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Scaffolding as a Teaching Skill when Teaching Music and Boosting Musical Creativity

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Master Thesis - Talent Development and Creativity

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Abstract

Scaffolding is a useful teaching tool to support student learning. It is a dynamic process involving the teacher providing temporary support contingent on and adapted to the student's level of understanding, helping them progress further than if they were unsupported. In music education, teachers may implicitly use scaffolding, but may be unaware of this. This study investigates an intervention implemented during the research project 'Creating music and creative behaviour in the classroom: The influence of coaching primary school teachers in following a Curious Minds approach', in which teachers learned basic pedagogical strategies to use when teaching music, including scaffolding and structured autonomy support. Data from the above research project were used in this study to determine any differences in teachers' use of scaffolding and the Model of Contingent Teaching after the intervention and explore a possible link between scaffolding and musical creativity. Results of Monte Carlo analyses conducted during this study indicate some evidence that the teachers' use of scaffolding became more contingent after the intervention. Exploratory results also indicate a trend towards a possible relationship between convergent thinking and action in musical creativity and contingency. Further investigation is needed to examine whether the intervention influenced the two other aspects of scaffolding: fading and responsibility transfer. Moreover, further research to investigate teachers' patterns of learning following such interventions would enable future interventions to be tailored to teachers' learning trajectories.

Keywords: scaffolding, music education, musical creativity, teaching skills, contingent support

Scaffolding as a Teaching Skill when Teaching Music and Boosting Musical Creativity

Education is an important aspect of society and should be widely accessible but, in practice, education is not always inclusive. The benefits of education are many for both the person receiving education and for society as it helps people develop their talents and reach their full potential. Education should be inclusive and accessible, so that everyone is able to realise their potential (UNESCO & Right to Education Initiative, 2019). However, the same forms of education may not be effective for all. Each student is unique and will therefore have different educational needs. Educational strategies should be developed to help teachers acquire useful skills to make their teaching inclusive and accessible (Vantieghem et al., 2020). In primary school, a focus on helping teachers develop their pedagogical skills can improve the inclusive nature of the classroom (Rusyani et al., 2021). This will support teachers in providing accessible education, to boost learning and decrease dropout rates (Vantieghem et al., 2020). This focus on improving accessibility is lacking in music education. When teaching music, primary teachers are faced with students of wide ranging abilities and need appropriate skills to ensure effective learning (Jellison & Draper, 2015).

Scaffolding

One such useful teaching skill is scaffolding. Scaffolding refers to temporary support provided by the teacher, contingent on and adapted to the student's level of understanding, which helps them progress further than if they were unsupported (Van de Pol et al., 2019). Scaffolding is often used in relation to Vygotsky's zone of proximal development (ZPD). ZPD refers to the distance between what a learner can do by themselves and what a learner can do when supported (scaffolded) by another who leads learners through the zone of proximal development. The degree of support (level of scaffolding) fades until the skill they were learning becomes something the learner can do successfully alone (Wood & Wood, 1996). Scaffolding can be seen as a dynamic process in the sense that the degree of scaffolding (level of support) depends on how much support a student needs (level of

understanding) and vice versa (van Geert & Steenbeek, 2005). Support is faded out gradually as the student's understanding increases and control of learning is returned progressively to the student (Van de Pol et al., 2019). There are, therefore, three central factors to scaffolding: contingency, fading and responsibility transfer (Van de Pol et al., 2010).

Autonomy and Support

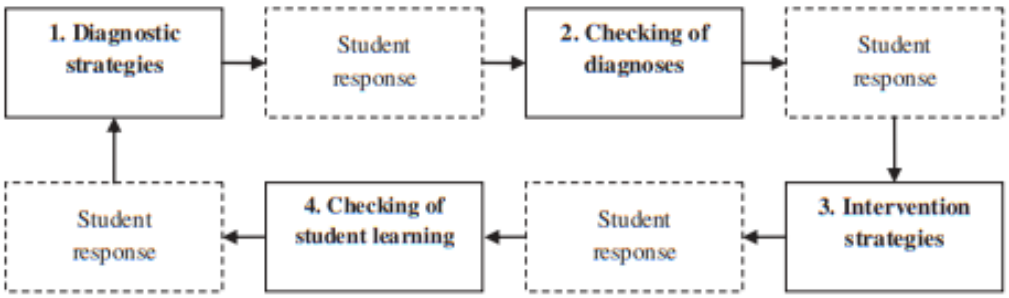
The aim of scaffolding is to support a learner until they can undertake a task or skill successfully on their own (Wood & Wood, 1996), or in other words, autonomously. For a learner, the goal of scaffolding is therefore autonomy (Kupers et al., 2016). This is apparent in the contingency of scaffolding, where a teacher exerts more control when a student requires more support and vice versa (Van de Pol et al., 2019). When teachers exert more control, they provide less support for a student's autonomy but, once a student demonstrates greater understanding, teachers can provide more autonomy support by relinquishing control. Fading and responsibility transfer (Van de Pol et al., 2010) also demonstrate the student's acquisition of autonomy and the teacher's provision of autonomy support. The teacher provides autonomy support by fading out teacher control and the student acquires autonomy by taking increased responsibility for their own learning.

Model of Contingent Teaching

Van de Pol et al. (2012) developed the Model of Contingent Teaching (MCT) to describe scaffolding. The MCT (see Figure 1) contains four steps that a teacher takes during scaffolding. First, the teacher uses 'diagnostic strategies' to determine a student's level of understanding (Van de Pol et al., 2014). Second, the teacher 'checks diagnoses' to make sure that they have the right perception of a student's level of understanding (Van de Pol et al., 2014). Once a student's level of understanding has been determined, the teacher can provide support based on this level. This is the third step: the application of 'intervention strategies', such as giving instructions or asking questions. After providing support, the teacher then checks the level of student understanding again. This is the fourth step. They ask diagnostic

questions to see if the support has helped the student learn so the teacher knows whether to increase or decrease (fade out) support (Van de Pol et al., 2014).

Figure 1
The Model of Contingent Teaching (MCT)



(Diagram from Van de Pol et al., 2014)

Scaffolding in Music Teaching

Scaffolding is an important teacher skill and can be applied in all areas of education, including music (Kupers et al., 2016). Some teachers may have their own interpretation of scaffolding (tips and tricks), which may not constitute contingent scaffolding, and others may be unaware of scaffolding (Verenikina, 2004) or merely apply aspects of it from observing other teachers (Karp, 2010). Van de Pol et al. (2014) conducted a study investigating the effect of a scaffolding intervention on teachers' use of scaffolding and contingency. The intervention comprised education based on the Model of Contingent Teaching, the opportunity to practise the model's steps, and reflection sessions after the practice sessions. The study found that the teachers taking part in the intervention provided more support, and more contingent support, after the intervention than before. These results indicate that an intervention based on coaching teachers in scaffolding can be effective in promoting teachers' use of scaffolding (Van de Pol et al., 2014). Although this study focused on teachers of social studies (Van de Pol et al., 2014), it is possible that similar results would be found for primary teachers teaching music.

During the research project ‘Creating music and creative behaviour in the classroom: The influence of coaching primary school teachers in following a Curious Minds approach’ (Hendriks, 2018), teachers were coached in teaching music and applying autonomy support in music lessons. Video Feedback Coaching, based on research by Van den Heijkant et al. (2000) was used as part of the intervention. The teachers used these videos to examine their teaching as a form of self-reflection and to further develop their teaching based on reflection and feedback. Information about music teaching and teaching skills, including scaffolding and the MCT, was also provided to the teachers during the intervention (Hendriks, 2018).

Students’ Musical Creativity

An important factor in music education is students’ musical creativity (Webster, 2002). Musical creativity can be considered as creative thinking, with convergent and divergent thinking working in a dynamic process alongside specific conditions and skills that together produce an outcome (Webster, 2002) during music making. Two terms related to musical creativity are originality (new ideas) and appropriateness (ideas are used correctly and effectively) (Payne, 2016). Divergent thinking refers to a type of thinking where no final goal or product is necessary, and the aim is to come up with many different original ideas. An example of divergent thinking in music could be brainstorming many different rhythms to play on the drums. Convergent thinking is a type of thinking that focuses on producing one appropriate product (Webster, 2002), such as creating a drum rhythm that matches a specific melody and time signature. According to Webster (2002), creative thinking is a process motivated by a need to resolve an issue, resulting in a product. In musical creativity, the needs that drive creative thinking are apparent in the analysis that occurs when listening to music, composing new music, and when performing or improvising.

Musical creativity does not only involve thinking but can also be considered as embodied: a dynamic process that occurs in interaction between a person and their environment, where the environment affects the person and vice versa. In other words,

musical creativity not only involves thinking about music but also using your body to interact with your environment (i.e., embodied), such as between a musician and their instrument (Malinin, 2019). Or, when composing, a musician could think of a melody but could also use their body to play the melody on an instrument (in their environment) as an aid to further developing their musical ideas. The sound of the melody when played on the instrument or the difficulty of the melody when played can affect the person's thoughts about the melody they are composing. Both the musician and the instrument are involved and affect each other. In the context of music education, an example of this dynamic process of musical creativity is the interaction between student and teacher (Bremmer & Nijs, 2020). For example, students sing a melody while a teacher uses gestures to indicate the beat. The students' adherence to the beat depends on their understanding of melody and rhythm and how clearly the teacher indicates the beat.

Musical Creativity and Scaffolding

Musical creativity in a student is a social and dynamic process that occurs in interaction with the environment, which in the case of scaffolding (a teacher-student interaction), is a teacher. In other words, a student's musical creativity is aided by a teacher. In that sense, musical creativity is a product of the whole interaction between teacher, student and musical task. Musical creativity is not only a student characteristic but is influenced by the teacher and the musical task itself. Scaffolding as a strategy in the interaction process can influence the development of musical creativity.

Wiggins (2011) found that when students gain proficiency, they demonstrate more agency in their musical creativity. Agency is also related to scaffolding (Kupers et al., 2016). As teacher support is faded out the student gains more responsibility for their own learning, i.e., more autonomy, (Van de Pol et al., 2019) and as they gain more control, they are provided with more space to demonstrate their agency (Kupers et al., 2016). In other words, the more knowledge or skills students acquire, the less support they need, and the more

freedom they gain to demonstrate their agency. Wiggins' (2011) findings regarding proficiency, agency and musical creativity can theoretically be linked to the relationship between scaffolding, autonomy and agency. Proficiency could be used as a synonym for the student understanding that is supported in scaffolding. Using scaffolding, a teacher can help a student gain the knowledge and skills needed to improve proficiency. During contingent scaffolding, as the student improves their proficiency, the teacher should provide more autonomy support, enabling the student to demonstrate more agency and musical creativity.

Research Questions and Hypotheses

The aim of this study is to explore how primary teachers' use of scaffolding developed during the research project 'Creating music and creative behaviour in the classroom: The influence of coaching primary school teachers in following a Curious Minds approach' (Hendriks, 2018). This study also aims to investigate whether teachers' use of scaffolding boosts students' musical creativity. Note that the research project by Hendriks (2018) will be referred to as the *research project* and the master thesis will be referred to as the *study*.

This study's first research question is: how does the group of teachers' use of scaffolding develop throughout the coaching? The hypothesis is that the support provided by the group of teachers will become more contingent after the intervention, as was seen in the research by Van de Pol et al. (2014). In both the research by Van de Pol et al. (2014) and the research project, teachers were taught about scaffolding and about the MCT.

This study's second research question is: how does the use of scaffolding differ between individual teachers? This second question is exploratory and examines whether there are general differences in how teachers use scaffolding and how their use of scaffolding developed during the research project.

The study's third and final research question is: is scaffolding linked to students' musical creativity? This third question is also exploratory and examines the possible

relationship between the contingent support of scaffolding and the convergent and/or divergent thought and action of musical creativity.

Method

Participants

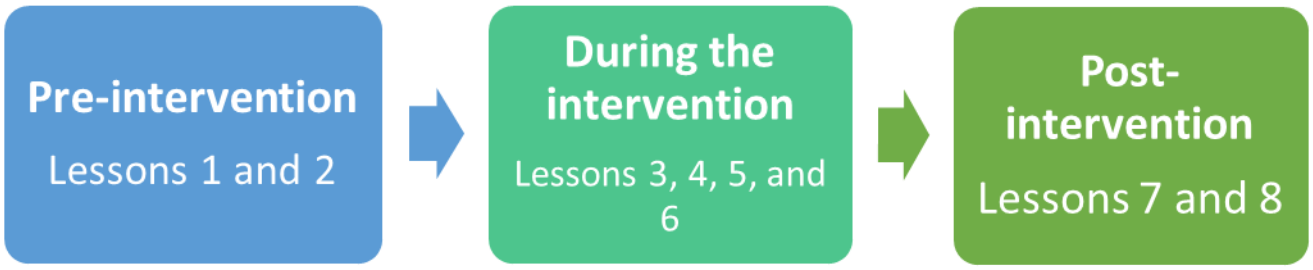
A total of 12 Dutch teachers who teach music for Dutch grade 3-6 as well as their students participated in the intervention during the research project (Hendriks, 2018). Due to time constraints, it was decided to only include teachers from the second year of the research project in this study and not the teachers from the first year, or the control group (n = 6). The final sample for this study, therefore, comprised 6 primary teachers (female). There was no specific reason why the teachers from the second year were selected. Each teacher had a class of between 19 and 25 students (M = 22.67, SD = 2.07) resulting in a total of 136 students. The teachers were aged between 29 and 40 years (M = 35.83, SD = 4.07) with teaching experience varying between 4 and 15 years (M = 8.33, SD = 4.46).

Design

Data Collection

During the research project, 10 lessons were filmed in the second year for each of the six teachers. For this study, eight lessons were analysed: two pre-intervention lessons, four lessons during the intervention, and two post-intervention lessons (see Figure 2).

Figure 2
Lesson Distribution for the Phases



Teacher-student interactions in selected fragments of these video recordings were used in the study. The fragments were selected by Hendriks (2018) during the research project

based on whether scaffolding was present: did a problem occur and/or did the teacher apply (aspects of) scaffolding? To be selected a fragment needed to portray an attempt at scaffolding by a teacher for a student or teacher-perceived problem. These fragments were between two and three minute video clips of a lesson in which scaffolding occurred. However, as scaffolding may not be occurring during the entire fragment, the more precise **episodes** of scaffolding within these fragments were coded in Mediacoder. Each episode begins either the first time the teacher starts to talk about a problem or with what the teacher said before a student asked about a problem. The episodes end when the teacher moves onto a new topic/task or ends a class. These episodes are the moment(s) within a fragment where scaffolding occurs (see the Coding Book (Hendriks & Kok, 2022) in the Appendix for more information on the beginning and end of scaffolding episodes).

The research project (Hendriks, 2018) was approved by the Psychology Ethical Committee of the University of Groningen. Teachers and parents gave their consent for the classes to be filmed and for the data to be used for research. Parts of these data were analysed in this study in accordance with the given approval and consent.

Variables

The scaffolding episodes were coded using a coding scheme (see Coding Book (Hendriks & Kok, 2022)) that was developed as part of this study and based on Van de Pol et al. (2019). The variables were coded in the Mediacoder program (Bos & Steenbeek, 2009). There were several variables in this study: contingency and the related student understanding/performance and autonomy support, the MCT steps taken, intervention strategies, and musical creativity. The second-order variables developed from these variables are described in the Data Analysis section. See Table 1 for an overview of all variables, their definitions, and how they were used. Overall, for each scaffolding episode, the following were coded to examine scaffolding: the number of MCT steps the teacher followed, the

intervention strategies used by the teacher in MCT step 3, and whether each teacher action or speech was contingent upon the student's understanding/performance.

Contingency. The first variable, contingency, is one operationalisation of scaffolding in this study. To code this variable, two other variables were needed: student understanding/performance (student variable) and autonomy support (teacher variable). In the research by Van de Pol et al. (2014), teacher control was used as the teacher variable to see if the level of control the teacher used in their support is contingent on the student's understanding. In this study, autonomy support was used as the teacher variable. The level of autonomy support was checked to see whether the level of autonomy support was contingent to student understanding/performance.

Each teacher action/utterance (a turn) and student action/utterance (a turn) in each episode was determined. The student turns were coded for the student understanding/performance variable and an autonomy support value was used to code the teacher turns as contingent or non-contingent. The autonomy support coding scheme developed to code autonomy support during the research project is included for information in this study's Coding Book (Hendriks & Kok, 2022). The verbal and non-verbal autonomy support values (with possible values 1-8) were examined using the coding scheme to decide the level of autonomy support (levels: low, medium, medium-high, high). Contingency was determined by the level of student understanding/performance in comparison with the teacher's level of verbal and non-verbal autonomy support.

To be contingent: the poorer the student understanding/performance, the less autonomy support should be provided by the teacher, and the higher the student understanding/performance, the more autonomy support should be provided by the teacher (see the Coding Book (Hendriks & Kok, 2022) for an explanation of these coding rules). Three-turn sequences were coded as contingent or not contingent based on this comparison.

These sequences were formed from an initial teacher action/utterance (T1), a student action/utterance (S1) that had a specific level of student understanding/performance, and a final teacher action/utterance (T2). Depending on the autonomy support provided by the teacher (T2) in relation to the student understanding/performance in S1, T2 was then coded as contingent or not contingent (see Figure 3).

Figure 3
Example of a Three-Turn Sequence

Teacher/student utterance		**Autonomy support**	**Student performance**	**Contingency**
Student-perceived problem*:* Earlier, a student asked what a vowel is. The teacher returns the (check) question to the class. Some students name the vowel A, showing some understanding.				
T_1	What is a vowel? (to class)	Medium		
S_1	Aaa…		Partial	
T_2	**A, E, I, O.. (models while students join in)**	**Low**		**Contingent**

The Model of Contingent Teaching. The second variable is the MCT (see Figure 1) of which there are four steps: diagnostic strategies, checking diagnoses, intervention strategies and checking student learning. Each scaffolding episode was coded with the number of steps the teacher completed in that episode. If steps were missing, they were noted as a comment on the scaffolding episode (see Coding Book (Hendriks & Kok, 2022) for further explanation).

Intervention Strategies. The third variable, intervention strategies, was a variable that examined the strategies the teachers implemented during MCT step three. This included seven possible strategies (Modelling, Instructing, Explaining, Feeding back, Hinting, Questioning, Encouragement) as well as an Other category. Each scaffolding episode was coded according to which of the seven possible strategies were present. Multiple intervention strategies could be selected providing they were present in the episode (see Coding Book (Hendriks & Kok, 2022) for further explanation).

Musical Creativity. Musical creativity can be considered as convergent and divergent thought (Webster, 2002) during music-making. Two variables that represent musical creativity had already been coded during the research project: divergent thought and action (DTA) and convergent thought and action (CTA). In this study, data for the previously coded DTA and CTA were used to find the mean DTA (MDTA) and CTA (MCTA) for each lesson.

Data Analysis

Monte Carlo Analysis. Monte Carlo analyses were used in this study. This is a permutation test that is non-parametric and is suitable for small group sizes (Todman and Dugard 2001), as is the case in this study with a sample size of six teachers. The analysis was conducted via Excel using the Add-in Poptools. In the Monte Carlo analyses, the results of the study were compared to simulated scores created by shuffling the results with 10,000 permutations (Hood, n.d.). The output of Poptools provided the number of permutations where the simulated results were greater or equal to the results of this study. The p-value was estimated from this number using the equation $p = (r+1)/(n+1)$, where r stands for the number of simulated scores that are greater or equal to the results of the study and n stands for the number of permutations (North et al., 2002). The alpha level in this study is 0.05 so a p-value below 0.05 was considered a significant difference, while a p-value below 0.1 was considered to indicate a trend.

Group of Teachers. For the first research question, examining how the group of teachers' use of scaffolding develops, second-order variables based on contingency and MCT variables were used. First, the **mean percentage incidence of contingency (MPIoC)** is presented in a line graph for each teacher and the whole group of teachers to examine the contingency of scaffolding development over the three phases (pre-intervention, during intervention and post-intervention). Second, the **incidence of contingency (IoC)** was used in a Monte Carlo analysis to compare IoC between the phases for the group. This Monte Carlo analysis compared the values of contingency (0 = non-contingent and 1 = contingent) for the

whole group per phase: between pre-intervention and during intervention, between during intervention and post-intervention, and between pre-intervention and post-intervention. These contingency values are the numbers of three-turn sequences that have either been coded as contingent or non-contingent. As the intervention phase involved four lessons compared with two lessons for the pre- and post-intervention phases, the incidence was divided by the number of lessons in each phase to make the results proportional. However, as the resultant p-values were very similar to the p-values of the Monte Carlo analyses without this division, the results without this division were used.

In a similar way to contingency, the MCT was also divided into two second-order variables. First, the **mean number of MCT steps taken (MNoMST)** is presented in a line graph for each teacher and the whole group to examine the development of MNoMST over the different phases. Second, the **incidence of MCT steps taken (IoMST**) was also examined in a Monte Carlo analysis, comparing the number of steps taken pre-intervention, during intervention, and post-intervention.

Individual Teachers. For the second research question, examining how the use of scaffolding differs between teachers, two teachers' development in relation to scaffolding was examined. The two teachers were selected based on contingency. More specifically, on the **total mean percentage incidence of contingency (TMPIoC)** and **the sum incidence of contingency (SIoC).** The two teachers with the highest and the lowest TMPIoC and SIoC were selected. This enabled a comparison between a teacher displaying a high level of contingency and a teacher displaying a low level of contingency. Each teacher's MPIoC and MNoMST is presented in a line graph. The individual use of intervention strategies was explored and compared proportionally: the incidence was divided by two for the during intervention phase as it has double the number of lessons. Different examples of contingent and non-contingent scaffolding in the selected two teachers' scaffolding episodes are also

transcribed for a qualitative exploration of the interaction between student and teacher during scaffolding.

Scaffolding and Musical Creativity. Finally, for the third question, examining whether scaffolding and musical creativity are linked, as mentioned, the mean values for DTA and CTA were calculated. These MDTA and MCTA were compared to the MPIoC and MNoMST taken per lesson for each teacher using Spearman's correlation. Spearman's correlation is a non-parametric test of correlation and although the sample size was small (n = 6), which discounts the use of Pearson's correlation, the number of observations (6 teachers x 8 lessons) was 48 and was considered sufficient to use Spearman's correlation.

Table 1
Overview of Variables

First Order Variables	Second Order Variables	Definition	Used in Research Question(s)
Contingency	Mean percentage incidence of contingency (MPIoC)	The percentage of three-turn sequences that are contingent per lesson	RQ 1: in a line graph with all the individual teachers and the group RQ 2: in a line graph with the two selected teachers RQ 3: individual teacher values correlated against variables of musical creativity
	Incidence of contingency (IoC)	The values of contingency (0 = non-contingent and 1 = contingent) coded for the three-turn sequences in each phase	RQ 1: in Monte Carlo analyses to investigate differences in the phases
	Total mean percentage incidence of contingency (TMPIoC)	The percentage of three-turn sequences that are contingent for all of a teacher's lessons	RQ 2: to select the two teachers
	Sum incidence of contingency (SIoC)	The sum of base coded values (0 or 1) of contingency for all a teacher's three-turn sequences	RQ 2: to select the two teachers
MCT	Mean number of MCT steps taken (MNoMST)	The mean value of the number of MCT steps taken for each lesson	RQ 1: in a line graph with all the individual teachers and the group RQ 2: in a line graph with the two selected teachers RQ 3: individual teacher values correlated against variables of musical creativity
	Incidence of MCT steps taken (IoMST)	The base coded values of the number of MCT steps taken for each scaffolding episode	RQ 1: in Monte Carlo analyses to investigate differences in the phases
Intervention strategies	Incidence of intervention strategies (IoIS)	The number of times each strategy was implemented by teachers during MCT step three in each phase	RQ 1: to compare the group use of intervention strategies in different phases RQ 2: to compare the two selected teachers' use of intervention strategies in different phases
Musical creativity	Mean divergent thinking and action (MDTA)	The mean of divergent thinking and action per lesson for each teacher	RQ 3: correlated against individual teacher values for contingency and MCT
	Mean convergent thinking and action (MCTA)	The mean of convergent thinking and action per lesson for each teacher	RQ 3: correlated against individual teacher values for contingency and MCT

Reliability

The inter-rater reliability for each variable was tested to determine the reliability of the Coding Book developed for this study. Two independent raters decided the beginning and end times of scaffolding episodes for a percentage of inter-rater agreement of 81% and the number of MCT steps for each episode for a similarity of 78%. Cohen's κ was run to determine the agreement between the raters regarding the first order variables of contingency, student understanding/performance and intervention strategies. There was a good degree of agreement regarding which three-turn sequences are contingent, $\kappa = .724$, $p < .001$. For student understanding/performance, an excellent degree of agreement was found, $\kappa = .763$, $p < .001$. Regarding the intervention strategies, the degree of agreement was excellent, $\kappa = .902$, $p < .001$.

Results

Group of Teachers

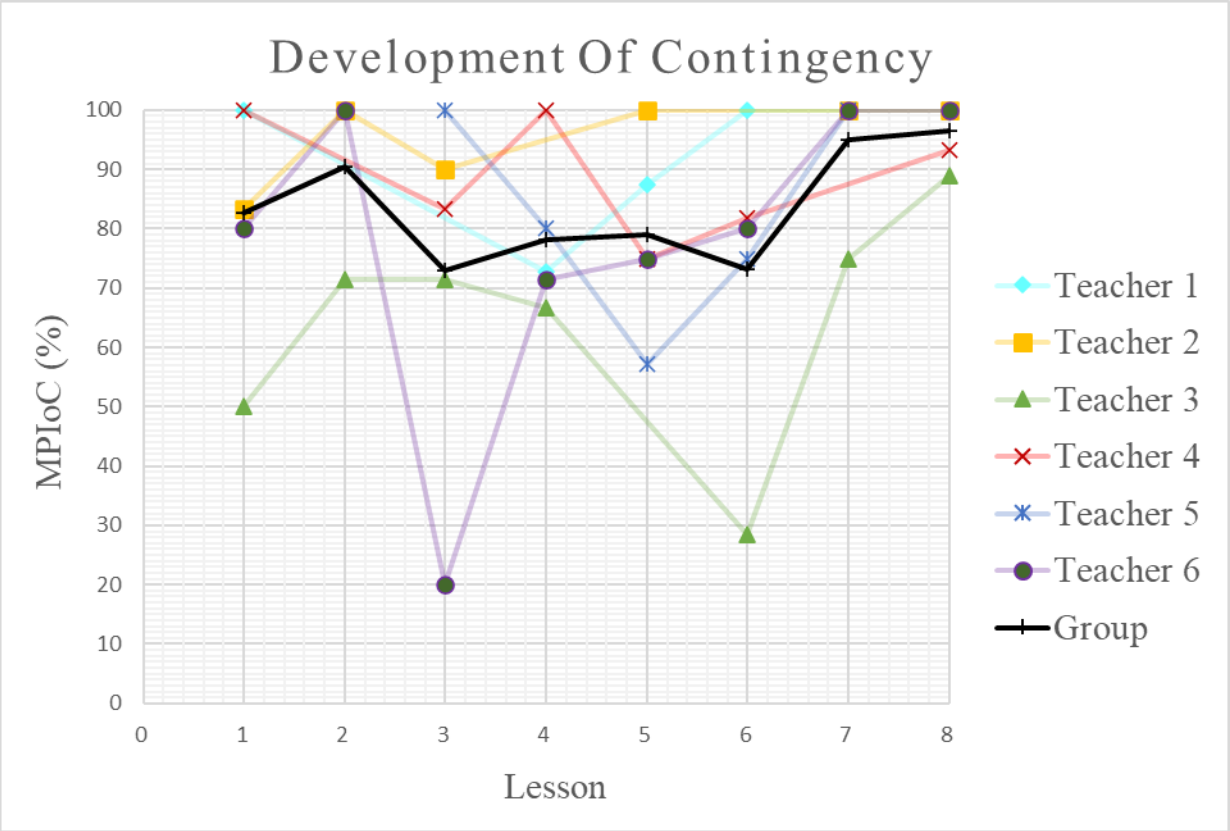
In the group of teachers (n = 6), there were several lessons where no scaffolding episodes were present. In all lessons, there was a scaffolding episode present for five teachers, apart from lesson two. For lesson two, only three teachers had a scaffolding episode. This section describes the results for the first research question: how does the group of teachers' use of scaffolding develop throughout the coaching intervention? The hypothesis was that the use of scaffolding would become more contingent. The hypothesis can be accepted if the results indicate that scaffolding became more contingent.

Contingency

For the whole group of teachers across the lessons, the range of MPIoC was 20-100%. There appeared to be a dip in MPIoC during intervention, which rose again post-intervention. Figure 4 shows the MPIoC for all teachers as a group per lesson and each individual teacher development. At group level, this indicates that contingency is higher in the pre-intervention phase and drops during the intervention phase before rising sharply post-intervention.

Figure 4

MPIoC for All Teachers and Group of Teachers



One Monte Carlo analysis comparing IoC for all teachers in the different phases was significant (see Table 2). This was the difference between during intervention (M = 76.01%, SD = 21.29%) and post-intervention (M = 95.72%, SD = 7.81%), p-value = 0.0003, which indicates that IoC post-intervention was significantly higher than during intervention. This p-value supports the hypothesis that support becomes more contingent after the coaching intervention. In addition, it could also be said that there is a trend towards a significant difference between IoC pre- (M = 85.60%, SD = 17.08%) and post-intervention (M = 95.72%, SD = 7.81%), p-value = 0.10.

Table 2
Monte Carlo Analysis Comparing Incidence of Contingency Between the Phases

Phases	Mean 1	Mean 2	p-value
Pre- vs during intervention	0.86	0.77	0.90
During vs post-intervention	0.77	0.96	0.00*
Pre- vs post-intervention	0.86	0.96	0.10

**Significant at 0.05 level*

Model of Contingent Teaching

For the whole group of teachers across the lessons, the range of MNoMST is 2 to 4. The Model of Contingent Teaching comprises four steps: Diagnostic strategies, Checking of Diagnoses, Intervention Strategies and Checking of Student Learning. In this study, the most commonly missed step was Step 4, Checking of Student Learning (19 times) while Step 2, Checking of Diagnoses was missed 10 times. Step 1 Diagnostic Strategies was only missed once.

Figure 5
NMoMST per Lesson for all Teachers

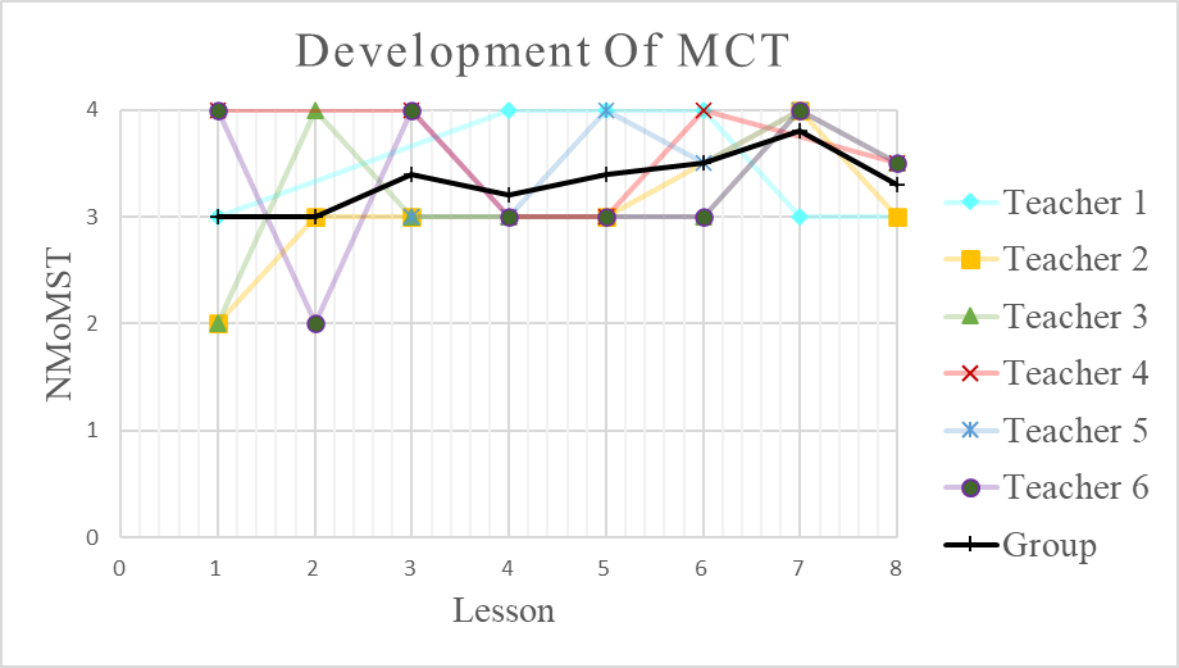


Figure 5 shows the MNoMST for all teachers per lesson. It indicates that the teachers generally use more MCT steps during intervention and post-intervention than pre-

intervention. The Monte Carlo analyses comparing all teachers' IoMST in different phases are non-significant at alpha = 0.05 (see Table 3). However, the Monte Carlo analysis comparing IoMST taken pre-intervention (M = 3.11, SD = 0.93) and post-intervention (M = 3.53, SD = 0.52, p = 0.07) indicates a trend towards a significant difference.

Table 3
Monte Carlo Analysis Comparing Steps of Model of Contingent Teaching Taken Between the Phases

Phases	Mean 1	Mean 2	p-value
Pre- vs during intervention	3.11	3.35	0.18
During vs post-intervention	3.35	3.53	0.20
Pre- vs post-intervention	3.11	3.53	0.07

Intervention Strategies

Table 4 shows the IoIS in each phase. The intervention strategies are ordinal as they become more autonomy supportive: modelling being the least and encouragement being the most. It appears that the intervention strategies most often used were instructing (a low autonomy supportive strategy) and questioning (a high autonomy supportive strategy). Feeding back and hinting were the least often used. These two intervention strategies are in the middle with regards to autonomy support. Encouragement was the only strategy that was not used at all pre-intervention. This suggests that encouragement was only practised and explored during intervention and post-intervention. It is also the highest autonomy supportive strategy. The incidence of intervention strategies increases from pre-intervention to during intervention and continues or remains the same post-intervention. The only exceptions are explaining, which decreases across the phases, feeding back which decreases during intervention and increases post-intervention, and hinting which remains the same.

Table 4
Intervention Strategies Implemented by Teachers in the Phases

Intervention strategies	Before	During	After
Modelling	3	8	4
Instructing	7	18	9
Explaining	3	2	1
Feeding back	1	0	2
Hinting	1	1	1
Questioning	5	18	9
Encouragement	0	6	4
Other	0	0	0

Individual Teachers

This section explores the second research question: how does the use of scaffolding differ between individual teachers? First, the trajectories of two selected teachers in MPIoC and MNoMST were examined and compared along with intervention strategy incidence. Examples of their scaffolding were then transcribed. Two teachers were selected based on contingency. Teacher 2 had the highest SIoC (43) and TMPIoC (94%) whereas teacher 3 had the lowest SIoC (28) tied with teacher 5 and the lowest TMPIoC (67%).

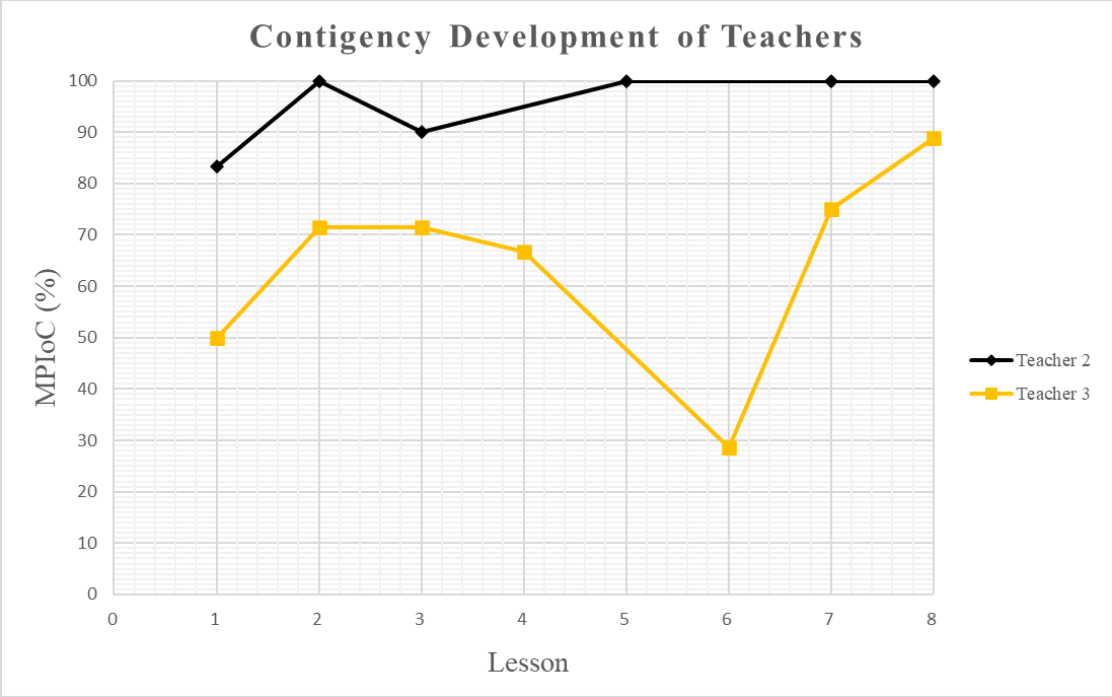
Table 5
Overall Mean Percentage Incidence and Sum Incidence of Contingency per Teacher

Teacher	TMPIoC	SIoC
1	89%	33
2	93%	43
3	67%	28
4	88%	42
5	82%	28
6	78%	31

Development of Two Teachers

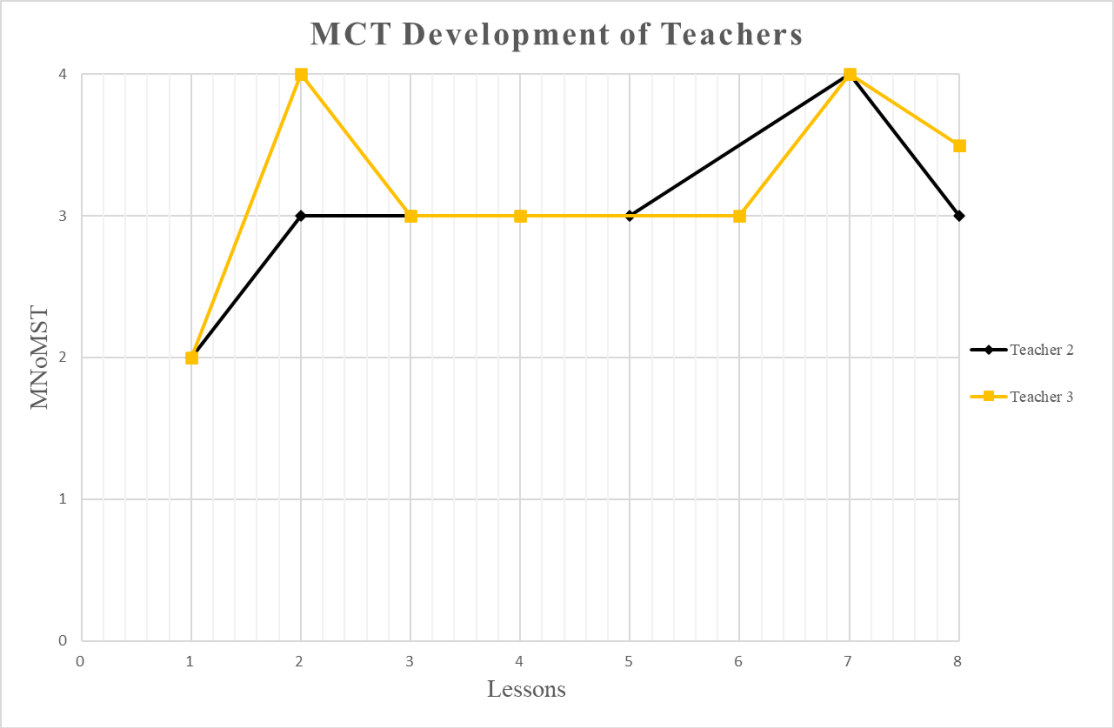
The graph (Figure 6) below shows how the MPIoC of Teacher 2 and Teacher 3 develops over the lessons. It appears that Teacher 2 presents more stable high MPIoC during intervention and post-intervention. The MPIoC varies considerably for the first three lessons, pre-intervention and during intervention but remains at 100% post-intervention. It appears that Teacher 3 has low MPIoC which increases slightly during pre-intervention but decreases during intervention before rising sharply post-intervention.

Figure 6
MPIoC per Lesson for the Selected Teachers



The graph (Figure 7) below shows how MNoMST by Teachers 2 and 3 develops over the lessons. It shows a steady increase in MNoMST per lesson for Teacher 2. This drops during the final lesson but is still higher than the first value. For Teacher 3, there was an initial fluctuating increase in MNoMST per lesson before stabilising during the intervention with the final value being higher than the first value.

Figure 7
Mean Steps of Model of Contingent Teaching Taken per Lesson for the



Teacher 2 appears to use more low autonomy supportive strategies (modelling and instructing) but also uses questioning, which is a high autonomy supportive strategy (see Table 6). Teacher 2 also only used three strategies.

Table 6
Intervention Strategies Implemented by Teacher 2 in the Phases

Intervention strategies	Before	During	After
Modelling	2	2	1
Instructing	2	2	2
Explaining	0	0	0
Feeding back	0	0	0
Hinting	0	0	0
Questioning	2	3	1
Encouragement	0	0	0
Other	0	0	0

In comparison, teacher 3 used six of the seven strategies, only leaving out feeding back (see Table 7). Interestingly, the use of hinting and explaining (medium autonomy supportive strategies) decreases during the phases for teacher 3 while encouragement (a high autonomy supportive strategy) is only used post-intervention.

Table 7
Intervention Strategies Implemented by Teacher 3 in the Phases

Intervention strategies	Before	During	After
Modelling	0	0	1
Instructing	1	2	2
Explaining	2	1	0
Feeding back	0	0	0
Hinting	1	1	0
Questioning	1	3	2
Encouragement	0	0	3
Other	0	0	0

Examples of Scaffolding

This section continues to examine the differences between the two selected teachers by exploring examples of scaffolding. Figure 8 is an example where the teacher maintains autonomy support with contingent three-turn sequences. Teacher 3 was attempting to see whether the class understood how a piano produces sound and used the intervention strategy questioning to do so. The teacher maintained the same level of autonomy support, medium-high, using questioning as the main intervention strategy. The students had a partial understanding of how a piano produces sound, with different students understanding different parts of the puzzle.

Figure 8

An Example of Contingent Maintained Autonomy Support (Teacher 3 in Phase 2)

Teacher/student utterance		Autonomy support	Student performance	Contingency
Teacher-perceived problem: Discussing what you can do with strings and how they produce sound and, specifically in these sequences, how a piano makes sound.				
T_1	And what happens then that makes the string vibrate? *(Gestures side to side like a string vibrating)*	Medium-High		Contingent
S_1	*(A different student)* It goes down.		Partial	
T_2	**What goes down?**	**Medium-High**		**Contingent**

In contrast, Figure 9 is an example of maintained autonomy support which is not contingent. Teacher 2 also uses questioning as the main intervention strategy but maintains the use of it despite a student's poor performance. The teacher asks the student the same question with more of an emphasis on using the body. This may not work as the student did not understand the first question that using the body means not using the mouth.

Figure 9

An Example of Non-Contingent Maintained Autonomy Support (Teacher 2 in Phase 2)

Teacher/student utterance		Autonomy support	Student performance	Contingency
Teacher-perceived problem*:* The class are making body sounds for the weather, and they have to decide what each kind of weather sounds like. Students are struggling with just using their body and not their mouths when coming up with a sound for thunder.				
T_1	We've only had rain, but is there also something with thunder? What would that sound like? (Student name)?	Medium-high		
S_O	*(Student making noises with instrument)*		Other	
T_O	I told you to put that on the table.			Other
S_1	Now I, boom-boom-boom-boom-boom *(makes quick boom sounds with mouth)*		Poor	
T_2 (T_1)	**With your mouth. Can we also do it with our body?**	**Medium-high**		**Non-contingent**

Figure 10 is an example of a contingent sequence where Teacher 2 decreased autonomy support. This starts with high autonomy support as the teacher is merely observing the class and student performance but decreases to medium-high autonomy support as the teacher asks a question, which is also introducing a new task. This sequence is contingent as medium-high and high autonomy support result in a contingent sequence when the student performance is good.

Figure 10

An Example of Contingent Decreased Autonomy Support (Teacher 2 in Phase 1)

Teacher/student utterance		Autonomy support	Student performance	Contingency
Teacher-perceived problem: The whole class is singing a song to a backing track, but they are not all singing along properly.				
T_2 (T_1)	**Yes! *(Lets class continue singing without her)***	High		Contingent
S_1	*(Class singing)*		Good	
T_2 (T_1)	**Who has- shh! Who has heard the second part? Is it different than the first part or is sort of the same?**	**Medium-high**		**Contingent**

In contrast, Figure 11 is an example of a teacher decreasing autonomy support in a non-contingent sequence. The teacher uses questioning as an intervention strategy (medium-high autonomy support) to which the students respond with good understanding and improvise when there are no instructions to follow on the board. This indicates that the students have a good understanding of how to follow the instructions, but the teacher tells them (low autonomy support) when the instructions will start again, and when they should stop improvising, resulting in a non-contingent three-turn sequence. It is possible that these students would have stopped improvising and followed the music without the teacher's instruction as they had good understanding. However, this good understanding is related to improvising and not to following the instructions. The teacher may have estimated that student understanding/performance for this would be poor and decided to intervene. This, however, does not follow the MCT and the teacher's estimation may be inaccurate.

Figure 11
An Example of Non-Contingent Decreased Autonomy Support (Teacher 3 in Phase 3)

Teacher/student utterance		Autonomy support	Student performance	Contingency
Teacher-perceived problem: The whole class playing a song along to a backing track using boomwhackers (colourful plastic pitched tubes) following along to music on the board, and there is a section where they have to improvise.				
T_1	What is this then?	Medium-High		
S_1	*(One student)* Oh, without music! We have to improvise. *(Class is improvising)*		Good	
T_2	**Pay attention. It's just about to come back.**	**Low**		**Non-contingent**

Figure 12 is an example of teacher 3 increasing autonomy support in a contingent sequence. The teacher uses explanation as an intervention strategy in this example, which is medium autonomy supportive. The students follow this explanation and sing well leading to a good student performance. The teacher then increases autonomy support to high by merely observing the class without singing along or gesturing, which results in a contingent three-turn sequence. As student performance is good, it is more beneficial to give students more autonomy support.

Figure 12
An Example of Contingent Increased Autonomy Support (Teacher 3 in Phase 1)

Teacher/student utterance		**Autonomy support**	**Student performance**	**Contingency**
Teacher-perceived problem*:* The whole class singing a Christmas song along to a backing track, but the singing is quiet.				
T_1	Ok, good. We're going to do it once more and I want to hear everyone. This doesn't mean that you have to scream, just sing in your normal voice, at the volume of your normal speaking voice. Ok? I'm going to turn it on. Pay attention! *(Indicates start of singing by gesturing the beat)*	Medium		
S_1	*(Class singing along to the backing track)*		Good	
T_2	***(Teacher observing)***	**High**		**Contingent**

These examples were chosen from teacher 2 and teacher 3. For these examples, a description was given of the intervention strategies used, most commonly questioning, and why each sequence was contingent or non-contingent according to the coding scheme. In these examples, teacher 2 uses questioning, even when it is non-contingent, whereas teacher 3 uses two different strategies: questioning and instructing. This supports the idea that teacher 2 continues using the same three intervention strategies, while teacher 3 has more variety in their intervention strategies. There was no example of increasing autonomy support resulting in a non-contingent sequence in the development of both teacher 2 and 3. However, this does not mean there is no example from one of the other teachers.

Scaffolding and Musical Creativity

Divergent Thinking and Action

This section concerns the third research question: how does scaffolding relate to students' musical creativity? The correlation between MDTA and MPIoC in each lesson was non-significant, r = .151, p = .379. The correlation between the MDTA and MNoMST in each lesson was non-significant, r = .075, p = .659. As both are non-significant this suggests that there is no link between the divergent thinking aspect of musical creativity and the contingency of scaffolding.

Convergent Thinking and Action

The correlation between MCTA and MPIoC in each lesson was non-significant (at an alpha of 0.05), r = .325, p = .053. The correlation between MCTA and MNoMST in each lesson was also non-significant, r = .214, p = .203. However, since the p-value of the correlation between MCTA and the MPIoC is less than 0.1, it suggests a trend towards a relationship between the convergent thinking aspect of musical creativity and the contingency of scaffolding.

Discussion

Group of Teachers

Contingency

For the first research question, the results somewhat support the hypothesis that after the intervention, teachers' support became more contingent as the teachers' contingency during the intervention and the teachers' contingency post-intervention were significantly different. This is in line with the results Van de Pol et al. (2014) found in their research into an intervention about the MCT. However, the differences pre- and post-intervention were non-significant, only indicating that there is a possible trend towards a significant difference.

This non-significant increase from pre-intervention to post-intervention is interesting. This may have occurred because teachers are trying to learn something new. When looking at the development of the MPIoC of the group, there is a trend of relatively high MPIoC pre-

intervention, which decreases at the beginning of the intervention, and increases during intervention, reaching its highest point post-intervention.

First, this decrease at the beginning of the intervention could be due to the teachers learning several new teaching skills and trying to apply them. The learning curve theory suggests that learning is slow at the beginning but that with more learning or use, the time needed decreases (Bills, 1934). This means that slower learning speed during intervention will increase post-intervention. Supporting this idea, the strategy of encouragement is only used after the intervention starts, suggesting that the teachers were learning about it during the intervention. However, this oversimplifies learning and learning trajectories could be examined instead. Learning trajectories refer to the process over time of how a student learns, such as the strategies they employ and how they interact with others. Teachers can estimate what they think students' trajectories will look like (hypothetical learning trajectory) but can only be certain of the trajectory once it has been completed (actual learning trajectory) (Battista, 2011). In this case, the teachers themselves are students as they are learning to develop their scaffolding skills. It is possible that the teachers learn about scaffolding slowly at the beginning of their trajectory.

Second, it is possible that teachers were exploring the use of new intervention strategies and applying them non-contingently. Each intervention strategy has an associated level of autonomy support. If an intervention strategy is used that has an autonomy support level that is too high or too low for the student understanding/performance, it will result in a non-contingent three-turn sequence. For example, the strategies of encouragement and questioning offer higher autonomy support and, for the use of these strategies to be contingent, they should be applied when students demonstrate a good understanding/performance. If these strategies were used when student

understanding/performance was poor, the sequence would have been coded as non-contingent, leading to a lower MPIoC.

Third, during the intervention phase, the teachers have a certain degree of freedom in choosing when to learn different skills, including when to focus on scaffolding. Some teachers may start from lesson 3 while others may only start in lesson 5 or 6. This could explain some of the fluctuation in the development of contingency and MCT.

Model of Contingent Teaching

The results of this study indicate a trend towards a possible difference between the MNoMST pre- and post-intervention. The Model of Contingent Teaching describes a method of teaching whereby the teachers can teach 'contingently'. It focuses on the contingency aspect of scaffolding. In other words, this method describes how a teacher can provide support that is contingent on a student's level of understanding. Therefore, the more steps a teacher completes, the more they are following a contingent way of teaching. The group development of MNoMST and IoMST suggest that there is a trend towards a significant difference in MNoMST between pre- and post-intervention. This is not very strong evidence but does support the hypothesis that scaffolding becomes more contingent as it suggests a trend towards teachers completing more MCT steps post-intervention.

The means indicate that some of the teachers used all four steps during the intervention and more used all four steps post-intervention. It may be useful to replicate this with a larger sample size, for example, examining the development of more teachers to determine whether there is a significant difference between MCT use during the intervention phases, which could indicate that the intervention provided teachers with a more structured knowledge of how to provide contingent support in terms of the MCT.

Intervention Strategies Implemented by Group

Overall, the incidence of most intervention strategies increased from pre-intervention to during intervention and, considering that during intervention there were four lessons and in

post-intervention there were two, the incidence remains the same or increases post-intervention. This study did not examine whether the use of scaffolding increases but rather whether the selected episodes of scaffolding were contingent. Interestingly, the use of encouragement only begins during the intervention and increases post-intervention, which suggests that encouragement was a strategy developed by teachers during the coaching intervention.

Individual Teachers

Development of the Two Teachers

Teacher 2, who had greater TMPIoC and SIoC, had a more stable development of contingency than teacher 3. Teacher 2 also had a steadier increase when examining NMoMST than teacher 3. This suggests that teacher 2 developed scaffolding skills faster and more steadily. However, when looking at the intervention strategies, teacher 2 did not try many intervention strategies and stuck to the same three, while teacher 3 tried almost all the intervention strategies, including encouragement, which only started post-intervention. This suggests that teacher 3 could possibly have been trying out and practising more strategies than teacher 2, which could result in a slower and more fluctuating development but with teacher 3 having a more diverse knowledge of scaffolding.

Observations of the Examples of Scaffolding

For these examples, the intervention strategies and why each sequence was contingent or non-contingent according to the coding scheme were described. The most common strategy was questioning in these selected examples. Interestingly, there was no example of increased autonomy support resulting in a non-contingent sequence in the development of teacher 2 or teacher 3. This does not mean there is no example from one of the other teachers does suggest that these two teachers were less likely to increase their level of autonomy support non-contingently. Perhaps these two teachers realised that when students have poor or partial student understanding/performance, they should not use an intervention strategy that provides

an increased level of autonomy support. There were examples of the two teachers maintaining a high level of autonomy support despite poor student understanding/performance but no examples of where they increased autonomy support after poor student understanding/performance.

Scaffolding and Musical Creativity

The results of this study do appear to indicate that there is a trend towards a relationship between the contingency of scaffolding and musical creativity. There was no significant correlation between MPIoC and MDTA, as well as no significant correlation between MNoMST and MDTA, or the MNoMST and MCTA. However, there was a trend towards a significant correlation for MPIoC and MCTA. This suggests that there is a possible relationship between scaffolding and the convergent thinking and action aspect of musical creativity. In other words, it is possible that scaffolding can in some way boost students' musical creativity when the students are aiming for one answer for a task in a music lesson. However, there is also the possibility that there is no relationship or another relationship between another facet of scaffolding, such as fading and transfer of responsibility. Although these results are exploratory and no conclusions can be drawn, these results do indicate that further research on convergent thinking and action and scaffolding in music teaching may be useful to determine whether there is some form of relationship.

Strengths and Limitations

The study has several strengths: the Coding Book, the operationalisation of scaffolding and the mixed-methods approach. First, the Coding Book (Hendriks & Kok, 2022) for this study is extensive. It was adapted from another coding scheme that has already been applied in scaffolding research. Van de Pol et al. (2019) developed and applied their coding scheme to examine the contingency of teachers' scaffolding and student learning. As the Van de Pol et al. (2019) coding scheme has been applied to examine contingency before, it is a reliable coding scheme to adapt. The inter-rater reliability was also examined to check

whether the Coding Book was written and explained well. This inter-rater reliability indicated that the Coding Book was explained well as the raters had good or excellent degrees of agreement.

Second, two different variables were used to operationalise scaffolding: contingency and the Model of Contingent Teaching, providing two different views of the contingency aspect of scaffolding. This means that not only is the contingency of each three-turn sequence examined, but MNoMST for each scaffolding episode was also found. Van de Pol et al. (2012) developed the MCT based on an examination of how teachers apply scaffolding, and it was found that after using the MCT as an intervention that teachers' scaffolding became more contingent, Van de Pol et al. (2014). This suggests that teachers who follow the MCT steps provide more contingent support. Therefore, examining both three-turn sequence contingency as well as the overall MCT provides a more overall view of the teachers' contingency.

Third, this study uses a mixed-methods approach, combining strengths from both quantitative and qualitative research. This is a wider research approach that does not limit the use of techniques. Typically, quantitative research focuses on testing hypotheses and on confirmation while qualitative research focuses on exploring and theorising (Johnson & Onwuegbuzie, 2004). In this study, quantitative analysis was used to examine whether scaffolding became more contingent after the intervention (first research question) and whether there appears to be a relationship between musical creativity and scaffolding (third research question), while qualitative analysis was used to examine the development of scaffolding for two teachers (second research question). This enabled expansion, which means using different methods for different research questions to widen the research scope (Johnson & Onwuegbuzie, 2004).

There are several limitations to this study: the small sample size, the focus on contingency, and the use of MDTA and MCTA over entire lessons to operationalise musical

creativity. First, the sample size is small with six teachers, and the control group and six other teachers were not included in this study. It is possible that, had the six other teachers and the control group been included, the results may have indicated that the intervention was more or less effective in developing scaffolding skills in teachers than demonstrated by the results of this study. This means that the evidence relating to the efficacy of this intervention with regard to scaffolding is not strong. Another study should be conducted to include these other teachers and a control group to determine whether the intervention was useful to teachers in developing their scaffolding skills.

Second, the focus in this study is only on contingency when there are three aspects of scaffolding. These three are responsibility transfer, contingency and fading (Van de Pol et al., 2010). These two other aspects are not explicitly examined in this study, and these could influence the development of scaffolding or demonstrate a different development of scaffolding. Fading is implicit when the last three-turn sequence of a scaffolding episode is coded as contingent, but this is not specifically examined. Further exploration should take place on whether responsibility transfer and fading can be incorporated with contingency in a coding scheme.

Finally, regarding the third question on musical creativity, the MCTA and MDTA used in this study were the mean CTA and DTA for an entire lesson. The values for contingency and MCT were only coded in scaffolding episodes that appeared in the lesson and not for the whole lesson. The MPIoC and MNoMST are based on the values coded during the scaffolding episode(s) within the lesson but not the entire lesson. It is possible that the MCTA and MDTA would be different if only the mean CTA and DTA from the scaffolding episodes was used.

Future Research

Further research could be conducted on scaffolding using data from the research project to examine the other aspects of scaffolding: fading and transfer of responsibility. In

this study, the focus was on contingency. These other aspects of scaffolding should also be included to produce a more overall view of whether the intervention was effective in aiding the teachers' development of scaffolding.

Future research could focus on how the MCT could be applied in different areas of education. For music teaching, the description of some of these steps was altered to accommodate the performance aspect. When a student is performing, the teacher could be observing as a diagnostic strategy or as a check of student learning. This is different to how the MCT is currently described. It should be explored whether an adapted version of the MCT is an accurate model of contingent teaching in music teaching. This could also be further explored in other areas of education, such as art or physical education, where the MCT may need to be adapted.

This study also indicated that there are differences in the individual learning trajectories of the two selected teachers. This is exploratory and is also a much too small sample from which to draw a conclusion. However, it may be useful to explore whether there are differences in teacher learning trajectories and how these arise. For example, are learning trajectories more stable if the focus is on practising a few intervention strategies and do they fluctuate more if the focus is on exploring different intervention strategies? As demonstrated by Steenbeek & van Geert (2013), learning trajectories can be used to produce dynamic simulation models of learning and could also contribute to research into learning and interventions. This could be applied practically to tailor interventions to learning trajectories.

As stated in the Results section, there is a trend towards a potential relationship between convergent thinking and action in musical creativity and the contingency of scaffolding. It may be useful to determine whether there is a relationship between convergent thinking and action in musical creativity and the contingency of scaffolding through further research. Other aspects of scaffolding could also be explored in relation to musical creativity.

Conclusion

For the first research question, there is some evidence that supports the hypothesis that teachers' use of scaffolding became more contingent after the intervention. For the second research question, the general trend of the selected teachers was that their contingency and MCT use increased, with one appearing to have a faster and steadier development and the other a slower and more fluctuating development. For the third research question, it appears that there is a trend indicating a potential relationship between convergent musical creativity (thinking and action) and scaffolding. Although both the second and third research questions are exploratory and no conclusions can be drawn, the study results for these questions indicate valuable areas for future research.

In conclusion, it is important that teachers are supported in developing their scaffolding skills, not only for teachers, but also for students, and this study indicates that the research project intervention may have helped towards this aim. However, further research should be conducted on the data from the research project to determine the efficacy of the intervention, such as studying the other six teachers and comparing these to the control group as well as investigating the other aspects of scaffolding: fading and responsibility transfer. In addition, teachers develop differently, and research could be conducted to examine teacher learning trajectories during an intervention as this may be useful for tailoring future interventions for teachers.

References

Battista, M. T. (2011). Conceptualizations and issues related to learning progressions, learning trajectories, and levels of sophistication. *The Mathematics Enthusiast*, *8*(3), 507–570. https://doi.org/10.54870/1551-3440.1228

Bills, A. G. (1934). General experimental psychology ([1st ed.], Ser. Longmans' psychology series). Longmans, Green. Retrieved October 12, 2022, from https://archive.org/details/generalexperimen00bill/page/192/mode/2up

Bos, J., & Steenbeek, H. (2009). Mediacoder: software voor het coderen van video- en audio-materialen. Groningen: Internal publication, IDP Department, University of Groningen.

Bremmer, M., & Nijs, L. (2020). The role of the body in instrumental and vocal music pedagogy: A dynamical systems theory perspective on the music teacher's bodily engagement in teaching and learning. *Frontiers in Education*, *5*. https://doi.org/10.3389/feduc.2020.00079

Heijkant, C. van den, Quak, G., Swet, J. van, Vloet, K., Vos, M. de, & Wegen, R. van (2000). *De klas in beeld: Video interactie begeleiding in school.* Heeswijk-Dinther: Esstede

Hendriks, L. (2018). *Creating music and creative behaviour in the classroom: The influence of coaching primary school teachers in following a Curious Minds approach.* [Unpublished manuscript].

Hendriks, L., & Kok, E. (2022). *Coding Book: Scaffolding.* [Unpublished manuscript].

Hood, G (n.d.). PopTools. Retrieved August 8, 2022, from https://bioquest.org/esteem/esteem_details.php?product_id=248

Jellison, J. A., & Draper, E. A. (2015). Music research in inclusive school settings: 1975 to 2013. *Journal of Research in Music Education*, *62*(4), 325–331. https://doi-org.proxy-ub.rug.nl/10.1177/0022429414554808

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189x033007014

Karp, A. (2010). Analyzing and attempting to overcome prospective teachers' difficulties during problem-solving instruction. *Journal of Mathematics Teacher Education*, *13*(2), 121–139. https://doi.org/10.1007/s10857-009-9127-y

Kupers, E., van Dijk, M., & van Geert, P. (2016). Changing Patterns of Scaffolding and Autonomy During Individual Music Lessons: A Mixed Methods Approach. *Journal of the Learning Sciences*, *26*(1), 131–166. https://doi.org/10.1080/10508406.2016.1259624

Malinin, L. H. (2019). How radical is embodied creativity? implications of 4E approaches for Creativity Research and Teaching. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.02372

North, B. V., Curtis, D., & Sham, P. C. (2002). A note on the calculation of empirical P values from Monte Carlo procedures. *American Journal of Human Genetics*, *71*(2), 439–441. https://doi.org/10.1086/341527

Payne, E. (2016). Creativity beyond innovation: Musical performance and craft. *Musicae Scientiae*, *20*(3), 325–344. https://doi.org/10.1177/1029864916631034

Rusyani, E., Hernawati, T., & Akhlan, R. (2021). Coaching of individual learning model for primary school teachers providing inclusive education. In A. G. Abdullah, V. Adriany, & C. U. Abdullah (Eds.), *Borderless education as a challenge in the 5.0 society: Proceedings of the 3rd International Conference on Educational Sciences (ICES 2019), 7 November 2019, Bandung, Indonesia.* (pp. 263–265). CRC Press/Routledge/Taylor & Francis Group. https://doi-org.proxy-ub.rug.nl/10.1201/9781003107279-50

Steenbeek, H., & van Geert, P. (2013). The emergence of learning-teaching trajectories in education: A complex dynamic systems approach. *Nonlinear Dynamics, Psychology, and Life Sciences, 17*(2), 233–267

Todman, J. B., & Dugard, P. (2001). *Single--case and small--n experimental designs: a practical guide to randomization tests*. Mahwah (NJ): Erlbaum.

UNESCO & Right to Education Initiative. (2019). *Right to education handbook*. UNESCO. https://www.right-to-education.org/resource/right-education-handbook

van Geert, P., & Steenbeek, H. (2005). The dynamics of scaffolding. *New Ideas in Psychology, 23*(3), 115–128. .

van de Pol, J., Mercer, N., & Volman, M. (2019). Scaffolding Student Understanding in Small-Group Work: Students' Uptake of Teacher Support in Subsequent Small-Group Interaction, *Journal of the Learning Sciences, 28*(2), 206-239, DOI: 10.1080/10508406.2018.1522258

van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in Teacher–Student Interaction: A Decade of Research. *Educational Psychology Review, 22*(3), 271–296. https://doi.org/10.1007/s10648-010-9127-6

van de Pol, J., Volman, M., & Beishuizen, J. (2012). Promoting teacher scaffolding in small-group work: A contingency perspective. *Teaching and Teacher Education, 28*(2), 193–205. https://doi.org/10.1016/j.tate.2011.09.009

van de Pol, J., Volman, M., Oort, F., & Beishuizen, J. (2014). Teacher Scaffolding in Small-Group Work: An Intervention Study, *Journal of the Learning Sciences, 23*:4, 600-650, DOI: 10.1080/10508406.2013.805300

Vantieghem, W., Roose, I., Gheyssens, E., Griful-Freixenet, J., Keppens, K., Vanderlinde, R., Struyven, K., & Van Avermaet, P. (2020). Professional vision of inclusive classrooms:

A validation of teachers' reasoning on differentiated instruction and teacher-student interactions. *Studies in Educational Evaluation, 67*(August 2019), 100912. https://doi.org/10.1016/j.stueduc.2020.100912

Verenikina, I. (2004). From theory to practice: What does the metaphor of scaffolding mean to educators today? *Outlines. Critical Practice Studies*, *6*(2), 5–16. https://doi.org/10.7146/ocps.v6i2.2140

Webster, P.R. (2002). Creative Thinking in Music: Advancing a Model, *Creative in Music Education in a series: Research to Practice: CMWA Biennial Series*.

Wood, D., & Wood, H. (1996). Vygotsky, tutoring and learning. *Oxford Review of Education, 22*(1), 5–16. https://doi.org/10.1080/0305498960220101

Wiggins, J. (2011). When the music is theirs: Scaffolding young songwriters. In M. Barrett (Ed.), *A cultural psychology for music education* (pp. 83–113). Oxford, UK: Oxford University Press.

Appendix: Coding Book

1. Procedure

1. Watch the scaffolding fragment without taking notes and see *whether there is scaffolding present*. Is there a moment where (a) student(s) needs help or is there a problem? For example, the teacher perceives a problem (teacher-perceived problem), a student asks a question, or does not know how to take part (student-perceived problem). The episode should start with a teacher utterance so for a teacher-perceived problem the episode should start with the teacher explaining a task or asking a question related which reveals the problem and for a student-perceived problem the episode should start with the teacher utterance before the student indicated a problem, which can be completely unrelated to the problem. If the problem occurred slightly before the beginning of the fragment, then the episode should start exactly at the beginning of the fragment when the teacher is speaking. Note that an utterance starts at the beginning even if the beginning starts with "uh," or "listen up." When you have determined the beginning of the episode, code this time as the beginning with an 'S' in Mediacoder. The scaffolding episode should end with a teacher utterance. The end of the scaffolding episode occurs when the students have good understanding, and the teacher has faded support or if the teacher walks away or moves onto a different topic despite the students demonstrating poor understanding. For example, if a teacher introduces a new sub-task after good student understanding, the class is ending, during a group improvisation three students have good understanding after a problem occurred, a teacher walks away before a problem is solved (poor student understanding), or the teacher moves onto a new subtask before a problem is solved (poor student understanding). When you have determined the end of the episode, this time should be coded as an 'E'. It can be useful to watch a minute or so before the start of the scaffolding fragment when a teacher perceived problem occurs towards the

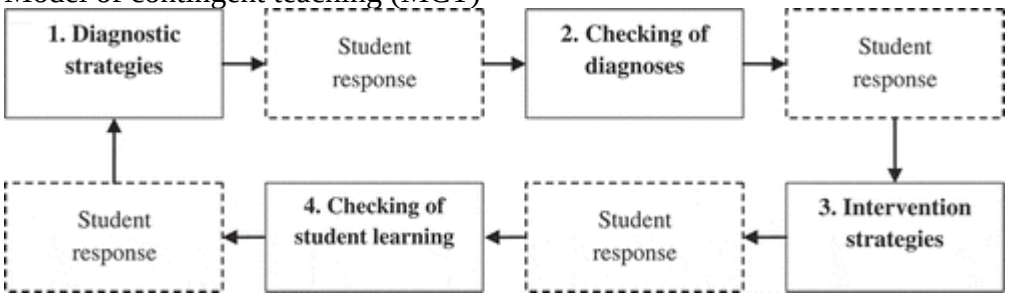
start of the scaffolding fragment, but you have not seen the problem that the teacher has perceived. Read the comments (comment clouds) about the task in Mediacoder if there are any.

2. Watch the fragment to decide *which of the steps of the MCT model* are followed and attribute an ordinal code in mediacoder at the beginning of the episode, according to coding scheme A. The unit of analysis for this variable is the entire episode. Note qualitatively in a comment on mediacoder which steps are present or not present for each scaffolding episode.
3. Watch the scaffolding fragment while taking notes to decide *which kind of scaffolding intervention strategies* are present in the fragment. Attribute the code(s) for scaffolding intervention strategies nominally at the beginning of the episode in mediacoder according to coding scheme B. The unit of analysis for this variable is step 3 of the MCT. The intervention strategies can also be considered somewhat ordinal in that they are ordered from forms of intervention strategy that provide low autonomy support to high autonomy support.
4. In this step the level of analysis will be the *student utterance* from the class, no matter which student (either verbal or musical). First, mark all the student utterances as student turns with a 'T' at the exact beginning second of the utterance. Second, look at the student response after teacher scaffolding utterances and decide on the level of *student understanding/performance*. Attribute an ordinal code in mediacoder at the exact beginning of the student utterance (the previously coded student turns: T), according to coding scheme C. Continue doing this until the end of the scaffolding episode.
5. Look at how the teacher continues scaffolding after the student response using the available autonomy support codes for each *teacher utterance* in mediacoder to decide

on whether *contingency* is present (1) or not (0). First, every teacher utterance should be coded with a 'T' at the exact beginning second of the utterance. The unit of analysis is the 3-turn sequences made up of a teacher turn, student turn, and a second teacher turn (i.e., T2) which is what is coded as contingent or non-contingent. By looking at the level of autonomy demonstrated in T1 and T2 for each sequence and the student understanding in the student turn, the sequence can be determined to be contingent or non-contingent. See explanation in coding scheme D.

2. Coding

Model of contingent teaching (MCT)



Step 1

Determining the student understanding level is an intrinsic part of scaffolding. In the model of contingent teaching this is the first step, called diagnosing strategies. For a teacher to be able to give support contingent to student understanding, the understanding has to be investigated and determined. For example, the teacher can ask questions. These kinds of diagnostic questions are usually open questions that do not lead a student to think in a certain direction or provide a student with hints (Van de Pol et al., 2014).

Step 2

Creating shared understanding between a student and a teacher is an important step before providing support. This step in the MCT aids the communication between a student and teacher and minimises the chance of a teacher having misconceptions of a student's current understanding. During this step, a teacher checks whether their perception of student

understanding is accurate, i.e. to check that the teacher has understood the student understanding level (Van de Pol et al., 2014).

Step 3

A teacher can provide support that is contingent to the student when the teacher has an accurate perception of student understanding. Contingent support is support adapted to what a student understands and then needs. In step 3, this contingent support is applied via different intervention strategies (van de Pol et al., 2014). See coding scheme B for the intervention strategies.

Step 4

After providing contingent support in step 3, a teacher should move on to the final step: step 4. During step 4, the teacher should check the new student understanding. This is similar to step 1, however, it comes after the intervention strategies to determine what the student now understands after being provided support. Has their understanding improved? Then the teacher can move on. Has the understanding not improved or not improved enough? Then the teacher can start the MCT again to determine if their understanding of the student was accurate and if a different strategy is necessary (van de Pol et al., 2014). For example, in music teaching this can be seen when a teacher asks or cues a student to perform.

By a teacher perceived problem:

Step 1 can be, for example, when a teacher listens to student performances. Step 2 is for creating shared understanding: for example, questions from the teacher that lead students to also perceive the problem, and thus create shared understanding. Step 4 can be seen, for example, when a teacher asks students to perform.

By a student perceived problem:

Step 1 can be, for example, questions by the teacher after being informed by students that they do not understand (parts of) the task, or that they have difficulties creating their

piece. Teacher questions may vary from asking the students to play what they have created so far, to questions aimed at verbal interaction (What part do not you understand? What have you done so far? Do you remember what was the first step?).

A. Coding for model of contingent teaching (MCT)

Description	Code
None of the model steps	0
One of the model steps	1
2 of the model steps	2
3 of the model steps	3
All 4 model steps	4

Code 0 is given when none of the model steps are found. For example, if the teacher does nothing when a problem appears, or a question is asked by a student. If it is code 0 then there is no need to continue with all the coding steps, only student understanding (coding scheme C) and contingency (coding scheme D). The student understanding will be poor, and the 3-turn sequence will be not contingent.

B. Intervention strategies

1. Modeling 2. Instructing 3. Explaining 4. Feeding back 5. Hinting 6. Questioning (Van de Pol et al., 2010) 7. Encouragement

There are different kinds of intervention strategies that can be applied as scaffolding. Van de Pol et al. (2010) suggested six scaffolding means: modeling, instructing, explaining, feeding back, hinting and questioning. Modeling (1) occurs when the teacher demonstrates a desired behaviour or skill so that the students can imitate the teacher. Instructing (2) refers to the teacher directing the students so that the students do what the teachers says to do. Explaining (3) involves the teacher providing more detailed information to the students, for example, a full explanation of why something needs to be done or clarifying a student question with an explanation. Feeding back (4) involves the providing the student with information (feedback) about their performance to the student. Hinting (5) refers to the teacher giving the student clues or suggestions to help the student improve without giving a

full explanation or instructions. Questioning (6) refers to the strategy whereby a teacher asks students questions that lead students to try and figure the answer out themselves (Van de Pol et al., 2010). Finally, encouragement (7) refers to when a teacher makes supportive comments to reassure and inspire the student. It sometimes happens that teachers do not give a solution themselves, but just give a stimulating/encouraging look and/or say "go on" and/or make a stimulating gesture. It usually happens when students are hesitating/pausing during play and look up to the teacher with a question mark in their eyes. This way the teacher stimulates further exploration, trying a new way, risk taking. For example, when a student is nervous to perform and a teacher says, "You can do it!"

Feedback vs Explaining

After a student performance, the teacher may ask the class to say something about it. She usually gives feedback, repeating a student's answer and adding something to it. This should be coded as feedback. Explaining is coded if the student does not understand it and/or something is not going well with a student performance and if the student then receives new information to perform the task properly.

Instructing vs Explaining

Instructing and explaining can appear quite similar but instructing is more commanding or ordering students to do things. For example, "Go over there and choose an instrument" or "Everybody sing along to this tune." Instructing can also happen during help with short interventions ("hit the drum" "no, not sideways, hit it on top", "listen well… now you!"). Explaining is where the teacher can still be telling students to do things, but the teacher is not commanding but telling them how and why. Explaining during the help phase in scaffolding is, for example, when a teacher takes the time to explain how a task can be carried out. It can be a repetition of what was already explained to the whole group before.

C. Coding of student understanding

Level of student understanding or student performance	Description	Coding
Other	When the student is unclear as their response could indicate good, partial or poor understanding. For example, when the teacher asks a closed check question, such as “do you remember this activity from last week?” and the students answer “yes”.	9
Poor	A student’s understanding should be coded as poor understanding (0) when the student utterance suggests that the student has no or very little understanding of the current activity or has a poor musical performance during the activity. For example, the student does not answer the teacher’s questions, the teacher indicates that the student’s answer is incorrect, or the student asks the teacher for explanation (Adapted from van de Pol et al., 2019).	0
Partial	A student’s understanding should be coded as partial understanding (1) when the student utterance suggests that the students has somewhat understood or performs somewhat following the instructions for the activity. For example, when a student starts to provide an answer to the question but does not do so completely, or when the teacher indicates that the student has left out part of the correct answer (Adapted from van de Pol et al., 2019).	1
Good	A student’s understanding should be coded as good understanding (2) when the student utterance indicates that the student has understood and performs well. For example, a student answers the question completely as indicated by the teacher’s approval (Adapted from van de Pol et al., 2019).	2

Other

An example of Other is that a student says he has understood, agrees with the teacher, or says he is ready with or knows how to perform the task without demonstrating good performance. Example:

Teacher explains how a task can be carried out. Student says: Ok.

Teacher gives an answer and asks if student understands. Student confirms.

Contingency

Contingency is determined by comparing the level of teacher control to the student understanding level. This contingency is necessary for scaffolding to take place (Van de Pol, 2019). In this study, teacher control will be examined using the variable autonomy support. The more autonomy support, the less teacher control and vice versa.

Three-turn sequences (i.e., a teacher turn, a student turn, and a second teacher turn) can be used to examine contingency (Van de Pol, 2019). T2 will be coded as contingent or not contingent, not T1. This means that the very first teacher turn (first T1) in a scaffolding episode is not coded.

When student understanding is good then a teacher can go forward with a new subtask. The introduction of a new subtask may require a different level of autonomy support. Such a three-turn sequence should still be considered contingent as support has been faded out by the teacher starting a new subtask after check of learning and good student performance.

If there is doubt about whether a 3-turn sequence is contingent or not, then the sequence should be watched one or two more times and judged by intuition on whether it is contingent or not. If this intuition then matches the outcome based on the rules under D in the codebook, then it should be scored according to the coding scheme D. If it still does not match, then it should be coded as not contingent.

D. Coding of teacher contingency

Category of contingency	Description	Coding
Other	Contingency should be coded as other when the teacher utterance unrelated to the intervention strategies. For example, when a teacher gives instructions or asks check questions unrelated to the problem: “Sit up properly,” or “	9
Not contingent	When the conditions for contingent support are not met. Including when 0 steps of MCT are followed.	0
Contingent	Support is contingent when (a) a teacher decreases autonomy support upon poor student understanding, (b) increases autonomy support upon good student understanding, (c) decreases autonomy support upon partial student understanding, (d) keeps autonomy support	1

	constant upon partial student understanding*, or (e) keeps low level of autonomy support upon poor understanding or keeps high level of autonomy support upon good understanding**. (Adapted from van de Pol et al., 2019). Condition (f) is when the teacher starts a new subtask after the students have reached good understanding. The introduction of the new subtask may offer low autonomy support, but it is contingent as the good student understanding is associated with the previous subtask. The support for the previous subtask has been faded out after good student understanding, indicating contingent support. Similarly, after a student has provided a correct answer, indicating good understanding, the teacher can ask the same question to a new student. The level of autonomy support remains the same instead of increasing the level of autonomy support since the teacher has faded out support to the initial student and is now starting with a new student. For example, if the class is improvising with sounds in a circle, the teacher may ask several students, "how does your animal sound?"	

Condition (d) + (e):

*(d) Contingent if autonomy support is constant. For partial understanding, autonomy support can be considered to have been kept constant if it stays within the categories medium or medium-high (levels 3-6). The level of autonomy support can change but it has to be within these categories to meet this condition.

**(e) Contingent if autonomy support is constant. For poor understanding, autonomy support can be considered to have been kept constant if it stays within the categories low or medium (levels 1-4). The level of autonomy support can change but it has to be within these categories to meet this condition. For good understanding, autonomy support can be considered to have been kept constant if it stays within the categories medium-high or high (levels 5-8). The level of autonomy support can change but it has to be within these categories to meet this condition.

Autonomy support

The below coding for autonomy support scheme is used only to decide contingency. The highest-level of autonomy support in a teacher turn should be used for contingency. This goes for verbal and non-verbal. For example, non-verbal autonomy support could be higher with a teacher observing and offering space with minimal intervention, but the verbal autonomy support could have been instruction about the task. If both these forms of autonomy support occur in one teacher turn, then the highest should be taken as the autonomy support for that turn in the contingency decision. So, in this example, the autonomy support would be considered high (level 7).

Coding scheme for teachers' creative autonomy support in music lessons

Creative verbal autonomy support (CASV)	**Level**	**Creative musical and non-verbal autonomy support (CASM)**
LOWER-LEVEL AUTONOMY SUPPORT		
	Low	
Stop *Stop please*	1	Stop sign *Raising hand*
Instruction *Repeat after me*	2	Modeling *Playing/singing/clapping etc. based on prescribed/teacher ideas*
	Medium	
Information *If you play the drum you need to hit it in the middle for a good sound*	3	Participative support *Playing/singing/clapping etc. along based on student ideas*
Teacher-centered question *Was this music fast or slow?*	4	Representational gesturing *Raising/lowering hand to indicate high or low tone during explanation*
HIGHER-LEVEL AUTONOMY SUPPORT		
	Medium-High	
General autonomy-supportive question/remark *Can you come choose an*	5	General autonomy-supportive movement or activity *Handing an instrument to a student*
Cognitive autonomy-supportive student-centered question *What do you think is the difference between a melody and a rhythm?*	6	Gesturing and turn-giving in order to elicit musical exploration *Indicating the beat, gesturing to indicate a student can join in*
	High	

Creative autonomy-supportive student-centered question *How does a ray of sun sound? Could you let us hear?*	7	Observing & offering space with minimal intervention *Closely listening to students' musical play and nodding to the beat*
Encouragement *Please continue, You can do it! Could you try it again? How could you do it differently?*	8	Encouragement *Highly stimulating support in gesture and/or movement and/or facial expression to stimulate exploration and*
Other	O	Other

3. Additional rules contingent teaching during scaffolding

When a child after poor performance indicates he/she does know the answer and wants to say something else (e.g. by raising his hand) and the teacher gives a turn, this is considered contingent.

Affirmative feedback (medium AS) after good performance observed by teacher is considered contingent as the teacher has checked student performance, thereby fading support. If short check questions are included during feedback (maintaining medium AS) this is considered contingent. If additional information (novelty) is given after good performance, this is considered contingent too because this applies to the rule about moving forward after good performance.

Example:

Teacher/student utterance		Autonomy support	Student performance	Contingency
T_1	Could you let us hear what you created?	High		
S_1	[students play short piece]		Good	
T_2	Well done. [smiles] You played the cabasa in different ways, right? (New sub topic)	Medium		Contingent
S1	Yes		Other	
T2	Right, I noticed, beautiful!	Medium		Contingent

Examples of contingent high AS after poor or no performance

Encouraging a student once after poor or no performance is considered contingent.

When a student asks a question (poor), the teacher can ask this question to the class once ("What is a vowel?") to see if this problem is a general problem or just this students'

problem. This means that she is asking a diagnostic medium AS check question (see under **(e)) which is contingent. There is a difference in one-to-one scaffolding compared to whole-class scaffolding. For instance, repeating a high autonomy-supportive question to the whole class after poor understanding can be a contingent strategy in whole class scaffolding. In one-to-one scaffolding a teacher would rephrase the question keeping the same level of AS.

When a task is difficult, and the teacher repeatedly (to establish if this is the case, look back scaffolding episode/fragment or even before the fragment) had to intervene to help students (reduce AS to medium-high, medium or low), she can adapt the task a bit so that uptake is easier for the children. How is this contingent? This means that after repeated poor or partial student performance, she has to keep AS constant (see d and e) by giving new instructions or information on how to perform the adapted task or ask the same question in steps or in another way (perhaps simpler or with other terms).

When student understanding/performance has *increased* from poor to partial, a teacher can also contingently *increase* AS to see if this triggers the next step from partial to good performance. This is an exception or addition to the Van de Pol et al. (2019) scheme. Here we saw that sometimes it is not the last state, but the last change in state of student understanding and its direction, can be used to establish if the teacher response was contingent or not. Did the direction (increase/decrease) correspond with the change and direction in student performance?

When the teacher walks away without the problem being solved this is coded not contingent. This is considered absence of autonomy support when a problem still exists.

Student performance

If in improvisation in a circle the level of performance is continuously good, no new student turns have to be scored until a partial or poor performance occurs.

4. Additional examples

Coded example of a contingent 3-turn sequence with decreasing autonomy support

Teacher/student utterance		Autonomy support	Student performance	Contingency
	Student-perceived problem: Earlier, a student asked what a vowel is. The teacher returns the (check) question to the class. Some students name the vowel A, showing some understanding.			
T_1	What is a vowel? (to class)	Medium		
S_1	Aaa…		Partial	
T_2	A, E, I, O.. (models while students join in)	Low		Contingent

5. Saving and naming json-files

Files should be saved under a name which reflects school, teacher and lesson, following the same structure:
School_Teacher_Lesson number_SCAF (Initials coder DEF date).
Files not yet coded: School_Teacher_Lesson number_SCAF (Initials coder FRG date). FRG means that the fragments are not coded yet.
Example file name: Sta_GRE_Les1_SCAF (EK DEF 040322).
Coded files can be stored in the appropriate folder for the coded files for the teacher concerned on uwp.rug.nl