	Russell and Woodward (2024)	CON; EMO; REF		KNO; CRI	
45	Savage and Harry (2024)		AUT	KNO; CRE	COL
46	Smith (2024)	CON; EMO; SEL; REF	AUT		
47	Snell and Azzara (2015)	CON; MOT; SEL	ENG; RIS; AUT	KNO; CRE	
48	Sutela et al. (2020)	CON; EMO; REF	ENG; AUT	KNO	COL
49	Sutela et al. (2021)	CON; EMO; SEL	ENG; AUT; ADA	KNO; CRI	COL; COM; EMP
50	Sutherland and Smith (2022)	CON; EMO; ENJ; MOT; SEL; REF	ENG; ADA	KNO; CRE	COL; COM
51	Terauchi (2022)	CON; EMO; ENJ; MOT		KNO; CRE; CRI	COL; COM; EMP
52	Tomlinson2015)	EMO; ENJ; MOT	ENG; RIS	KNO; PRO	COL; COM
53	Tomlinson (2018)	CON; ENJ; REF		KNO; CRE; PRO; CRI	COL; COM
54	Varvarigou (2017a)	CON; EMO; ENJ; SEL	ENG; RIS	KNO; CRE; CRI	COL; COM
55	Varvarigou (2017b)	CON; MOT	ENG	KNO; CRE	COL; COM
56	Veloso (2017)	FLO	RIS	PRO	COL; COM
57	Verneert et al. (2024)	CON; ENJ; MOT; FLO	ENG; RIS		COL
58	Wall (2018)	ENJ	AUT	KNO; PRO; CRI	COL; COM
59	Wang (2023)	MOT		CRE; PRO	
60	West (2019)	CON; EMO; ENJ	ENG	KNO; CRE; CRI	COL
61	Yao and Qin (2024)	CON; MOT; SEL		KNO; CRE; CRI	
62	Zalar et al. (2015)	EMO; SEL		KNO; CRE	COL; COM
63	Zhang (2023)	MOT; SEL		KNO; CRE	

Appendix C

Interview guide

- Can you describe your current teaching situation? (e.g., grade levels, number of students, weekly lesson frequency)
- Which specific pedagogical approaches do you use (e.g., Orff, Kodály)?
- Which creative activities do you use in your class, and why? (e.g., composition, improvisation)
- How do you incorporate improvisation activities into your lessons?
- What challenges do you and your students face when implementing improvisation activities?
- Which improvisation activities do you find work well for your students, and why?
- How do you think improvisation activities influence your students, if at all?
- Do you evaluate students' improvisation products or provide feedback?
 - If yes, how?
 - If not, why?
- Which pedagogical approaches for teaching improvisation would you recommend?
- Are there any themes or experiences that we didn't address that you believe are essential for this interview?

Do you have anything to add or clarify?

Appendix D List of information of participants

ID	Gender	Age – Teaching experience (years)	Grade	Location	Instrument (Main - Second)	Improvisation Background
PMT1	F	26 – 2	4	Den Haag	Singing – Piano	Informal – She improvised (singing and play the piano) with her jazz-pianist father since childhood. She did not receive formal training before bachelor. At the Conservatory, she continued in ensemble and singing lessons, exploring jazz, blues, pentatonic, and text-based improvisations. Now she uses it for composition and teaching ideas. She feels comfortable but still self-critical.
PMT2	F	20 – 3	3	Amsterdam	Singing – Violin	Moderate (recent trained in jazz) – Transitioned from classical to jazz violin. She enjoys vocal and instrumental improvisation. Her first formal training was through jazz lessons. She applies simple story-based improvisation in private teaching.
PMT3	F	25 – 4	4	Utrecht	Flute – Piano, Singing	Minimal – Classically trained, limited experience before study. First exposure through Kobranie (vocal painting) and solfège hand-sign improvisations in year 1. Finds solo improvisation freeing, but group contexts anxiety-provoking. Applies light tonal exploration with flute students but seeks more theory and training to teach confidently.
PMT4	M	22 – 3	3	Tilburg	Bass Guitar – Drums	Informal – Played in family jam sessions since childhood (mainly drumming); later explored bass and free group improvisation; connects music improv with theater background; limited formal training, mostly self-initiated.
PMT5	F	26 – 1	3	Zwolle	Singing – Piano, Guitar	Moderate – Band experience with pop/rock improvisation; first formal course on improvisation (Indian, jazz, folk, bluegrass); scatting and vocal painting in bachelor; now uses improvisation for teaching piano/songwriting and body percussion in secondary school.
PMT6	M	22 – 2	4	Leiden	Classical Guitar – Piano	Moderate (multi-instrumental) – Self-taught piano and drums; early blues improvisation on guitar; later studied experimental/atonal improvisation in “music phenomenon” and “experimental improvisation” courses.
PMT7	F	21 – 2	3	Maastricht	Clarinet – Saxophone	Minimal – Classical background; first improvisation in theory lessons using pentatonic and jazz scales; initially anxious but learned to accept “no mistakes” mindset.
PMT8	M	29 – 10	4	Rotterdam	Piano – Carinet	Limited (classical) – Arranged for wind band and occasionally improvised at home; learned basic blues-scale improvisation in piano practicum and vocal painting workshops.
PMT9	M	22 – 3	3	Groningen	Piano – Drums	Advanced (jazz focus) – Four years of jazz piano; improvises weekly in jazz combos and elective free-improv classes; strong harmonic awareness and ensemble interaction.
PMT10	F	26 – 2	4	Enschede	Piano – Flute	Moderate (semi-classical) – Classical training; early melodic improvisation within known pieces; later practiced ensemble jamming and pop-rock arrangements during bachelor.

Appendix E Questionnaire dimensions and items

Constructs	Items	
Attitude toward studying improvisation	AS1	Improvisation makes my study more satisfying.
	AS2	I like improvisation in my study.
	AS3	I feel more motivated for my studies when I improvise.
	AS4	Improvisation makes my study more effective.
	AS5	Improvisation is an effective way to enhance my musical development.
	AS6	Improvisation improves my musical abilities.
Attitude toward teaching improvisation	AT1	The use of improvisation will make my teaching more satisfying.
	AT2	I will certainly use improvisation in my future teaching.
	AT3	Students will be more motivated for my future teaching when I use improvisation activities.
	AT4	Because of the use of improvisation activities, my future teaching will become more efficient.
	AT5	I feel challenged to teach improvisation effectively in the future.
	AT6	The use of improvisation will improve my future teaching.
Attitude toward inclusion of improvisation	AI1	I feel it is important for me to learn to improvise in my bachelor's studies.
	AI2	I feel it is important for music teachers to include improvisation in their teaching.
	AI3	I feel it is important for music teachers to include improvisation in primary school.
	AI4	I feel it is important for music teachers to include improvisation in secondary school.
Self-efficacy for improvisation	SEI1	I am able to accomplish most of the improvisation tasks I set for myself.
	SEI2	When facing difficult tasks of improvisation, I am certain that I will accomplish them well.
	SEI3	In general, I think that I can obtain outcomes of improvisation activities that are important to me.
	SEI4	I believe I can succeed in improvisation activities to which I set my mind.
	SEI5	I am able to successfully overcome improvisation challenges.
	SEI6	I am confident that I can perform effectively on various improvisational tasks.
	SEI7	Compared to other people, I can improvise very well.
	SEI8	Even when the task is tough, I can improvise quite well.
Self-efficacy for teaching improvisation	SETI1	I am confident in using a variety of improvisation strategies as a future teacher.
	SETI2	I am confident in providing an alternative explanation or example of improvisation in my future teaching when students are confused.
	SETI3	I am confident in scaffolding good improvisation activities for my students.
	SETI4	I am confident in implementing various strategies of improvisation activity in my future teaching.
	SETI5	As a future teacher, I am confident in responding to difficult questions of improvisation from my students.
	SETI6	As a future teacher, I am confident in adjusting the difficulty of improvisation tasks to the proper level for students' needs.
	SETI7	My students will easily grasp the improvisation skills I teach.
	SETI8	I am confident in providing appropriate improvisation challenges for very capable students.

Appendix F Structural paths

IV	DV	Pre-service teacher							In-service teacher					
		Estimate	SE	z	pvalue	p_sig	beta		Estimate	SE	z	pvalue	p_sig	beta
ANG	→ INT_MOT	0.109	0.384	0.284	0.777		0.045	-	-0.350	0.134	-2.614	0.009	**	-0.201
ANX	→ INT_MOT	0.159	0.354	0.451	0.652		0.066		0.109	0.127	0.854	0.393		0.062
JOY	→ INT_MOT	2.303	0.315	7.310	0.000	***	0.957	+	1.318	0.130	10.156	0.000	***	0.758
ANG	→ EXT_MOT	0.171	0.399	0.430	0.667		0.069		-0.211	0.129	-1.634	0.102		-0.129
ANX	→ EXT_MOT	0.436	0.373	1.169	0.243		0.175		0.099	0.124	0.803	0.422		0.061
JOY	→ EXT_MOT	2.506	0.362	6.920	0.000	***	1.007	+	1.244	0.124	10.059	0.000	***	0.760
ANG	→ AMT	0.294	0.139	2.110	0.035	*	0.268	±	0.628	0.105	5.991	0.000	***	0.491
ANX	→ AMT	0.080	0.132	0.612	0.541		0.073		-0.075	0.093	-0.809	0.419		-0.059
JOY	→ AMT	-0.149	0.087	-1.715	0.086		-0.136	-	-0.413	0.068	-6.043	0.000	***	-0.323
ANG	→ AT	-0.128	0.414	-0.309	0.757		-0.048		-0.255	0.133	-1.916	0.055		-0.138
ANX	→ AT	0.363	0.390	0.931	0.352		0.136		-0.012	0.128	-0.096	0.924		-0.007
JOY	→ AT	2.572	0.369	6.963	0.000	***	0.962	+	1.469	0.141	10.419	0.000	***	0.794
ANG	→ SE	0.189	0.166	1.141	0.254		0.116	-	0.271	0.115	2.344	0.019	*	0.150
ANX	→ SE	-0.404	0.164	-2.463	0.014	*	-0.248	±	-0.296	0.112	-2.648	0.008	**	-0.164
JOY	→ SE	1.159	0.140	8.253	0.000	***	0.712	+	1.517	0.129	11.787	0.000	***	0.841
INT_MOT	→ SN	0.187	0.082	2.270	0.023	*	0.264	±	0.332	0.072	4.637	0.000	***	0.362
EXT_MOT	→ SN	0.388	0.091	4.286	0.000	***	0.568	±	0.426	0.075	5.658	0.000	***	0.438
AMT	→ SN	-0.058	0.079	-0.729	0.466		-0.037	-	-0.130	0.059	-2.210	0.027	*	-0.104
SE	→ TE_Engagement	1.054	0.120	8.769	0.000	***	0.864	+	1.553	0.167	9.303	0.000	***	0.942
SE	→ TE_Instruction	0.862	0.099	8.718	0.000	***	0.814	+	1.164	0.113	10.260	0.000	***	0.903
SE	→ TE_Management	1.896	0.355	5.344	0.000	***	0.951	+	1.977	0.284	6.961	0.000	***	0.963
SN	→ Intention	0.784	0.145	5.406	0.000	***	0.545	+	0.977	0.123	7.915	0.000	***	0.569
INT_MOT	→ Intention	0.454	0.121	3.753	0.000	***	0.447	±	0.294	0.098	3.010	0.003	**	0.187
EXT_MOT	→ Intention	-0.016	0.107	-0.144	0.885		-0.016		0.111	0.097	1.139	0.255		0.066
AMT	→ Intention	-0.212	0.090	-2.353	0.019	*	-0.095	±	-0.219	0.070	-3.134	0.002	**	-0.102
AT	→ Intention	-0.038	0.098	-0.389	0.698		-0.042	-	0.207	0.088	2.361	0.018	*	0.140
SE	→ Intention	-0.727	0.505	-1.438	0.150		-0.484		-0.747	0.578	-1.292	0.196		-0.492
TE_Engagement	→ Intention	0.091	0.118	0.765	0.444		0.074		0.023	0.124	0.189	0.850		0.025
TE_Instruction	→ Intention	0.036	0.107	0.341	0.733		0.026		0.110	0.107	1.029	0.303		0.093
TE_Management	→ Intention	0.311	0.180	1.726	0.084		0.412		0.307	0.165	1.860	0.063		0.415

Note: IV = Independent variables, DV = Dependent variables. Cells are marked to indicate cross-group differences in statistical significance: + indicates consistent significance across groups, ± indicates significance in both groups with different strength levels, and - indicates divergent significance patterns between groups (significant in one group only).

Appendix G Indirect effect paths

Pre-service teacher					In-service teacher				
Effect	Estimate	CI_Lower	CI_Upper	Sig_CI	Effect	Estimate	CI_Lower	CI_Upper	Sig_CI
ind_JOY_EXTMOT_SN_INTENT	0.518	0.146	1.022	YES	ind_JOY_INTMOT_INTENT	1.046	0.280	2.661	YES
ind_JOY_INTMOT_SN_INTENT	0.427	0.107	0.922	YES	ind_JOY_EXTMOT_SN_INTENT	0.763	0.242	1.831	YES
ind_EXTMOT_SN_INTENT	0.417	0.194	0.733	YES	ind_EXTMOT_SN_INTENT	0.304	0.115	0.613	YES
ind_JOY_INTMOT_INTENT	0.387	0.007	0.849	YES	ind_JOY_SE_INTENT	-0.840	-3.772	0.587	NO
ind_INTMOT_SN_INTENT	0.324	0.114	0.650	YES	ind_SE_TE_ALL_INTENT	0.713	-0.388	3.223	NO
ind_ANG_AMT_INTENT	-0.137	-0.434	-0.016	YES	ind_SE_TEmgmt_INTENT	0.587	-0.275	2.688	NO
ind_JOY_AMT_INTENT	0.090	0.010	0.193	YES	ind_JOY_INTMOT_SN_INTENT	0.337	-0.047	1.082	NO
ind_JOY_SE_INTENT	-1.131	-4.319	0.612	NO	ind_ANX_SE_INTENT	0.292	-0.557	1.998	NO
ind_SE_TE_ALL_INTENT	0.769	-0.319	2.879	NO	ind_INTMOT_SN_INTENT	0.146	-0.014	0.360	NO
ind_SE_TEmgmt_INTENT	0.606	-0.060	2.121	NO	ind_ANG_SE_INTENT	-0.137	-1.695	0.809	NO
ind_JOY_AT_INTENT	0.304	-0.059	0.797	NO	ind_ANX_EXTMOT_SN_INTENT	0.134	-1.962	2.927	NO
ind_ANX_SE_INTENT	0.220	-0.576	1.278	NO	ind_JOY_AT_INTENT	-0.098	-1.120	0.609	NO
ind_ANG_SE_INTENT	-0.201	-1.266	0.650	NO	ind_SE_Teeng_INTENT	0.095	-0.198	0.484	NO
ind_JOY_EXTMOT_INTENT	0.138	-0.235	0.539	NO	ind_ANX_INTMOT_INTENT	0.074	-3.572	5.091	NO
ind_SE_TEinstr_INTENT	0.128	-0.179	0.529	NO	ind_ANG_AMT_INTENT	-0.062	-0.265	0.059	NO
ind_AMT_SN_INTENT	-0.127	-0.353	0.012	NO	ind_ANG_EXTMOT_SN_INTENT	0.052	-2.967	2.376	NO
ind_ANG_INTMOT_SN_INTENT	-0.114	-1.832	0.130	NO	ind_ANG_INTMOT_INTENT	0.048	-5.320	4.076	NO
ind_ANG_INTMOT_INTENT	-0.104	-1.803	0.125	NO	ind_AMT_SN_INTENT	-0.045	-0.224	0.085	NO
ind_ANG_EXTMOT_SN_INTENT	-0.089	-2.068	0.206	NO	ind_JOY_EXTMOT_INTENT	-0.040	-0.934	0.780	NO
ind_ANG_AMT_SN_INTENT	-0.079	-0.303	0.009	NO	ind_JOY_AMT_INTENT	0.032	-0.014	0.123	NO
ind_ANG_AT_INTENT	-0.053	-1.101	0.136	NO	ind_SE_TEinstr_INTENT	0.031	-0.261	0.351	NO
ind_JOY_AMT_SN_INTENT	0.052	-0.006	0.159	NO	ind_ANX_INTMOT_SN_INTENT	0.024	-0.998	1.390	NO
ind_ANX_EXTMOT_SN_INTENT	0.042	-0.238	1.954	NO	ind_ANX_AMT_INTENT	-0.017	-0.164	0.154	NO
ind_ANX_INTMOT_SN_INTENT	0.036	-0.203	1.700	NO	ind_ANG_INTMOT_SN_INTENT	0.016	-1.481	1.131	NO
ind_SE_Teeng_INTENT	0.036	-0.405	0.762	NO	ind_ANX_AT_INTENT	-0.014	-2.381	0.989	NO
ind_ANX_INTMOT_INTENT	0.033	-0.195	1.657	NO	ind_ANG_AMT_SN_INTENT	-0.013	-0.091	0.047	NO
ind_ANG_EXTMOT_INTENT	-0.024	-0.657	0.168	NO	ind_JOY_AMT_SN_INTENT	0.007	-0.013	0.063	NO
ind_ANX_AMT_INTENT	0.017	-0.067	0.276	NO	ind_ANX_EXTMOT_INTENT	-0.007	-1.196	1.233	NO
ind_ANX_EXTMOT_INTENT	0.011	-0.156	0.622	NO	ind_ANG_AT_INTENT	0.005	-1.143	2.502	NO
ind_ANX_AMT_SN_INTENT	0.010	-0.045	0.180	NO	ind_ANX_AMT_SN_INTENT	-0.004	-0.073	0.042	NO
ind_ANX_AT_INTENT	-0.002	-0.206	1.001	NO	ind_ANG_EXTMOT_INTENT	-0.003	-1.230	1.229	NO

Appendix H Items assessed for each variable

Construct	No.	Item
Familiarity with the national curriculum		How familiar are you with the content of the National Curriculum in music?
Verbal persuasion/support		Rate the support of improvisation activity provided by your course / teacher / education / colleague at your school.
Mastery experience		Rate your satisfaction with your improvisation skill.
Self-efficacy	SE1	I am confident about my own improvisation.
	SE2	Improvisation would not challenge me.
	SE3	I would be comfortable to improvise.
Joy	JOY1	I generally enjoy guiding improvisation activities.
	JOY2	I generally have so much fun in improvisation activities that I gladly prepare and lead them in my lessons
	JOY3	I often have reasons to be happy while I guide improvisation activities.
	JOY4	I generally guide improvisation activities with enthusiasm
Anxiety	ANX1	I generally feel tense and nervous while guiding improvisation activities
	ANX2	I am often worried that my guiding of improvisation activities isn't going so well
	ANX3	Preparing to improvise activities for teaching often causes me to worry.
	ANX4	I feel uneasy when I think about guiding improvisation activities.
Anger	ANG1	I often have reasons to be angry while I guide improvisation activities.
	ANG2	I often feel annoyed while guiding improvisation activities.
	ANG3	Sometimes I get really mad while I guide improvisation activities.
	ANG4	Guiding improvisation activities generally frustrates me.
Attitude	AT1	The use of improvisation makes my teaching more satisfying.
	AT2	I like to use improvisation activities in my teaching.
	AT3	Students are more motivated by my teaching when I use improvisation activities.
	AT4	Because of the use of improvisation activities, my teaching will become more efficient.
	AT5	I feel challenged to lead improvisation activities effectively.
	AT6	The use of improvisation improves my teaching.
Intrinsic motivation	INT1	Because this represents a meaningful choice to me.
	INT2	Because this is an important goal to me.
	INT3	Because I enjoy doing it.
	INT4	Because it's fun.
Extrinsic motivation	EXT1	Because I'm supposed to do so.
	EXT2	Because the improvisation activity of my teaching is very important
	EXT3	Because the improvisation activity of my teaching plan obliges me to do it
	EXT4	Because improvisation activity is required.
Amotivation	AMT1	I don't see the relevance of carrying out this task.

	AMT2	I don't see the reason.
	AMT3	I don't see its purpose.
Teacher efficacy (TE)	TE1	I am confident in controlling students' disruptive behaviors during improvisation activities.
	TE2	I am confident in motivating students who show low interest during improvisation activities.
TE_Engagement: TE2, 3, 4, 11	TE3	I am confident in getting students to believe they can do well in improvisation activities.
TE_Instruction: TE5, 9, 10, 12	TE4	I am confident in helping my students value improvisation activities.
TE_Management: TE1, 6, 7, 8	TE5	I am confident in scaffolding good improvisation activities for my students.
	TE6	I am confident in getting my students to follow classroom rules during improvisation activities.
	TE7	I am confident in calming a student who is disruptive or noisy during improvisational activities.
	TE8	I am confident in establishing a classroom management system with each group of students during improvisation activities.
	TE9	I am confident in using a variety of improvisation strategies as a teacher.
	TE10	I think I am confident in providing an alternative explanation or example of improvisation in my teaching when students are confused.
	TE11	I am confident in supporting practicing improvisation.
	TE12	I am confident in implementing various strategies of improvisation activity in my teaching.
Subjective norm	SN1	People who influence my behavior think that I should use improvisation activities.
	SN2	People who are important to me will support me in using improvisation activities.
	SN3	People whose views I respect support the use of improvisation activities.
Behavioral intention to use	BIU1	I intend to guide improvisation activity in the future
	BIU2	I expect that I will guide improvisation activity in the future.
	BIU3	I plan to guide improvisation activity in the future.
Attitude for future persistence	AP1	Having considered the time I have spent and the stress I have experienced, I am still willing to lead improvisation activities in my lesson.
	AP2	Given freedom to choose, I shall not guide improvisation activities in my teaching.

Note: Participants scored all items on Five-point Likert scales: Verbal persuasion/support and Mastery experience (1—Nonexistent, 2—Poor, 3—Adequate, 4—Good, and 5—Excellent); Self-efficacy (1 - Strongly Disagree to 5 - Strongly Agree); Emotions (1 - Strongly Disagree to 5 - Strongly Agree); Attitudes (1 - Completely inapplicable to 5 - Completely Applicable); Motivations (1 - Completely inapplicable to 5 - Completely Applicable); Subjective norm (1 - Strongly Disagree to 5 - Strongly Agree); Teacher efficacy (1—Nothing, 2—Very Little, 3—Some Influence, 4—Quite A Bit, and 5—A Great Deal); Behavioral intention to use (1 - Strongly Disagree to 5 - Strongly Agree); Attitude for future persistence (1 - Strongly Disagree to 5 - Strongly Agree).

Appendix I Direct and indirect effects predicting pre-service and in-service music teachers' intention to implement improvisation activities.

