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Examining the Effect of Aural Preparation on Second Grade Students'

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Abstract

Aural preparation is operationally defined as hearing, performing, decoding, and creating rhythms or pitches aurally prior to the introduction of music notation. The purpose of this study was to explore the effect of aural preparation on second grade students' music literacy rhythm skills (i.e. reading, performing, and dictation). The research questions that guided this study included: (1) What are the psychometric qualities (i.e., validity and reliability) of the three measures used in this study used to assess rhythmic potential and achievement? (2) How does aural preparation affect students' ability to read and perform rhythms? (3) How does aural preparation affect students' ability to decode and dictate rhythms? Six second grade elementary school classes (N = 125 students) participated in this study. Three classes (n = 64) received aural preparation interventions, and three classes (n = 61) received no aural preparation interventions. Each participant was administered a pretest and posttest that assessed rhythm dictation and rhythm performance skills. Results indicated a significant increase in performance skills but no significant increase in dictation skills when students received aural preparation interventions. Implications for use of aural preparation in the general music classroom as well as future research are discussed.

Introduction

Music literacy is defined as "the ability: (1) to see symbols and to think or reproduce the sound; and (2) to hear the sound and to think or write the symbol" (Campbell & Scott-Kassner, 1995, p. 96). Based upon this definition, a musically literate student should be able to (a) perform music notation without the aid of an instrument, (b) hear or think of a musical phrase and write out the musical notation for the phrase, and (c) be able to read, perform, decode, and compose

rhythms and pitches. As Choksy, Abramson, Gillespie, Woods and York (2001) noted, "musical literacy should not be the property of a chosen few, but a general knowledge of all" (p. 82).

Teaching students music literacy skills has long been a part of the North American music education curriculum (Mark, 2008). In early music education, Mason (1834) outlined an important note reading sequence that laid the foundation for many future music methodologies and curricula. This outline included: (a) singing by rote, (b) reading notation of previously learned melodies, (c) reading new melodies, and (d) part-singing. In particular, these four stages began with an aural (i.e., "sound") experience and followed with a visual (i.e., "sight") experience. The goal of this sequential cycle was to foster musical literacy via note-reading processes. Several methodologies used today implement Mason's sequence of "sound before sight," including Kodály (Kodály, Bónis, Halápy, and Macnicol, 1974) and Music Learning Theory (Gordon, 2013), for example. However, these methodologies differ in terms of the specific skills taught during the "sound" stage.

Music Literacy: Kodály and Gordon

The Kodály method is highly sequential, has a strong emphasis on music literacy, and is based on high quality literature (Kodály, et al., 1974). The Kodály methodology introduces new rhythms and pitches through three distinct phases: prepare, present, and practice. In particular, a new rhythm or pitch is prepared aurally, visually, and kinesthetically through imitation and performance. In the Kodály method, students are asked to imitate and perform rhythms before being introduced to traditional notation. However, they are not typically asked to decode or create rhythms aurally prior to reading musical notation (Szőnyi, 1973).

Based heavily on the research of Edwin Gordon, Music Learning Theory (MLT) focuses on audiation, a term used to indicate when music is heard and understood silently by the listener when the actual sounds are not present (Gordon, 2013). In MLT, skills are divided into two main categories: discrimination (i.e., rote learning) and inference (i.e., conceptual learning). During the discrimination phase students experience a specified learning sequence. First, students hear and echo sounds orally through nonsense syllables such as "bum" or "bah." Second, students make verbal associations with sounds by naming patterns with either solfège or rhythm syllables. Third, students experience partial syntheses where the teacher may sing or play a pattern and students recognize the pattern and name it. Fourth, students learn to associate the music symbols that represent the sounds they have already learned. Since audiation has ideally occurred in the first three steps, students do not "decode" patterns but rather "recognize" patterns (Gordon, 2007). Students are then encouraged to read and write known patterns as well as make inferences on their own. MLT engages students in decoding or recognizing known patterns and naming them prior to introducing music notation, but it does not engage students in creating new patterns. Inference learning does not occur until students have been taught how to discriminate various sounds and have made discriminations successfully.

Palmer (1976) compared a Gordon-based methodology, a Kodály-based methodology, and a control group to explore which had the greatest effect on 4th graders' rhythmic reading abilities. Using Gordon's (1965) *Musical Aptitude Profile* (MAP) to measure both written and performance achievement in rhythm reading, Palmer found that both the Gordon and Kodály groups had a larger increase in students' MAP scores than the control group, suggesting that both Gordon- and Kodály-based methodologies may have a positive effect on student's rhythmic performance and writing abilities.

Conversational Solfege and the Aural Experience

Influenced by both the Kodály and Gordon methodologies, C*onversational Solfege* (CS) is a music literacy curriculum where students are asked to hear, perform, decode, and create music in the aural experience stage of the music literacy sequence (Feierabend, 2001). CS is a curriculum and not a methodology; therefore, CS provides specific directions and exemplars of each stage of learning. During the CS curriculum, the learner echos patterns, decodes familiar and unfamiliar patterns, and creates original patterns aurally through reading notation and writing notation. A unique component of the CS curriculum is asking students to not only experience and perform rhythm patterns, but to also decode and create rhythm patterns before introducing the musical notation of those patterns (Feierabend, 2001).

CS is divided into 12 sequential steps that can be categorized into four broader categories: readiness, Conversational Solfege, reading, and writing. Each time a new rhythm or pitch set is introduced, the learner experiences all four categories and all twelve steps. *Readiness* is when rhythm or pitches are experienced through hearing and student performance, but not labeled with rhythmic syllables (ta, ti-di/du, du-de) or solfège (do, re mi, etc.). *Conversational Solfege* asks students to attach rhythm syllables, or solfège, to specific sounds without visual aid. In particular, games and activities are aurally based and facilitate ear training through hearing, echoing, decoding, and creating original patterns using the newly introduced rhythm or pitch through the use of rhythm syllables or solfège. Traditional notation is introduced during the *reading* section, where students echo, decode, and perform patterns from the pitch or rhythm set using flashcards. *Writing* occurs when students copy, decode, and create patterns by writing out the appropriate notation. The CS curriculum recommends experiencing rhythm and pitches through rote learning, performance, decoding, and creating aurally before music notation is

introduced. This is similar to Kodály and Gordon methodologies, however, the Kodály philosophy does not include decoding and creating in the aural stage and Gordon's philosophy does not include creating patterns in the aural stage.

Several studies have investigated the effect of having students echo, perform, decode, and create patterns aurally prior to reading music notation. Holmes (2009) compared how movable-do instruction and fixed-do instruction improved the pitch sight-reading skills of seven- and eight-year-olds. Holmes' moveable-do instruction was based on *CS* and fixed-do instruction was based on two Russian solfège textbooks: *Solfeggio Podgotovitelny Class* by Frolova (2006) and *Solfeggio dlya 1 classa detskoy muzykalnoy shkoly* by Metallidi & Pertcovskaya (2003). Holmes indicated that the pitch sight-reading scores of the movable-do group (based on CS) increased by 9.79 points, the fixed-do group increased by 8.48 points, and the control group increased by 1.53 points. Dictation skills were not tested in this study.

Several instructional techniques have been explored to help improve students' rhythm music literacy abilities, including beat awareness (Boyle, 1970), direct instruction (Lowe, 2012), rhythmic syllable systems (Bebeau, 1982; Colley, 1987; Cha, 2015), visual and aural stimuli (Shehan, 1987), beat subdivision (Gauthier & Dunn, 2004), color-coded notation (Rogers, 1991), shape notes (Kyme, 1960), learning modalities (Persellin, 1992) and specific literacy curriculums based on Kodály (Palmer, 1976; Hanson, 2003), Gordon (Palmer, 1976), Frolova, Metalidi and Petcovskaya (Holmes, 2009), and Feierabend (Holmes, 2009). These studies suggest specified teaching techniques as a method for improving students' ability to read notation; however, the effects of students hearing, performing, decoding, and creating patterns using specific rhythms prior to introducing notation has not been directly explored. The purpose of this study is to

explore the effects of aural preparation on rhythmic music literacy skills of second grade students. The research questions that guide this study include:

1. What are the psychometric qualities (i.e., validity and reliability) of the three measures used to measure rhythmic potential and rhythmic achievement?
2. How does the aural preparation affect students' ability to read and perform rhythms?
3. How does aural preparation affect students' ability to decode and dictate rhythms?

Method

Participants

Six second-grade classes (N = 125; male, n = 68; female, n = 57; M = 8 years) from an upper-middle class elementary school in the southeast United States participated in this study. Each of the six classes ranged in size from 21 to 25 students. The study was conducted as part of the students' normally scheduled general music classes. Informed consent was obtained from the participants and their parents/guardians. To maintain anonymity, student data were labeled through a randomized numerical coding system.

Research Design

This study used a matching-only pretest-posttest control group research design. The *Intermediate Measures of Music Audiation* (IMMA) (Gordon, 1986), performance task, and dictation task were administered to all participants prior to treatment. The rhythm portion of the IMMA was administered as a pretest only in order to match intact classes into balanced treatment and control groups based upon rhythmic music potential. The IMMA was chosen based on its convenience, ease of administration, and reputation for reliable and valid data. The mean IMMA raw scores of previously formed classes were used to create two similarly matched

groups across class assignment. The control group (n = 61) demonstrated an average measure of .99 logits (SD = .59 logits) (observed average = 28.30, SD = 4.28). The treatment group (n = 64) demonstrated an average measure of .98 logits (SD = .57 logits (observed average = 28.20, SD = 4.32). Detailed psychometric results of the IMMA administration is found in the results section.

Both treatment and control groups participated in eight rhythmic literacy teaching sessions lasting between 15 and 20 minutes. All sessions took place during regularly scheduled music lessons and were taught by the principal investigator. Lesson plans for both groups were reviewed by a CS certified trainer to ensure that they were aligned with the CS methodology. The specific amount of session time was chosen to imitate a typical school setting where instructional time is limited. Both groups used the same rhythmic patterns, activities, poems, and songs from Unit 2 of CS (see Appendix A). The unit was specifically selected because it focused on dotted quarter notes and three beamed eighth notes in 6/8 time. In particular, Unit 2 was selected because of the participants' lack of exposure to the 6/8 time signature.

Both groups followed the activities and guidelines prescribed in CS. They both used the rhythm syllable du for a dotted quarter note and du-da-di for three beamed eighth notes. Both groups used a kinesthetic motor as suggested in the CS curriculum. For 6/8 time, students tapped one elbow three times and then the other three times reinforcing both the micro and macro beat. The four sections of CS included: readiness, Conversational Solfege, reading, and writing. The non-aural preparation (i.e., control) group participated in eight lessons, including one lesson in readiness, zero lessons in Conversational Solfege, four lessons in reading, and three lessons in writing. The control group did not experience any lessons in the Conversational Solfege category because this is when students are expected to aurally decode and create patterns. The aural preparation (i.e., treatment) group participated eight lesson plans, including one lesson in

readiness, four lessons in Conversational Solfege, two lessons in reading, and one lesson in writing. Detailed lesson plans for each lesson are included in Appendix A.

Musical Tasks and Related Measurement Instruments

Two musical tasks (performance and dictation) were used to assess rhythmic skills. The performance and dictation tasks used for this study were based on Colley's (1987) performance test and dictation test. Colley's test was chosen because it was most relevant for the typical activities that take place in the music classes. All students were evaluated using the performance and dictation tasks as a pretest and a posttest in order to measure differences across group means across time.

The measurement instruments for each task were created/adapted by the principal investigator in order to specifically align to the performance and dictation tasks. The performance test (see Appendix B) assessed the students' ability to read and perform rhythms. Ten examples, two measures long in a 6/8 time signature consisting of dotted quarter notes and three beamed eighth notes were randomly selected from Unit 2, patterns set 2a and 2b from *Conversational Solfege* (Feierabend, 2001). Participants were tested and audio was recorded individually by the principal investigator using a Zoom H1n handy recorder. Five examples were performed using rhythm syllables and five examples were performed on a woodblock with a metronome set to a dotted quarter note equals sixty beats per minute. Recordings were labeled with student numbers and stored in an online file storage system (i.e., Dropbox).

A 5-point rating scale was used based on Bebeau's (1982) performance measurement scale (See Appendix B). The 5-point scale was used to assess three criteria: rhythmic accuracy,

steady tempo, and proportional rhythms. The highest possible raw score on the performance task was 50 points and the lowest possible raw score was ten points.

Due to the performance nature of the task, two content experts were solicited to act as raters. Both raters were certified music educators currently teaching kindergarten through fifth grade elementary general music. Raters were asked to participate based on their professional experience and convenience of participating. The principal investigator and two raters met, prior to the raters' evaluations, and discussed the performance assessment rubric. Practice exemplars were evaluated together to ensure the raters' understanding of and agreement upon the vocabulary included in the measurement instrument. Both raters separately evaluated all 125 audio recordings using the paper version of the form in Appendix B . Forms were returned to the principal investigator and data was recorded into an Excel spreadsheet.

The dictation task assessed the student's ability to aurally decode and write the notation of a given rhythm pattern. The dictation assessment included 10 examples (see Appendix C). Rhythm examples were played on a single note (F above middle C) on the piano at 60 beats per minute. The dictation tasks were recorded to ensure uniformity. The rhythmic patterns consisted of two measures of 6/8 time signature and only included dotted quarter notes and three beamed eighth notes. Patterns were randomly selected from Unit 2, patterns set 2a and 2b from *Conversational Solfege* (Feierabend, 2001). The participants were asked to write the notation that matched the pattern played in the recording. All rhythm patterns were played three times with a 5 second pause in between each repetition. Participants were allowed to write the rhythms throughout the recordings being played. Each beat was evaluated dichotomously (e.g., correct = 1, incorrect = 0). The highest possible raw score on the dictation task was 40 points and the lowest possible raw score was zero points.

Psychometric Considerations

In order to investigate the psychometric qualities (i.e., validity and reliability) of the IMMA, the performance measure, and the dictation measure, the Rasch measurement model (Rasch, 1960/1980) was used. In the behavioral, social, and health sciences, Rasch measurement theory is often a preferred method for determining the psychometric properties of a measure (Engelhard, 2013). Specifically, the Rasch model is underscored by five requirements of invariant measurement: (1) person-invariant calibration of test items: the calibration of the items must be independent of the particular persons used for calibration; (2) non-crossing item response functions: any person must have a better chance of success on an easy item than on a more difficult item; (3) item-invariant measurement of persons: the measurement of persons must be independent of the particular items that happen to be used for the measuring: item-invariant measurement of persons; (4) non-crossing person response functions: a more able person must always have a better chance of success on any item than a less able person; (5) unidimensionality: items must be measuring a single underlying latent variable (Engelhard and Perkins, 2011).

In the case that raters mediate the assessment process (as in the performance task described above), the five requirements of invariant measurement can be extended to the raters (Engelhard, 2013). Specifically, the five requirements for rater-mediated invariant measurement include: (a) rater invariant measurement of persons: the measurement of students must be independent of the particular raters that happen to be used for the measuring; (b) non-crossing person response functions: a higher achieving student must always have a better chance of obtaining higher ratings from raters than a lower achieving student; (c) person-invariant calibration of raters: the calibration of the raters must be independent of the particular students

used for calibration; (d) non-crossing rater response functions: any student must have a better chance of obtaining a higher rating from lenient raters than from more severe raters; and (e) unidimensionality: students and raters must be simultaneously located on a single underlying latent variable). When the data demonstrate adequate fit to the Rasch model, invariant measurement is achieved, allowing for confidence in the measurement instruments themselves (i.e., construct validity) as well as the inferences about the students made from the measurement instruments (i.e., predictive validity). Analysis of the data was conducted using the computer program FACETS (Linacre, 2014).

Results

Between the administration of the pretest and posttest, five students transferred schools and did not complete the treatment or posttest. Their data are not included in any results. Furthermore, six additional students' data were not included in this paper at the request of their parent/guardian.

Summary Statistics

In order to answer research question 1 (*What are the psychometric qualities of the three measures used in this study used to assess rhythmic potential and achievement?*), summary statistics and model-data fit for the calibrations of students, items, and raters for each measure were evaluated. Summary statistics for the IMMA, performance task, and dictation task are displayed in Table 1. The rhythm demonstrated overall significant differences for items (χ^2 (39) = 308, p = 0.00, *Rel* = 0.87) and students (χ^2 (113) = 259.9, p = 0.00, *Rel* = 0.57), indicating that the measure was able to significantly separate items based upon difficulty level and the measure was also able to separate students based upon overall achievement level. However, reliability of separation (interpreted similarly to Cronbach's Alpha) was considerably low for the IMMA

student measure. The performance task demonstrated overall significant differences for items (χ^2 (9) = 1081.9, p = 0.00, *Rel* = 0.99) and students (χ^2 (249) = 3526.6, p = 0.00, *Rel* = 0.94) with high reliability. The performance task was a performance assessment; therefore, the raters were included in the measurement model to investigate and control for their quality (i.e., severity) based upon overall interpretations of leniency/severity and fit to the model. The two performance task raters were not significantly different from one another in regard to overall severity (χ^2 (1) = 0.20, p = 0.68, *Rel* = 0.00), suggesting that the raters used the items and scored the students in a similar manner. The dictation measure demonstrated overall significant differences for items (χ^2 (9) = 272.2, p = 0.00, *Rel* = 0.97) and students (χ^2 (249) = 805.5, p = 0.00, *Rel* = 0.82) with moderate to strong reliability.

Fit statistics are empirical quality indicators for the response patterns based on expected predictability and invariant requirements of the Rasch measurement model. Fit values close to the expected value of 1.00 indicate good data fit to the model. The acceptable range for parameter-level fit statistics (e.g., overall students, overall items) is between 0.50 and 1.50 and the acceptable range for element-level fit statistics (e.g., each student, each item) in the context of a classroom setting is 0.40 and 1.60 (Wright & Linacre, 1994). Values above the recommended range indicate too much randomness in the response patterns for productive measurement. Values below the recommended range indicate not enough randomness in the response patterns for productive measurement. Infit MSE for IMMA items (*M* = 0.99, *SD* = 0.10) and IMMA students (*M* = 0.99, *SD* = 0.13) fell within parameter level fit statistics (0.50 – 1.50). Infit MSE for performance items (*M* = 0.98, *SD* = 0.15), performance students (*M* = 0.99, *SD* = 0.47) and performance raters (*M* = 0.98, *SD* = 0.15) also fell within parameter level fit statistics (0.50 – 1.50). Infit MSE for dictation items (*M* = 1.07, *SD* = 0.23) and dictation students (*M* =

1.04, *SD* = 0.53) fell within parameter level fit statistics (0.50 – 1.50) as well. Good construct validity is associated with the adequate item fit. This suggests strong construct validity of items and strong predictive validity of the students for the IMMA, performance task and dictation task. The descriptive statistics for the pretest and posttest performance task and the pretest and posttest dictation task can be found in Table 2.

Table 1
Summary Statistics IMMA, Performance Task, Dictation Task

	IMMA		**Performance Task**			**Dictation Task**	
	Items	**Students**	**Items**	**Students**	**Raters**	**Items**	**Students**
Measure (Logits)							
Mean	0.00	0.98	0.00	0.68	0.00	0.00	2.36
SD	0.65	0.58	0.60	1.27	0.01	0.57	1.48
N	40	125	10	250	2	10	250
Infit MSE							
Mean	0.99	0.99	0.98	0.99	0.98	1.07	1.04
SD	0.10	0.13	0.15	0.47	0.15	0.23	0.53
St. Infit MSE							
Mean	0.20	0.10	-0.30	-0.01	-0.70	0.40	0.10
SD	1.20	0.90	2.3	1.40	5.20	1.60	1.10
Outfit MSE							
Mean	0.97	0.97	1.01	1.01	1.01	0.96	0.96
SD	0.14	0.19	0.21	0.53	0.06	0.24	0.59
Std. Outfit MSE							
Mean	0.10	0.00	-0.10	-0.10	0.20	-0.10	0.00
SD	1.3	1.00	2.60	1.40	1.80	1.40	1.00
Separation Statistics							
Reliability of Separation	0.88	0.57	0.99	0.94	0.00	0.97	0.82
Chi-Square	308.0	259.0	1081.9	3526.6	0.20	272.7	805.5
Degrees of Freedom	39*	113*	9*	249*	1	9*	249*

* $p < .01$

Table 2
Descriptive Data for the Performance Task and Dictation Task

	Aural Preparation Treatment Group (N = 64)		**Non-aural Preparation Control Group (N = 61)**	
	Pretest *M* (*SD*)	**Posttest *M* (*SD*)**	**Pretest *M* (*SD*)**	**Posttest *M* (*SD*)**
Performance Task	-0.13 (0.98)	1.72 (0.99)	-0.04 (1.06)	1.19 (0.94)
Dictation Task	1.49 (1.00)	3.04 (1.39)	1.69 (1.39)	3.24 (1.23)

Item and Student Calibrations for the IMMA

The calibrations of the rhythm portion of the IMMA for items is provided in Appendix D. The calibrations of the rhythm portion of the IMMA for students is provided in Appendix E. IMMA item number 27 achieved the highest linear measure (1.32 logits) indicating it was the most difficult question and IMMA item number 3 achieved the lowest linear measure (-1.28 logits) indicating it was the least difficult question. All rhythm IMMA items fell within an acceptable range of model data fit (0.60 – 1.40). Student 79 achieved the highest linear measure (2.35 logits) indicating the highest rhythmic potential prior to treatment and student 116 achieved the lowest linear measure (-0.70) indicating the lowest rhythmic potential prior to treatment. All students fell within an acceptable range of model data fit (0.60 – 1.40).

Item and Student Calibrations for the Performance Task

The calibrations of the items on the performance task is provided in Appendix F. The calibrations of the students on the performance task is provided in Appendix G. The calibrations of the raters on the performance task is provided in Appendix H. Item 8 achieved the highest linear measure (1.15 logits) indicating that it was the most difficult item and item 10 achieved the lowest linear measure (-1.10 logits) indicating that was the least difficult item. All items fell

within an acceptable range of model data fit (0.60 – 1.40). The performance task posttest score for student 72 was the highest linear measure (4.44 logits) while the performance task pretest score for student 107 was the lowest linear measure (-2.78). The pretest scores for nine students were above the recommended fit statistics range (0.60 – 1.40), while the pretest scores for 23 students were below the recommended fit statistics range. The posttest scores for 11 students were above the recommended fit statistics range (0.60 – 1.40), while the posttest score scores for 27 students were below the recommended fit statistics range.

Item and Student Calibrations for the Dictation Task

The calibrations of the items on the dictation task is provided in Appendix I. The calibrations of the students on the dictation task is provided in Appendix J. Item 1 achieved the highest linear measure (0.92 logits) indicating that it was the most difficult item and item 4 achieved the lowest linear measure (-1.03 logits) indicating that it was the least difficult item. Item 4 (1.42 logits) was slightly over the acceptable range of model data fit (0.60 – 1.40). The pretest scores for 14 students and posttest scores for 69 students were the highest linear measures (4.19 logits) while the pretest score for student 78 was the lowest linear measure (-0.38). The pretest scores for students 25 were above the recommended fit statistics range (0.60 – 1.40) while the pretest scores for students 26 were below the recommended fit statistics range. The posttest scores for 12 students were above the recommended fit statistics range (0.60 – 1.40) while the posttest score for 15 students were below the recommended fit statistics range.

Examining Changes in Pretest and Posttest Scores across Measures

In order to answer research question number two (*How does the aural preparation affect students' ability to read and perform rhythms?),* a one-way ANCOVA was conducted to compare the differences in the treatment and control groups' achievement scores on the performance task after controlling for pretest scores. A statistically significant difference in overall means was found between the control and treatment groups (F (1,122) =11.04, $p < 0.01$). An examination of estimated marginal means demonstrated that the treatment group (M = 1.72 logits) performed significantly higher than the control group (M = 1.18 logits) on the performance task (See Table 3). Furthermore, the treatment group's mean logit score increased by 1.59 logits from pretest to posttest while the control group's mean logit score increased by 1.15 logits from pretest to posttest (See Table 2).

Table 3
Performance Assessment – Univariate Analysis of Covariance (ANCOVA)

Source	Sum of Squares	*df*	Mean Square	*F*	*p*	η^2	Noncent. Parameter	Observed Power[b]
Corrected Model	22.99[a]	2	11.50	13.92	0.00	0.19	27.85	0.10
Intercept	269.72	1	269.72	326.63	0.00	0.73	326.63	1.00
pretest	14.87	1	14.87	18.00	0.00	0.13	18.00	0.99
Treatment	9.12	1	9.12	11.04	0.01	0.08	11.04	0.91
Error	100.74	122	0.83					
Total	387.16	125						
Corrected Total	123.74	124						

a. R Squared = 0.19 (adjusted R Squared = 0.17)
b. Computed using alpha = 0.05

In order to answer research question number three (*How does aural preparation affect students' ability to decode and dictate rhythms?),* a one-way ANCOVA was conducted to compare the differences in the treatment and control groups' achievement scores on the dictation

task after controlling for pretest scores. Overall, there was not a significant difference in overall means between the treatment and control groups (F (1,122) = 0.61, p = 0.44) (See Table 4). The treatment and control groups mean logit score both increased by 1.55 logits from pretest to posttest showing no significant difference between groups (See Table 2).

Table 4
Dictation Assessment – Univariate Analysis of Covariance (ANCOVA)

Source	Sum of Squares	*df*	Mean Square	*F*	*p*	η^2	Noncent. Parameter	Observed Power[b]
Corrected Model	69.91[a]	2	34.95	29.57	0.00	0.33	59.14	1.00
Intercept	213.66	1	213.66	180.74	0.00	0.60	180.74	1.00
pretest	68.50	1	68.50	57.95	0.00	0.32	57.95	1.00
Treatment	0.72	1	0.72	0.61	0.44	0.01	0.61	0.12
Error	144.22	122	1.18					
Total	1446.77	125						
Corrected Total	214.13	124						

a. R Squared = 0.33 (adjusted R Squared = 0.32)
b. Computed using alpha = 0.05

Conclusion

The purpose of this study was to explore the effects of aural preparation on rhythmic music literacy skills of second-grade students. The role of the first research question was to investigate the psychometric qualities of the three measures used in this study. The rhythm portion of the IMMA, the performance task, and the dictation task all demonstrated significant separation and acceptable goodness of fit. As a result, the IMMA, performance task, and dictation task were able to reliably separate marked differences in student achievement levels and differences in item difficulties, suggesting that the measurements are sensitive enough to provide confidence in the measures and related inferences. Overall, the psychometric

investigation suggests strong construct validity of items and strong predictive validity of the students for all measurements used.

The role of the second research question was to investigate how aural preparation would affect students' ability to read and perform rhythms. Results suggest that the treatment had a significant effect on improving reading and performance skills as measured by the performance task. The treatment group demonstrated a significantly higher overall mean score than the control group on the performance task.

The role of the third research question was to investigate the effects of aural preparation on students' decoding and writing skills as measured by the dictation task. There was not a statistically significant difference between treatment and control groups on the dictation task.

Discussion

Measurements

All three measurements demonstrated an acceptable goodness of fit, which supports previous validity/reliability reports of the rhythm portion of the IMMA for second graders (Gordon, 1986, p. 92). While the IMMA is recommended for students in grades one through six, at 40 items long it requires an attention span that challenged many second graders, which is one possible explanation for the low reliability results. Future research might utilize Gordon's Primary Measures of Music Audition (PMMA), which, with fewer items, is recommended for grades kindergarten through three.

The performance task demonstrated high reliability for both items (*Rel* = 0.99) and students (*Rel* = 0.94). Additionally, the dictation task showed high reliability for both items (*Rel* = 0.97) and students (*Rel* = 0.82). Because the performance task was scored using a five-point

rubric as opposed to a dichotomously scored method (correct or incorrect) as in the dictation task, data were more descriptive for the performance task than the dictation task. This is evident in the range of scores for each assessment. The performance task logit scale ranged from -2.78 to 4.44 whereas the dictation task logit scale ranged from -0.38 to 4.19. This sensitivity may have aided in indicating a significant difference between groups on the performance task. There was also a ceiling effect on the dictation task. For example, 14 students earned a perfect score on the dictation pretest and 69 of the 125 students (55%) earned a perfect score on the dictation posttest. There may be differences in the dictation skill levels of those 69 students, but they were not evident as there were not enough difficult items indicated in the assessment instrument to separate their performances. In contrast, no students earned a perfect score on the performance pretest. Rater one scored four students as earning a perfect score on the performance posttest while rater two scored zero students as earning a perfect score on the posttest. These data suggest that the performance test was more descriptive than the dictation measurement. It is recommended that an improved assessment be used for dictation assessment in future studies. During the performance task a metronome was set to 60 beats per minute. This aided the raters greatly when assessing each recording. After review of the audio recordings, many students seemed to struggle to not rush the dotted quarter note. In future research the metronome marking could possibly be set at a higher rate of speed to aid all students' achievement.

Performance

The aural preparation group mean (1.72 logits) was found to be significantly higher ($p < 0.01$) than the non-aural preparation group mean (1.18 logits) on the performance task. In addition to demonstrating more gains on the performance task from pretest to posttest, the aural

preparation groups experienced the music literature at a deeper level. Aural preparation activities were based on songs more often than the non-aural preparation groups, possibly providing the group with a seemingly better understanding and comfort with the literature. Anecdotally, the principal investigator observed that the aural preparation group learned and experienced more literature because they were not focused on the symbols, but rather on the music and sounds. Non-aural preparation groups spent more time with the notation symbols that were not necessarily related to a particular song. Because the songs were more prevalent, the aural-preparation groups may have had a better feel for the 6/8 time signature. This seemed to increase their aural understanding of the rhythmic relationship between a dotted quarter note and three beamed eighth notes. The principal investigator also observed that the aural-preparation group seemed to be better at accenting the strong beats in the meter as opposed to giving the same weight to all six eighth notes. This accenting was not part of the criteria on the assessment instrument and therefore would not have been included in the scoring, but having a better understanding of rhythmic relationships may have helped the aural-preparation students maintain a steady beat more effectively. During the performance task a metronome was set at 60 beats-per-minute, which is a rather slow tempo. Understanding the feeling of the time signature and rhythmic relationships between the two rhythms may have helped aural preparation students maintain control over the slow tempo resulting in higher evaluations on the performance task.

Dictation

The aural preparation group mean (3.01 logits) was found to be slightly lower than the non-aural preparation group mean (3.22 logits), but not at a statistically significant level. As mentioned earlier, the descriptive data of the dictation task did not seem to be as sensitive as the

performance task data. The dictation task seemed to have a ceiling effect as evidenced by 55% of the students earning a perfect score on the dictation posttest. Because unit two of CS only has two rhythms (dotted quarter note, three beamed eighth notes) the students can either pick one rhythm or the other for each response. This gives students a 50% chance of getting each answer correct. A more descriptive assessment may have provided better clarity and precision in scoring. It should also be noted that all students in the study had already experienced all twelve steps of unit one of CS. Unit one follows the same 12 steps as unit two but focuses on quarter notes and paired eighth notes in 2/4 time rather than dotted quarter notes and three beamed eighth notes in 6/8 time. Having already learned the skills to decode quarter notes and paired eighth notes in CS unit one might have had a carryover effect on students abilities to decode dotted quarter notes and three beamed eighth notes in this study.

Research from this study suggests that aural skills can be confidently taught to second grade students. Spending class time on aural preparation proved beneficial in improving student achievement on the performance task. Results also indicated that exposure to written notation for only 38% of the lessons (aural preparation group) versus exposure to written notation for 88% of the lessons (non-aural preparation group) had a non-significant effect on students' ability to decode and write rhythmic patterns. This suggests aural skills and exposure to written music notation should be balanced to better ensure high student achievement.

Limitations of this research include the use of only two contrasting rhythms (dotted quarter note and three beamed eighth notes in 6/8 time signature). Further research is needed to investigate if more complex rhythm patterns would change the results of this study. In this study the treatment group spent five lessons on aural skills and three on reading and writing skills. Future research could alter the lesson schedule to include more or less aural lessons and explore

whether that change effects the results. Students in this study had already experienced all four sections of CS Unit 1 and parts of Unit 4. Further research is also needed to see if no experience with CS would affect the results. Since students had already experienced aural preparation with other rhythms (e.g., quarter note and paired eighth notes) and pitch (e.g., do, re, mi), these skills may have carried over to the current study. This study was also limited to the assessment of rhythm only and would need to be replicated with pitch patterns to investigate similarities or differences in results.

The 2014 National Core Arts Standards for Music (National Association for Music Education (NAfME) outline several rhythmic literacy performance standards. They include not only reading and performing, but also creating, improvising, generating patterns (NAfME, n.d.). The Standards emphasize a broad definition of music literacy, as evidenced through the artistic process of creating, performing, responding, and connecting that align with the definition provided by Campbell and Scott-Kasner (1995). Students are now expected to not only read and perform patterns but improvise and write them as well. The field of music education now clearly expects students to not only perform but to engage in other artistic processes such as create, respond, and connect. This leads general music teachers to consider how to better engage students in these artistic processes through the "sound" portion of our preparation sequence. Results from this study suggest that aurally hearing, performing, decoding, and creating patterns prior to introducing musical notation may increase second grade students' abilities to perform, create, respond, and connect via rhythm-based learning.

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Examining the Effect of Aural Preparation on Second Grade Students' Music Literacy Rhythm Skills

APPENDIX A

Lesson Plans for Control and Treatment Groups

All page numbers below refer to:

Feierabend, J. M. (2001). *Conversational solfege level 1: Teachers manual*. Chicago: GIA Publications.

Non-Aural Preparation Group (Control Group)

Session 1 (1. Readiness-Rote)

1. Echo Me (p. 19) – teacher speaks patterns on neutral syllable, students echo
2. Learn this Rhyme (p. 19) - *Oh My! Fish in the Sky!* (p. 149)
3. Layering with Ostinatos (p. 20)
    a. Ostinato – "What shall we do there's a fish in the sky?" (teacher vs. student)
    b. Add speech ostinato to poem, transfer ostinato to instruments and against poem

Session 2 (1. Readiness-Rote, 6. Reading Rote)

1. Review Poem - *Oh My! Fish in the Sky!* (p. 149)
2. Teach Song – *Oh Dear What Can the Matter Be* (p. 139)
3. Read Patterns from Pattern Cards (p. 39)
    a. Teacher reads patterns 2a on syllables, students echo

Session 3 (6. Reading Rote, 7. Reading-Decoding Familiar)

1. Read Patterns from Pattern Cards (p. 39)
    a. Teacher reads patterns 2a on syllables, students echo
2. Read patterns (p. 40)
    a. Students read patterns 2a on syllables
3. Read and Remember (p. 40)
    a. Teacher displays flashcard from patterns 2a while students study card
    b. Teachers hides card and students perform card on rhythm syllables

Session 4 (7. Reading-Decoding Familiar, 8. Reading-Decoding Unfamiliar)

1. Multiple Choice (p. 43)
    a. Teacher displays two or more patterns selected from patterns 2a
    b. Teacher performs patterns
    c. Students indicate which pattern teacher performed
2. Read patterns (p. 40)

    a. Students read patterns 2b on syllables
3. Take a Reading Walk (p. 41)
    a. Students read their flashcard from patterns 2a and 2b at the same time (multiple flashcards will be read at the same time)
    b. Students travel to the next flashcard and repeat process

Session 5 (7. Reading-Decoding Familiar, 8. Reading-Decoding Unfamiliar)

1. Read patterns (p. 40)
    a. Students read patterns 2b on syllables
2. I Think I Made an Error (p. 41)
    a. Teacher reads patterns from 2a and 2b, but makes alteration
    b. Students identify error and read pattern correctly

Session 6 (8. Reading-Decoding Unfamiliar, 9. Writing-Rote)

1. Lost My Partner (p. 43)

    Students are given a flashcard

    Students read their pattern and travel around the room looking for the other person who also has their identical pattern
2. Copy These Patterns (p. 50)

    Students copy rhythm patterns and then speak them

Session 7 (10. Writing-Decode Familiar, 11. Writing-Decode-Unfamiliar)

1. Unscramble (p. 285)
    a. Teacher distributes rhythmcard packets
    b. Students decode familiar rhyme - *Oh My! Fish in the Sky!* (p. 149)
    c. Students decode unfamiliar rhyme - *Stirring the Brew* (p. 157)

Session 8 (11. Writing-Decode-Unfamiliar, 12 – Writing-Create)

1. Create Worksheet (p. 369)
    a. Using the rhythm boxes students create 4 original patterns
    b. Students perform patterns

Aural Preparation Group (Experimental Group)

Session 1 (1. Readiness-Rote)

1. Echo Me (p. 19) – teacher speaks patterns on neutral syllable, students echo
2. Learn this Rhyme (p. 19) - *Oh My! Fish in the Sky!* (p. 149)
3. Layering with Ostinatos (p. 20)
    a. Ostinato – "What shall we do there's a fish in the sky?"
    b. Add speech ostinato to poem, transfer ostinato to instruments and against poem

Session 2 (1. Readiness-Rote, 2. Conversational Solfege-Rote)

1. Review Poem - *Oh My! Fish in the Sky!* (p. 149)
2. Echo Me (p. 23) – teacher speaks patterns on rhythm syllables, students echo
3. Who Speaks What (p. 21)
    a. Teacher speaks patterns with syllables from 2a, but only girls says eighth notes and only boys say dotted quarter notes
    b. Girls and boys switch jobs
4. Teach Song – *Oh Dear What Can the Matter Be* (p. 139)

Session 3 (2. Conversational Solfege-Rote, 3. Conversational Solfege-Decode Familiar)

1. Clap for Your Syllable (p. 22)
    a. Teacher speaks pattern with syllables from 2a
    b. Students speak the eighth notes, but clap the dotted quarter notes
2. I'm Thinking of Something that Begins With _____
    a. Teacher speaks pattern from 2a
    b. Teachers gives clues about pattern such as I'm thinking of something that begins with du-da-di
    c. Students decode pattern as a class
3. Phrase by Phrase (p. 26)
    a. Teacher speaks *Oh My! Fish in the Sky!* (p. 149) one phrase at a time
    b. Students echo no syllables

Session 4 (3. Conversational Solfege-Decode Familiar, 4. Conversational Solfege-Decode Unfamiliar)

1. Jungle Messages (p. 25)
    a. Teacher plays rhythm on drum from patterns 2a and 2b
    b. Students echo on syllables
2. I'm Thinking of Something that Begins With _____
    a. Teacher speaks pattern from 2a and 2b
    b. Teacher gives clues about pattern such as I'm thinking of something that begins with du-da-di
    c. Students decode pattern
3. Create a Pattern that Includes… (p. 31)

    a. Students create a rhythm pattern that with a restriction such as: "Create a pattern that begins with du-da-di"

Session 5 (4. Conversational Solfege-Decode Unfamiliar, 5. Conversational Solfege-Create)

1. Jungle Messages (p. 25)
    a. Teacher plays rhythm on drum from patterns 2a and 2b
    b. Students echo on syllables
2. Question/Answer (p. 30)
    a. Teacher performs rhythm pattern
    b. Individuals create a different pattern and perform back to teacher
    c. In pairs, one student asks the "question" while the other one gives a different "answer"

Session 6 (6. Reading Rote, 7. Reading-Decoding Familiar)

1. Read Patterns from Pattern Cards (p. 39)
    a. Teacher reads patterns 2a on syllables, students echo
2. Read patterns (p. 40)
    a. Students read patterns 2a on syllables
3. Read and Remember (p. 40)
    a. Teacher displays flashcard from patterns 2a while students study card
    b. Teacher hides card and students perform card on rhythm syllables

Session 7 (7. Reading-Decoding Familiar, 8. Reading-Decoding Unfamiliar)

1. Multiple Choice (p. 43)
    a. Teacher displays two or more patterns selected from patterns 2a
    b. Teacher performs pattern
    c. Students indicate which pattern teacher performed
2. Read patterns (p. 40)
    a. Students read patterns 2b on syllables
3. Take a Reading Walk (p. 41)
    a. Students read their flashcard from patterns 2a and 2b at the same time (multiple flashcards will be read at the same time)
    b. Students travel to the next flashcard and repeat process

Session 8 (10. Writing-Decode Familiar, 11. Writing-Decode Unfamiliar, 12-Writing-Create)

1. Popsicle Sticks (p. 50) Substitute rhythmcards (p. 285) for popsicle sticks
    a. Students use cards to copy pattern displayed by teacher
    b. Students speak card on syllables
2. Unscramble (p. 285)
    a. Teacher distributes rhythmcard packets
    Students decode familiar rhyme - *Oh My! Fish in the Sky!* (p. 149)
3. Create a Pattern that Includes… (p. 55)
    a. Using rhythmcards, students create patterns with a specific beginning, ending or pattern

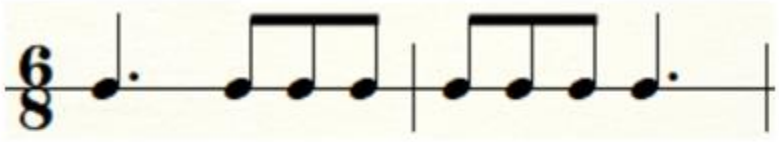
APPENDIX B

Performance Assessment

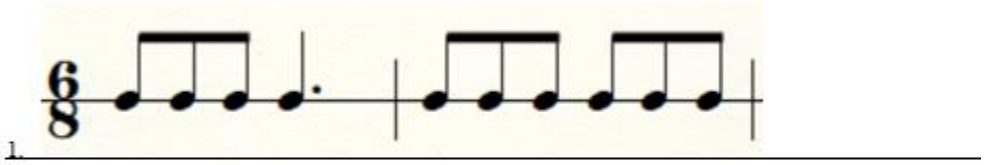
Performance Assessment

Read the pattern using rhythm syllables or on the woodblock as directed

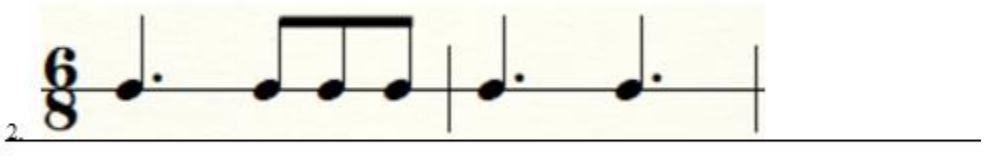
Sample:



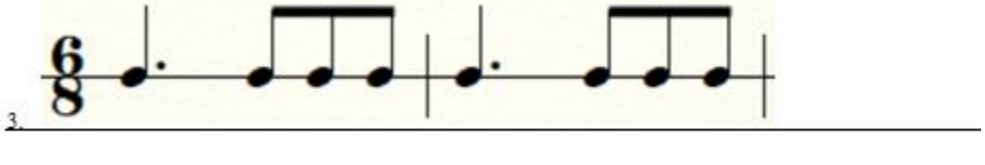
1.



2.



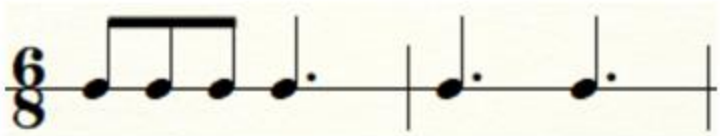
3.

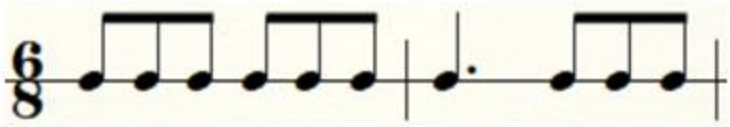


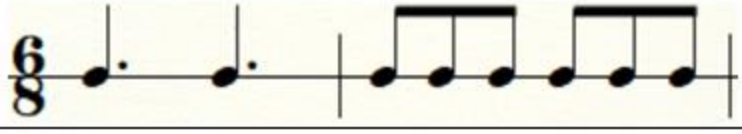
4.

5. 

6. 

7. 

8. 

9. 

10. 

Grading Sheet
Student Number: _____
Total Score: _____

1)	1	2	3	4	5
2)	1	2	3	4	5
3)	1	2	3	4	5
4)	1	2	3	4	5
5)	1	2	3	4	5
6)	1	2	3	4	5
7)	1	2	3	4	5
8)	1	2	3	4	5
9)	1	2	3	4	5
10)	1	2	3	4	5

Performance Assessment Scoring Rubric

5 – Steady tempo and accurate rhythms throughout
4 – Inaccurate tempo, accurate rhythms throughout
3 – Inaccurate tempo, or missed one rhythm unit
2 – Inaccurate tempo, or missed two rhythm units
1 – Missed more than two rhythm units

Rhythm unit – one beat of music, in 6/8 time that would be a dotted quarter note or three beamed eighth notes

The first four rhythm performed were assessed. If extra rhythms were performed they made the final rhythm unit incorrect.

The 3 eighth notes had to be even relative to one another to be counted correct.

The dotted quarter note had to be as long as 3 eighth notes to be counted correct.

APPENDIX C

Dictation Assessment

(____/40)

Notation Assessment

Name: _____ Homeroom Teacher: _____

Write the pattern that you hear. You may use dotted quarter note ♩. *or 3 eighth notes* ♫

Sample A:

Sample B:

1.

2.

3.

4. 6 8 _____ _____ | _____ _____ ||

5. 6 8 _____ _____ | _____ _____ ||

6. 6 8 _____ _____ | _____ _____ ||

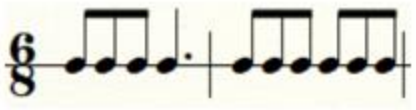
7. 6 8 _____ _____ | _____ _____ ||

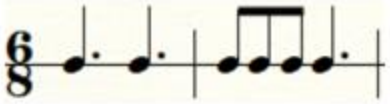
8. 6 8 _____ _____ | _____ _____ ||

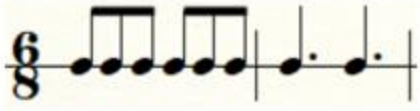
9. 6 8 _____ _____ | _____ _____ ||

10. 6 8 _____ _____ | _____ _____ ||

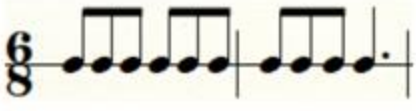
Answer Key:

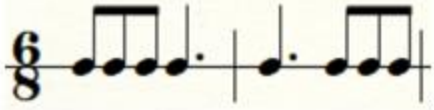
1. B  (2b-5)

2. A  (2a-8)

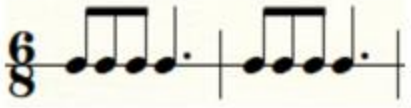
3. B  2a-3)

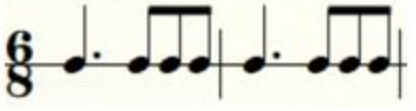
4. C  (2b-1)

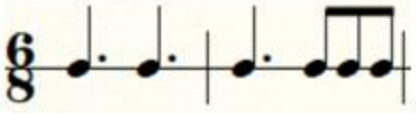
5. A  (2a-5)

6. B  (2b-3)

7. A  (2a-1)

8. C  (2a-4)

9. B  (2a-2)

10. C  ((2b-4)

APPENDIX D

Calibration of the Items for the Rhythm Portion of the IMMA Assessment

Item Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
35	0.42	1.32	0.20	1.19	3.37	1.22	3.07
27	0.42	1.32	0.20	1.14	2.49	1.15	2.22
14	0.46	1.13	0.19	1.08	1.55	1.11	1.82
20	0.54	0.83	0.19	0.95	-0.95	0.96	-0.72
7	0.54	0.80	0.20	1.14	2.60	1.16	2.66
26	0.57	0.68	0.20	1.07	1.25	1.07	1.14
19	0.60	0.57	0.20	1.07	1.22	1.08	1.21
30	0.60	0.57	0.20	1.05	0.76	1.04	0.58
37	0.60	0.55	0.20	1.01	0.22	1.02	0.27
34	0.61	0.53	0.20	1.11	1.77	1.11	1.55
29	0.61	0.49	0.20	1.21	3.04	1.23	2.95
21	0.64	0.37	0.20	0.91	-1.33	0.88	-1.53
24	0.66	0.29	0.20	1.00	-0.03	0.98	-0.18
36	0.66	0.27	0.21	1.00	-0.02	0.99	-0.07
32	0.68	0.20	0.21	0.95	-0.55	0.94	-0.62
31	0.69	0.11	0.21	1.16	1.72	1.16	1.50
8	0.69	0.11	0.21	1.09	1.06	1.11	1.01
11	0.70	0.07	0.21	0.92	-0.85	0.92	-0.68
5	0.70	0.07	0.21	0.94	-0.59	0.90	-0.88
4	0.74	-0.11	0.22	0.99	-0.05	1.01	0.10
9	0.74	-0.11	0.22	1.05	0.50	0.99	-0.01
25	0.74	-0.11	0.22	0.98	-0.12	0.97	-0.20
6	0.74	-0.11	0.22	0.92	-0.70	0.90	-0.79
33	0.74	-0.11	0.22	0.93	-0.60	0.88	-0.93
15	0.75	-0.16	0.22	0.93	-0.60	0.92	-0.57
13	0.75	-0.21	0.22	1.03	0.26	0.99	-0.04
16	0.75	-0.21	0.22	0.83	-1.51	0.75	-1.90
39	0.76	-0.24	0.23	0.94	-0.52	0.95	-0.28
28	0.76	-0.26	0.23	1.05	0.48	1.05	0.38
23	0.78	-0.37	0.23	0.87	-1.04	0.76	-1.62
2	0.80	-0.48	0.24	0.93	-0.47	0.89	-0.65
1	0.81	-0.54	0.24	0.98	-0.11	1.02	0.15
38	0.81	-0.58	0.25	0.92	-0.53	0.97	-0.11
18	0.83	-0.73	0.26	1.00	0.03	0.93	-0.29
17	0.83	-0.73	0.26	0.89	-0.67	0.87	-0.63
40	0.84	-0.77	0.26	0.88	-0.70	0.74	-1.30
10	0.87	-1.02	0.28	0.89	-0.53	0.76	-0.99
22	0.87	-1.02	0.28	0.86	-0.67	0.67	-1.45

12	0.88	-1.10	0.29	0.90	-0.43	0.79	-0.79
3	0.89	-1.28	0.31	0.95	-0.16	0.77	-0.80
Mean	0.70	0.00	0.22	0.99	0.21	0.97	0.06
SD	0.12	0.65	0.03	0.10	1.21	0.14	1.26

Note. The items are presented in Measure order, from high to low.

APPENDIX E

Calibration of the Students for the Rhythm Portion of the IMMA Assessment

Student Number	Observed Average	Measure	Standard Error	Infit *MSE*	Standard Infit	Outfit *MSE*	Standard Outfit
79	0.90	2.35	0.54	0.87	-0.20	0.82	-0.21
30	0.85	1.86	0.45	0.96	-0.03	0.89	-0.16
34	0.85	1.86	0.45	1.00	0.10	0.93	-0.04
42	0.85	1.86	0.45	0.98	0.02	0.87	-0.23
51	0.85	1.86	0.45	0.87	-0.35	0.65	-0.90
97	0.85	1.86	0.45	0.85	-0.43	0.67	-0.84
98	0.85	1.86	0.45	0.83	-0.52	0.60	-1.09
2	0.85	1.86	0.45	1.05	0.25	1.10	0.38
14	0.85	1.86	0.45	0.78	-0.70	0.61	-1.03
33	0.82	1.67	0.43	0.83	-0.62	0.65	-1.05
37	0.82	1.67	0.43	1.00	0.08	0.92	-0.13
38	0.82	1.67	0.43	1.03	0.19	0.99	0.09
46	0.82	1.67	0.43	1.05	0.29	1.06	0.28
109	0.82	1.67	0.43	0.89	-0.36	0.77	-0.62
15	0.82	1.67	0.43	0.85	-0.53	0.67	-0.97
17	0.82	1.67	0.43	0.80	-0.72	0.65	-1.06
122	0.82	1.67	0.43	0.98	0.00	0.97	0.03
25	0.80	1.49	0.41	1.15	0.69	1.37	1.20
27	0.80	1.49	0.41	0.98	-0.01	0.86	-0.37
36	0.80	1.49	0.41	1.00	0.09	0.99	0.07
55	0.80	1.49	0.41	1.00	0.06	0.99	0.07
106	0.80	1.49	0.41	0.89	-0.42	0.79	-0.66
110	0.80	1.49	0.41	1.07	0.37	0.94	-0.09
6	0.80	1.49	0.41	0.75	-1.09	0.61	-1.41
8	0.80	1.49	0.41	0.89	-0.40	0.81	-0.55
73	0.80	1.49	0.41	1.06	0.33	1.16	0.62
75	0.80	1.49	0.41	0.92	-0.29	0.78	-0.67
117	0.80	1.49	0.41	1.04	0.27	1.15	0.58
29	0.77	1.33	0.39	0.88	-0.55	0.91	-0.23
39	0.77	1.33	0.39	0.98	-0.05	0.93	-0.18
63	0.77	1.33	0.39	0.89	-0.47	0.83	-0.58
103	0.77	1.33	0.39	1.04	0.26	1.00	0.08
112	0.77	1.33	0.39	0.97	-0.08	1.06	0.31
3	0.77	1.33	0.39	0.82	-0.84	0.69	-1.22
10	0.77	1.33	0.39	0.90	-0.42	0.86	-0.46
69	0.77	1.33	0.39	0.99	0.01	0.85	-0.49
70	0.77	1.33	0.39	0.96	-0.12	1.01	0.13
76	0.77	1.33	0.39	0.81	-0.94	0.78	-0.80

125	0.77	1.33	0.39	0.91	-0.40	0.78	-0.80
31	0.75	1.19	0.38	1.06	0.36	0.95	-0.13
95	0.75	1.19	0.38	0.96	-0.18	0.87	-0.50
96	0.75	1.19	0.38	1.02	0.14	1.05	0.27
108	0.75	1.19	0.38	0.84	-0.88	0.71	-1.28
19	0.75	1.19	0.38	0.87	-0.70	0.76	-1.01
22	0.75	1.19	0.38	0.95	-0.18	0.86	-0.52
81	0.75	1.19	0.38	0.92	-0.38	0.83	-0.64
83	0.75	1.19	0.38	0.93	-0.32	0.91	-0.31
91	0.75	1.19	0.38	0.98	-0.02	0.97	-0.04
28	0.73	1.05	0.37	1.02	0.16	0.96	-0.11
35	0.73	1.05	0.37	0.85	-0.86	0.77	-1.08
41	0.73	1.05	0.37	0.93	-0.37	0.98	0.00
20	0.73	1.05	0.37	1.01	0.09	1.02	0.15
85	0.73	1.05	0.37	0.81	-1.13	0.73	-1.28
86	0.73	1.05	0.37	0.88	-0.66	0.78	-1.04
89	0.73	1.05	0.37	1.03	0.23	0.92	-0.28
43	0.70	0.92	0.36	0.99	-0.01	1.00	0.07
45	0.70	0.92	0.36	1.12	0.80	1.21	1.05
60	0.70	0.92	0.36	0.76	-1.69	0.69	-1.72
62	0.70	0.92	0.36	1.09	0.66	1.10	0.56
92	0.70	0.92	0.36	1.08	0.55	1.17	0.91
101	0.70	0.92	0.36	1.01	0.10	0.95	-0.18
18	0.70	0.92	0.36	0.87	-0.87	0.81	-0.99
71	0.70	0.92	0.36	0.98	-0.10	0.89	-0.51
78	0.70	0.92	0.36	0.92	-0.47	0.90	-0.48
84	0.70	0.92	0.36	0.85	-0.98	0.78	-1.17
87	0.70	0.92	0.36	0.93	-0.41	1.00	0.07
123	0.70	0.92	0.36	1.06	0.41	1.01	0.13
40	0.68	0.79	0.35	1.02	0.21	0.99	-0.02
50	0.68	0.79	0.35	1.12	0.86	1.11	0.67
56	0.68	0.79	0.35	1.11	0.82	1.19	1.08
67	0.68	0.79	0.35	1.21	1.48	1.35	1.87
104	0.68	0.79	0.35	0.95	-0.33	0.89	-0.59
11	0.68	0.79	0.35	1.19	1.32	1.18	1.01
13	0.68	0.79	0.35	1.12	0.88	1.05	0.32
16	0.68	0.79	0.35	0.86	-1.04	0.83	-0.97
74	0.68	0.79	0.35	0.95	-0.34	0.91	-0.44
82	0.68	0.79	0.35	1.00	0.01	0.97	-0.12
118	0.68	0.79	0.35	1.05	0.40	1.14	0.85
121	0.68	0.79	0.35	0.93	-0.44	0.99	0.00
124	0.68	0.79	0.35	1.07	0.53	1.02	0.16
24	0.65	0.67	0.35	0.90	-0.81	0.86	-0.88
57	0.65	0.67	0.35	0.97	-0.23	0.91	-0.53

59	0.65	0.67	0.35	1.00	0.01	1.01	0.12
94	0.65	0.67	0.35	0.91	-0.71	0.93	-0.41
12	0.65	0.67	0.35	0.97	-0.17	0.91	-0.53
72	0.65	0.67	0.35	0.95	-0.38	0.91	-0.55
77	0.65	0.67	0.35	0.92	-0.61	0.89	-0.69
114	0.65	0.67	0.35	0.98	-0.14	0.92	-0.49
23	0.62	0.55	0.34	1.33	2.58	1.45	2.83
64	0.62	0.55	0.34	0.97	-0.26	0.97	-0.18
65	0.62	0.55	0.34	0.92	-0.67	0.91	-0.61
93	0.62	0.55	0.34	0.97	-0.21	0.93	-0.43
100	0.62	0.55	0.34	0.89	-0.92	0.88	-0.86
111	0.62	0.55	0.34	1.02	0.21	0.98	-0.08
7	0.62	0.55	0.34	0.98	-0.17	0.97	-0.16
47	0.60	0.44	0.34	1.04	0.37	1.05	0.44
54	0.60	0.44	0.34	1.34	2.85	1.43	2.94
99	0.60	0.44	0.34	1.16	1.41	1.21	1.53
90	0.60	0.44	0.34	1.03	0.32	0.99	-0.04
26	0.57	0.33	0.33	0.98	-0.21	1.00	0.00
9	0.57	0.33	0.33	0.94	-0.60	0.91	-0.74
58	0.55	0.22	0.33	1.28	2.71	1.32	2.65
66	0.55	0.22	0.33	1.18	1.77	1.21	1.82
120	0.55	0.22	0.33	1.25	2.47	1.29	2.45
44	0.52	0.11	0.33	1.28	2.79	1.33	2.83
107	0.52	0.11	0.33	1.01	0.13	1.04	0.45
5	0.52	0.11	0.33	1.24	2.41	1.26	2.28
49	0.50	0.00	0.33	1.11	1.15	1.14	1.26
1	0.50	0.00	0.33	1.24	2.48	1.28	2.49
115	0.47	-0.11	0.33	1.25	2.56	1.31	2.64
88	0.43	-0.33	0.33	1.13	1.30	1.12	0.96
52	0.40	-0.44	0.34	1.22	1.96	1.24	1.75
61	0.35	-0.67	0.35	1.19	1.45	1.25	1.53
116	0.34	-0.70	0.37	1.13	0.94	1.11	0.66
Mean	0.70	0.98	0.38	0.10	0.14	0.97	0.05
SD	0.11	0.58	0.04	0.13	0.93	0.19	1.01

Note. The items are presented in Measure order, from high to low.

APPENDIX F

Calibration of the Items for the Performance Assessment

Item Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
8	2.64	1.15	0.05	1.13	1.95	1.11	1.38
9	3.17	0.52	0.05	0.92	-1.22	1.02	0.25
1	3.42	0.22	0.05	1.12	1.78	1.13	1.74
4	3.49	0.13	0.05	0.98	-0.31	0.97	-0.37
7	3.52	0.09	0.05	0.79	-3.34	0.78	-3.24
6	3.63	-0.05	0.05	1.26	3.59	1.38	4.59
3	3.79	-0.27	0.05	0.84	-2.46	0.77	-3.16
5	3.83	-0.33	0.05	0.85	-2.25	0.78	-3.07
2	3.86	-0.36	0.05	0.87	-1.98	0.90	-1.29
10	4.29	-1.10	0.06	1.06	0.80	1.22	2.18
Mean	3.56	0.00	0.05	0.98	-0.34	1.01	-0.10
SD	0.44	0.60	0.00	0.16	2.29	0.21	2.63

Note. The items are presented in Measure order, from high to low.

APPENDIX G

Calibration of the Students for the Performance Assessment

Student Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
72post	4.95	4.44	1.02	1.08	0.40	3.37	1.69
7post	4.90	3.71	0.73	0.86	0.02	0.74	-0.09
22post	4.90	3.71	0.73	1.09	0.36	2.21	1.39
30post	4.90	3.71	0.73	0.83	-0.03	0.60	-0.31
122post	4.90	3.71	0.73	0.85	0.01	0.74	-0.09
6post	4.85	3.27	0.61	0.91	0.04	0.78	-0.14
83post	4.85	3.27	0.61	1.05	0.28	1.21	0.52
24post	4.80	2.94	0.53	1.92	1.57	1.40	0.82
25post	4.80	2.94	0.53	1.00	0.17	1.09	0.34
28post	4.80	2.94	0.53	1.04	0.24	1.15	0.44
75post	4.80	2.94	0.53	0.60	-0.73	0.47	-0.98
98pre	4.75	2.69	0.48	0.67	-0.62	0.69	-0.50
18post	4.75	2.69	0.48	1.31	0.74	1.52	1.06
31post	4.75	2.69	0.48	1.53	1.11	1.15	0.45
38post	4.75	2.69	0.48	0.89	-0.08	0.98	0.13
70post	4.75	2.69	0.48	0.89	-0.07	0.83	-0.17
81post	4.75	2.69	0.48	0.91	-0.02	0.65	-0.61
131post	4.75	2.69	0.48	1.42	0.94	1.44	0.92
136post	4.75	2.69	0.48	0.98	0.13	0.95	0.08
39pre	4.70	2.47	0.44	0.52	-1.14	0.48	-1.21
14post	4.70	2.47	0.44	0.55	-1.02	0.54	-1.00
17post	4.70	2.47	0.44	1.78	1.54	2.22	2.09
65post	4.70	2.47	0.44	0.55	-1.03	0.56	-0.94
73post	4.70	2.47	0.44	1.23	0.62	1.06	0.29
25pre	4.65	2.29	0.42	0.95	0.04	1.16	0.49
20post	4.65	2.29	0.42	1.59	1.28	1.76	1.54
27post	4.65	2.29	0.42	1.02	0.20	1.04	0.24
46post	4.65	2.29	0.42	1.06	0.29	0.98	0.10
69post	4.65	2.29	0.42	0.76	-0.45	0.78	-0.39
123post	4.65	2.29	0.42	0.63	-0.81	0.87	-0.16
128post	4.65	2.29	0.42	0.64	-0.78	0.69	-0.64
72pre	4.60	2.13	0.39	1.23	0.63	1.09	0.34
16post	4.60	2.13	0.39	0.79	-0.37	0.63	-0.85
42post	4.60	2.13	0.39	1.08	0.32	1.19	0.56
55post	4.60	2.13	0.39	0.84	-0.26	0.71	-0.61
61post	4.60	2.13	0.39	1.21	0.59	1.14	0.46

63post	4.60	2.13	0.39	1.18	0.53	1.34	0.85
87post	4.60	2.13	0.39	0.71	-0.60	0.68	-0.71
98post	4.60	2.13	0.39	1.11	0.39	1.11	0.38
115post	4.60	2.13	0.39	0.69	-0.68	0.59	-0.97
87pre	4.55	1.98	0.37	0.77	-0.44	0.80	-0.37
8post	4.55	1.98	0.37	0.88	-0.17	0.94	-0.01
78post	4.55	1.98	0.37	1.31	0.81	1.15	0.49
117post	4.55	1.98	0.37	0.64	-0.84	0.64	-0.85
22pre	4.50	1.85	0.35	0.48	-1.44	0.65	-0.85
58post	4.50	1.85	0.35	1.10	0.37	1.04	0.24
62post	4.50	1.85	0.35	1.09	0.35	1.17	0.54
76post	4.50	1.85	0.35	1.46	1.12	1.36	0.94
79post	4.50	1.85	0.35	0.87	-0.20	0.87	-0.19
114post	4.50	1.85	0.35	1.05	0.26	1.26	0.73
135post	4.50	1.85	0.35	0.71	-0.65	0.71	-0.66
85pre	4.45	1.73	0.34	0.79	-0.44	0.95	0.01
93pre	4.45	1.73	0.34	0.66	-0.83	0.72	-0.65
36post	4.45	1.73	0.34	1.17	0.54	1.20	0.61
125post	4.45	1.73	0.34	1.27	0.76	1.25	0.71
127post	4.45	1.73	0.34	0.67	-0.78	0.83	-0.32
89pre	4.40	1.62	0.33	0.42	-1.78	0.49	-1.51
37post	4.40	1.62	0.33	1.45	1.12	1.61	1.46
39post	4.40	1.62	0.33	1.02	0.18	1.07	0.30
74post	4.40	1.62	0.33	1.22	0.65	1.12	0.42
100post	4.40	1.62	0.33	2.09	2.22	1.32	0.87
132post	4.40	1.62	0.33	1.78	1.73	1.67	1.56
23pre	4.35	1.51	0.32	1.38	1.00	1.26	0.75
5post	4.35	1.51	0.32	1.45	1.15	1.01	0.15
29post	4.35	1.51	0.32	2.11	2.30	1.90	1.99
45post	4.35	1.51	0.32	0.56	-1.22	0.71	-0.71
85post	4.35	1.51	0.32	1.84	1.85	1.95	2.07
134post	4.35	1.51	0.32	0.49	-1.51	0.68	-0.82
2post	4.30	1.42	0.31	0.86	-0.26	0.92	-0.10
40post	4.30	1.42	0.31	0.40	-1.90	0.50	-1.49
103post	4.30	1.42	0.31	1.32	0.88	1.27	0.78
111post	4.30	1.42	0.31	0.80	-0.43	0.91	-0.12
121post	4.30	1.42	0.31	3.07	3.66	2.95	3.54
124post	4.30	1.42	0.31	0.51	-1.44	0.67	-0.86
74pre	4.25	1.33	0.30	0.53	-1.38	0.62	-1.06
33post	4.25	1.33	0.30	2.17	2.46	1.98	2.16
129post	4.25	1.33	0.30	0.71	-0.71	0.82	-0.37
75pre	4.20	1.24	0.29	1.36	0.98	1.29	0.84

3post	4.20	1.24	0.29	0.64	-0.99	0.69	-0.82
95post	4.20	1.24	0.29	0.53	-1.39	0.56	-1.27
107post	4.20	1.24	0.29	0.84	-0.34	0.81	-0.43
6pre	4.15	1.16	0.28	0.51	-1.50	0.59	-1.20
81pre	4.15	1.16	0.28	1.06	0.30	1.02	0.17
97pre	4.15	1.16	0.28	0.71	-0.75	0.78	-0.53
61pre	4.10	1.08	0.27	0.45	-1.83	0.47	-1.68
71pre	4.10	1.08	0.27	0.70	-0.81	0.74	-0.66
10post	4.10	1.08	0.27	0.79	-0.50	0.90	-0.16
12post	4.10	1.08	0.27	1.12	0.43	1.05	0.26
23post	4.10	1.08	0.27	0.61	-1.15	0.68	-0.87
43post	4.10	1.08	0.27	0.36	-2.26	0.41	-2.00
57post	4.10	1.08	0.27	1.76	1.84	1.62	1.55
71post	4.10	1.08	0.27	1.12	0.44	0.86	-0.27
84post	4.10	1.08	0.27	0.64	-1.01	0.74	-0.67
116post	4.10	1.08	0.27	1.22	0.70	1.12	0.43
3pre	4.05	1.01	0.27	0.99	0.08	1.03	0.20
41pre	4.05	1.01	0.27	2.40	2.97	2.49	3.06
9post	4.05	1.01	0.27	1.28	0.85	1.21	0.66
89post	4.05	1.01	0.27	1.42	1.15	1.49	1.30
57pre	4.00	0.94	0.26	1.43	1.19	1.37	1.05
95pre	4.00	0.94	0.26	1.19	0.64	1.13	0.48
19post	4.00	0.94	0.26	1.04	0.24	0.97	0.04
108post	4.00	0.94	0.26	0.49	-1.71	0.48	-1.67
109post	4.00	0.94	0.26	0.37	-2.27	0.37	-2.21
120post	4.00	0.94	0.26	1.59	1.56	1.33	0.96
20pre	3.95	0.87	0.26	0.52	-1.57	0.50	-1.64
63pre	3.95	0.87	0.26	0.48	-1.77	0.51	-1.57
78pre	3.95	0.87	0.26	0.77	-0.60	0.75	-0.66
35post	3.95	0.87	0.26	0.55	-1.45	0.57	-1.30
49post	3.95	0.87	0.26	0.82	-0.43	0.87	-0.28
130post	3.95	0.87	0.26	0.50	-1.68	0.52	-1.52
83pre	3.90	0.80	0.25	0.58	-1.34	0.63	-1.09
64post	3.90	0.80	0.25	1.05	0.25	0.93	-0.08
77post	3.90	0.80	0.25	0.38	-2.29	0.44	-1.90
93post	3.90	0.80	0.25	1.30	0.92	1.43	1.20
58pre	3.85	0.74	0.25	1.04	0.23	0.98	0.05
59pre	3.85	0.74	0.25	0.33	-2.65	0.34	-2.47
65pre	3.85	0.74	0.25	0.53	-1.57	0.52	-1.56
92pre	3.85	0.74	0.25	1.02	0.17	0.82	-0.45
41post	3.85	0.74	0.25	1.46	1.31	1.55	1.46
112post	3.85	0.74	0.25	0.37	-2.41	0.40	-2.17

126post	3.85	0.74	0.25	0.67	-0.98	0.66	-0.99
139post	3.85	0.74	0.25	1.48	1.35	1.68	1.75
50post	3.80	0.68	0.24	0.44	-2.03	0.41	-2.15
67post	3.80	0.68	0.24	0.47	-1.91	0.50	-1.70
91post	3.80	0.68	0.24	1.34	1.04	1.29	0.89
114pre	3.75	0.62	0.24	0.68	-1.01	0.72	-0.81
11post	3.75	0.62	0.24	1.22	0.74	1.13	0.47
54post	3.75	0.62	0.24	1.10	0.40	1.04	0.22
66post	3.75	0.62	0.24	1.16	0.56	1.06	0.30
43pre	3.70	0.56	0.24	0.72	-0.84	0.62	-1.19
64pre	3.70	0.56	0.24	0.78	-0.64	0.77	-0.63
60post	3.70	0.56	0.24	1.09	0.38	1.02	0.18
86post	3.70	0.56	0.24	0.54	-1.61	0.51	-1.68
88post	3.70	0.56	0.24	2.24	2.97	1.98	2.39
90post	3.70	0.56	0.24	0.60	-1.35	0.59	-1.34
110post	3.70	0.56	0.24	0.59	-1.39	0.53	-1.61
24pre	3.65	0.51	0.23	1.20	0.69	1.12	0.45
54pre	3.65	0.51	0.23	0.97	0.01	0.92	-0.15
104post	3.65	0.51	0.23	0.77	-0.66	0.71	-0.88
14pre	3.60	0.45	0.23	0.51	-1.79	0.54	-1.61
17pre	3.60	0.45	0.23	1.06	0.29	1.12	0.47
97post	3.60	0.45	0.23	0.85	-0.38	0.83	-0.45
99post	3.60	0.45	0.23	0.48	-1.94	0.64	-1.14
101post	3.60	0.45	0.23	0.81	-0.55	0.76	-0.68
100pre	3.55	0.40	0.23	0.38	-2.55	0.37	-2.49
116pre	3.55	0.40	0.23	1.10	0.41	1.08	0.34
130pre	3.55	0.40	0.23	0.66	-1.13	0.73	-0.84
11pre	3.50	0.35	0.23	1.00	0.12	0.90	-0.22
13post	3.50	0.35	0.23	0.52	-1.79	0.49	-1.91
38pre	3.45	0.30	0.22	0.94	-0.09	0.94	-0.09
15post	3.45	0.30	0.22	2.52	3.67	2.71	3.87
92post	3.45	0.30	0.22	0.48	-2.02	0.49	-1.94
18pre	3.40	0.25	0.22	1.03	0.20	0.99	0.07
55pre	3.40	0.25	0.22	0.34	-2.95	0.31	-3.05
66pre	3.40	0.25	0.22	0.64	-1.29	0.63	-1.29
34post	3.40	0.25	0.22	0.45	-2.26	0.45	-2.14
56post	3.40	0.25	0.22	0.66	-1.17	0.64	-1.24
59post	3.40	0.25	0.22	0.43	-2.37	0.43	-2.29
35pre	3.35	0.20	0.22	1.24	0.85	1.20	0.73
112pre	3.35	0.20	0.22	2.98	4.55	3.89	5.72
94post	3.35	0.20	0.22	0.55	-1.76	0.62	-1.36
47post	3.30	0.15	0.22	0.39	-2.68	0.39	-2.57

51post	3.30	0.15	0.22	0.84	-0.48	0.81	-0.56
28pre	3.25	0.10	0.22	1.65	1.99	2.24	3.21
47pre	3.25	0.10	0.22	0.34	-3.05	0.32	-3.05
117pre	3.25	0.10	0.22	1.50	1.60	1.48	1.49
128pre	3.25	0.10	0.22	1.03	0.21	1.09	0.38
15pre	3.16	0.07	0.22	1.67	2.02	1.68	2.01
27pre	3.20	0.06	0.21	1.97	2.78	1.91	2.54
108pre	3.20	0.06	0.21	1.87	2.55	1.86	2.44
37pre	3.15	0.01	0.21	1.11	0.48	1.19	0.71
60pre	3.15	0.01	0.21	0.74	-0.94	0.67	-1.21
1post	3.15	0.01	0.21	0.87	-0.41	0.84	-0.48
16pre	3.10	-0.03	0.21	1.19	0.75	1.20	0.75
30pre	3.10	-0.03	0.21	0.39	-2.80	0.40	-2.64
44post	3.10	-0.03	0.21	0.95	-0.08	0.88	-0.33
118post	3.10	-0.03	0.21	0.98	0.01	0.95	-0.07
29pre	3.05	-0.08	0.21	1.05	0.27	1.05	0.28
73pre	3.05	-0.08	0.21	1.28	1.04	1.22	0.83
127pre	3.05	-0.08	0.21	0.86	-0.45	0.76	-0.81
82post	3.05	-0.08	0.21	0.25	-3.97	0.25	-3.77
106post	3.05	-0.08	0.21	1.31	1.14	1.28	1.01
7pre	3.00	-0.12	0.21	2.85	4.73	3.08	4.91
134pre	3.00	-0.12	0.21	0.90	-0.28	0.86	-0.42
1pre	2.95	-0.17	0.21	1.17	0.70	1.06	0.30
40pre	2.95	-0.17	0.21	1.32	1.18	1.33	1.15
52post	2.95	-0.17	0.21	0.67	-1.32	0.67	-1.25
5pre	2.90	-0.21	0.21	1.26	0.99	1.17	0.66
49pre	2.90	-0.21	0.21	0.79	-0.77	0.78	-0.75
94pre	2.90	-0.21	0.21	1.50	1.72	1.48	1.60
8pre	2.85	-0.25	0.21	1.04	0.23	0.97	-0.01
110pre	2.85	-0.25	0.21	0.79	-0.76	0.75	-0.88
124pre	2.85	-0.25	0.21	0.46	-2.49	0.44	-2.49
46pre	2.80	-0.30	0.21	1.57	1.93	1.56	1.82
123pre	2.70	-0.38	0.21	0.55	-1.98	0.70	-1.11
2pre	2.65	-0.43	0.21	1.07	0.36	0.98	0.02
111pre	2.65	-0.43	0.21	0.99	0.03	1.06	0.32
76pre	2.60	-0.47	0.21	0.73	-1.08	0.68	-1.19
99pre	2.60	-0.47	0.21	1.02	0.16	0.95	-0.09
125pre	2.60	-0.47	0.21	2.26	3.70	2.37	3.63
96post	2.55	-0.51	0.21	0.89	-0.35	0.82	-0.60
12pre	2.50	-0.56	0.21	0.67	-1.34	0.64	-1.35
106pre	2.50	-0.56	0.21	0.63	-1.58	0.62	-1.44
121pre	2.50	-0.56	0.21	1.09	0.42	1.08	0.35
84pre	2.45	-0.60	0.21	1.27	1.04	1.20	0.76
132pre	2.45	-0.60	0.21	1.63	2.11	2.45	3.69

33pre	2.40	-0.65	0.21	1.04	0.23	0.99	0.05
26post	2.40	-0.65	0.21	0.29	-3.75	0.29	-3.38
67pre	2.35	-0.69	0.21	0.90	-0.31	0.78	-0.72
86pre	2.35	-0.69	0.21	0.63	-1.51	0.65	-1.26
109pre	2.35	-0.69	0.21	0.90	-0.28	1.48	1.49
118pre	2.35	-0.69	0.21	1.10	0.46	1.05	0.28
9pre	2.30	-0.74	0.22	1.42	1.47	1.36	1.17
50pre	2.30	-0.74	0.22	0.75	-0.91	1.37	1.18
96pre	2.30	-0.74	0.22	0.92	-0.23	0.85	-0.44
122pre	2.30	-0.74	0.22	1.55	1.84	1.54	1.63
42pre	2.25	-0.79	0.22	0.77	-0.82	0.99	0.08
51pre	2.25	-0.79	0.22	1.30	1.10	2.16	2.94
62pre	2.25	-0.79	0.22	0.71	-1.10	0.69	-1.03
91pre	2.25	-0.79	0.22	0.52	-2.06	0.52	-1.80
120pre	2.25	-0.79	0.22	0.51	-2.10	0.49	-1.93
131pre	2.25	-0.79	0.22	1.10	0.43	1.04	0.22
135pre	2.25	-0.79	0.22	0.90	-0.29	0.84	-0.44
45pre	2.20	-0.83	0.22	0.98	0.02	0.94	-0.09
77pre	2.20	-0.83	0.22	0.44	-2.51	0.44	-2.17
79pre	2.20	-0.83	0.22	0.91	-0.24	0.83	-0.45
31pre	2.10	-0.93	0.22	0.97	-0.03	0.88	-0.26
69pre	2.00	-1.04	0.23	0.76	-0.78	0.72	-0.78
70pre	2.00	-1.04	0.23	0.65	-1.23	0.64	-1.09
56pre	1.95	-1.09	0.24	0.51	-1.85	0.50	-1.60
90pre	1.95	-1.09	0.24	1.46	1.41	1.37	1.04
126pre	1.90	-1.15	0.24	0.68	-1.03	0.75	-0.63
26pre	1.85	-1.20	0.24	0.91	-0.19	1.18	0.58
88pre	1.80	-1.27	0.25	0.88	-0.27	0.88	-0.17
103pre	1.80	-1.27	0.25	0.51	-1.68	0.60	-1.03
139pre	1.80	-1.27	0.25	0.73	-0.79	0.95	0.00
10pre	1.75	-1.33	0.26	0.74	-0.72	0.68	-0.75
19pre	1.75	-1.33	0.26	1.12	0.45	1.10	0.38
34pre	1.75	-1.33	0.26	0.88	-0.24	0.89	-0.15
44pre	1.75	-1.33	0.26	0.72	-0.80	0.89	-0.14
82pre	1.75	-1.33	0.26	1.38	1.11	1.22	0.64
101pre	1.70	-1.40	0.26	0.64	-1.06	0.58	-1.03
115pre	1.70	-1.40	0.26	1.38	1.06	1.31	0.80
52pre	1.65	-1.47	0.27	1.60	1.49	1.27	0.70
129pre	1.65	-1.47	0.27	0.99	0.10	0.91	-0.06
136pre	1.60	-1.54	0.28	1.24	0.71	0.94	0.02
104pre	1.55	-1.62	0.29	1.04	0.24	1.16	0.47
13pre	1.35	-2.03	0.36	0.88	-0.09	1.06	0.30
36pre	1.25	-2.33	0.42	1.34	0.71	0.57	-0.51
107pre	1.15	-2.78	0.54	1.45	0.78	1.62	0.90

Mean	3.57	0.68	0.29	0.99	-0.13	1.01	-0.08
SD	0.95	1.27	0.11	0.47	1.38	0.53	1.36

Note. The items are presented in Measure order, from high to low. Pre refers to pretest and post refers to posttest.

APPENDIX H

Calibration of the Raters for the Performance Assessment

Rater Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
2	3.56	0.01	0.02	0.88	-4.33	0.96	-1.06
1	3.57	-0.01	0.02	1.09	2.97	1.05	1.42
Mean	3.57	0.00	0.02	0.99	-0.68	1.01	0.18
SD	0.00	0.01	0.00	0.15	5.16	0.06	1.75

Note. The items are presented in Measure order, from high to low.

APPENDIX I

Calibration of the Items for the Dictation Assessment

Item Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
1	3.95	0.92	0.08	1.20	1.86	1.25	2.09
6	4.24	0.45	0.08	0.95	-0.48	0.93	-0.52
9	4.29	0.36	0.08	1.34	2.89	1.38	2.49
8	4.32	0.32	0.09	0.99	-0.02	0.96	-0.23
7	4.40	0.15	0.09	0.94	-0.48	0.98	-0.08
3	4.50	-0.05	0.09	0.96	-0.28	0.87	-0.74
2	4.54	-0.14	0.10	0.80	-1.69	0.91	-0.45
5	4.64	-0.39	0.11	0.80	-1.50	0.60	-2.21
10	4.71	-0.60	0.11	1.31	1.89	1.08	0.42
4	4.82	-1.03	0.14	1.42	2.03	0.63	-1.42
Mean	4.44	0.00	0.10	1.07	0.42	0.96	-0.07
SD	0.26	0.57	0.02	0.23	1.61	0.24	1.44

Note. The items are presented in Measure order, from high to low.

APPENDIX J

Calibration of the Students for the Dictation Assessment

Student Number	Observed Average	Measure	Standard Error	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
6pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
17pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
20pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
22pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
25pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
28pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
29pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
30pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
33pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
37pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
39pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
46pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
70pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
95pre	5.00	4.19	1.77	1.00	0.00	1.00	0.00
2post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
3post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
6post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
8post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
14post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
16post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
17post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
18post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
20post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
22post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
23post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
24post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
25post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
27post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
28post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
29post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
30post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
31post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
33post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
36post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
37post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
38post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
39post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
40post	5.00	4.19	1.77	1.00	0.00	1.00	0.00

41post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
42post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
44post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
45post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
46post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
50post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
51post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
54post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
57post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
61post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
62post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
63post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
65post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
66post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
70post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
71post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
73post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
75post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
76post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
78post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
79post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
81post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
83post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
85post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
87post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
89post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
93post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
95post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
97post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
98post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
104post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
108post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
109post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
112post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
117post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
120post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
121post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
123post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
124post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
125post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
127post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
129post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
130post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
131post	5.00	4.19	1.77	1.00	0.00	1.00	0.00

132post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
135post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
139post	5.00	4.19	1.77	1.00	0.00	1.00	0.00
23pre	4.90	3.09	0.94	0.86	0.31	1.06	0.52
27pre	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
40pre	4.90	3.09	0.94	0.87	0.32	1.17	0.59
42pre	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
117pre	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
127pre	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
35post	4.90	3.09	0.94	0.78	0.23	0.61	0.16
47post	4.90	3.09	0.94	0.78	0.23	0.61	0.16
59post	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
74post	4.90	3.09	0.94	0.82	0.28	0.81	0.34
101post	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
136post	4.90	3.09	0.94	0.57	0.03	0.27	-0.26
3pre	4.80	2.50	0.65	1.09	0.41	0.51	-0.19
14pre	4.80	2.50	0.65	1.46	0.74	1.02	0.38
31pre	4.80	2.50	0.65	1.51	0.78	1.16	0.50
36pre	4.80	2.50	0.65	1.09	0.41	0.51	-0.19
63pre	4.80	2.50	0.65	0.42	-0.50	0.30	-0.56
85pre	4.80	2.50	0.65	1.60	0.86	1.56	0.80
15post	4.80	2.50	0.65	0.53	-0.31	0.56	-0.13
77post	4.80	2.50	0.65	0.50	-0.37	0.43	-0.32
82post	4.80	2.50	0.65	0.59	-0.21	1.08	0.43
107post	4.80	2.50	0.65	0.54	-0.29	0.62	-0.05
110post	4.80	2.50	0.65	0.50	-0.37	0.43	-0.32
111post	4.80	2.50	0.65	1.46	0.74	1.02	0.38
116post	4.80	2.50	0.65	1.53	0.80	1.24	0.56
122post	4.80	2.50	0.65	1.09	0.41	0.51	-0.19
61pre	4.70	2.15	0.53	1.19	0.49	1.08	0.38
79pre	4.70	2.15	0.53	0.80	-0.04	0.58	-0.26
120pre	4.70	2.15	0.53	0.72	-0.18	0.43	-0.51
121pre	4.70	2.15	0.53	1.50	0.83	2.97	1.76
7post	4.70	2.15	0.53	1.65	0.98	0.80	0.07
10post	4.70	2.15	0.53	1.65	0.98	0.80	0.07
34post	4.70	2.15	0.53	0.75	-0.13	0.75	-0.01
43post	4.70	2.15	0.53	1.13	0.42	0.86	0.14
58post	4.70	2.15	0.53	2.55	1.72	3.37	1.96
84post	4.70	2.15	0.53	1.10	0.37	0.82	0.09
94post	4.70	2.15	0.53	0.94	0.17	0.78	0.04
100post	4.70	2.15	0.53	1.12	0.40	0.87	0.15
128post	4.70	2.15	0.53	0.72	-0.18	0.43	-0.51
16pre	4.60	1.91	0.47	0.68	-0.36	0.59	-0.35
18pre	4.60	1.91	0.47	1.02	0.25	0.86	0.08

41pre	4.60	1.91	0.47	3.05	2.33	2.30	1.49
66pre	4.60	1.91	0.47	0.76	-0.20	0.74	-0.11
69pre	4.60	1.91	0.47	0.74	-0.24	0.64	-0.26
72pre	4.60	1.91	0.47	0.74	-0.24	0.62	-0.30
87pre	4.60	1.91	0.47	0.74	-0.24	0.64	-0.26
108pre	4.60	1.91	0.47	0.90	0.05	1.11	0.40
116pre	4.60	1.91	0.47	1.29	0.63	0.90	0.13
132pre	4.60	1.91	0.47	1.69	1.11	1.94	1.20
69post	4.60	1.91	0.47	0.74	-0.24	0.62	-0.30
86post	4.60	1.91	0.47	1.55	0.96	1.23	0.53
103post	4.60	1.91	0.47	1.02	0.25	0.86	0.08
114post	4.60	1.91	0.47	1.36	0.73	1.11	0.39
118post	4.60	1.91	0.47	0.92	0.09	0.68	-0.20
2pre	4.50	1.71	0.42	1.30	0.67	0.95	0.16
8pre	4.50	1.71	0.42	1.98	1.55	1.99	1.34
24pre	4.50	1.71	0.42	0.79	-0.22	0.65	-0.34
35pre	4.50	1.71	0.42	1.23	0.56	1.02	0.26
51pre	4.50	1.71	0.42	2.08	1.65	2.46	1.73
81pre	4.50	1.71	0.42	1.22	0.55	0.84	-0.02
83pre	4.50	1.71	0.42	0.90	0.01	0.61	-0.42
98pre	4.50	1.71	0.42	1.31	0.69	0.96	0.18
104pre	4.50	1.71	0.42	0.67	-0.47	0.52	-0.60
109pre	4.50	1.71	0.42	0.61	-0.62	0.74	-0.17
118pre	4.50	1.71	0.42	0.78	-0.23	0.62	-0.40
135pre	4.50	1.71	0.42	0.94	0.09	0.65	-0.35
92post	4.50	1.71	0.42	1.25	0.60	1.03	0.28
106post	4.50	1.71	0.42	2.45	2.04	1.85	1.21
19pre	4.40	1.55	0.39	0.59	-0.78	0.58	-0.57
38pre	4.40	1.55	0.39	0.35	-1.53	0.32	-1.28
78pre	4.40	1.55	0.39	0.97	0.12	0.72	-0.29
89pre	4.40	1.55	0.39	1.01	0.18	1.26	0.59
97pre	4.40	1.55	0.39	1.59	1.14	1.03	0.27
55post	4.40	1.55	0.39	1.98	1.66	1.56	0.97
134post	4.40	1.55	0.39	0.95	0.07	0.69	-0.33
7pre	4.30	1.40	0.37	0.97	0.10	0.89	-0.01
74pre	4.30	1.40	0.37	0.90	-0.06	1.25	0.59
122pre	4.30	1.40	0.37	1.46	1.01	1.22	0.55
123pre	4.30	1.40	0.37	0.70	-0.56	0.55	-0.73
11pre	4.20	1.27	0.35	0.55	-1.04	0.47	-1.07
13pre	4.20	1.27	0.35	1.13	0.43	0.89	-0.04
15pre	4.20	1.27	0.35	1.14	0.44	0.95	0.09
45pre	4.20	1.27	0.35	0.73	-0.53	0.61	-0.68
50pre	4.20	1.27	0.35	0.30	-2.06	0.30	-1.66
57pre	4.20	1.27	0.35	0.36	-1.78	0.35	-1.45

76pre	4.20	1.27	0.35	1.67	1.39	1.29	0.67
129pre	4.20	1.27	0.35	0.57	-0.99	0.52	-0.90
131pre	4.20	1.27	0.35	0.73	-0.53	0.61	-0.68
136pre	4.20	1.27	0.35	0.86	-0.18	0.73	-0.37
5post	4.20	1.27	0.35	0.63	-0.82	0.57	-0.77
11post	4.20	1.27	0.35	1.00	0.16	0.91	0.01
13post	4.20	1.27	0.35	0.54	-1.10	0.55	-0.82
60post	4.20	1.27	0.35	1.21	0.58	1.26	0.62
67post	4.20	1.27	0.35	0.68	-0.66	0.59	-0.73
72post	4.20	1.27	0.35	0.60	-0.89	0.71	-0.42
10pre	4.10	1.15	0.34	1.34	0.86	1.08	0.32
34pre	4.10	1.15	0.34	0.54	-1.18	0.50	-1.05
43pre	4.10	1.15	0.34	0.33	-2.01	0.31	-1.76
62pre	4.10	1.15	0.34	1.05	0.27	1.18	0.51
71pre	4.10	1.15	0.34	0.78	-0.41	0.72	-0.44
92pre	4.10	1.15	0.34	0.33	-2.04	0.31	-1.76
93pre	4.10	1.15	0.34	0.39	-1.77	0.38	-1.48
128pre	4.10	1.15	0.34	1.21	0.61	1.00	0.17
52post	4.10	1.15	0.34	1.24	0.67	1.31	0.73
56post	4.10	1.15	0.34	0.72	-0.59	0.78	-0.31
99post	4.10	1.15	0.34	1.54	1.23	1.44	0.94
103pre	4.00	1.04	0.33	0.73	-0.59	0.65	-0.68
110pre	4.00	1.04	0.33	0.52	-1.28	0.47	-1.24
130pre	4.00	1.04	0.33	0.36	-1.95	0.34	-1.76
1post	4.00	1.04	0.33	1.19	0.58	1.00	0.16
49post	4.00	1.04	0.33	1.37	0.94	1.49	1.06
5pre	3.90	0.94	0.32	0.66	-0.83	0.62	-0.84
9pre	3.90	0.94	0.32	0.47	-1.54	0.46	-1.38
47pre	3.90	0.94	0.32	1.30	0.83	1.27	0.70
55pre	3.90	0.94	0.32	1.18	0.56	1.12	0.41
65pre	3.90	0.94	0.32	1.37	0.97	1.33	0.81
75pre	3.90	0.94	0.32	2.03	2.13	2.21	2.16
94pre	3.90	0.94	0.32	0.61	-1.02	0.72	-0.54
26post	3.90	0.94	0.32	0.21	-2.90	0.21	-2.52
64post	3.90	0.94	0.32	0.38	-1.95	0.35	-1.79
91post	3.90	0.94	0.32	0.94	-0.01	0.86	-0.17
96post	3.90	0.94	0.32	0.31	-2.29	0.33	-1.92
73pre	3.80	0.84	0.31	1.34	0.92	1.55	1.24
86pre	3.80	0.84	0.31	0.49	-1.47	0.46	-1.45
111pre	3.80	0.84	0.31	1.60	1.43	1.59	1.30
112pre	3.80	0.84	0.31	2.11	2.29	2.59	2.74
114pre	3.80	0.84	0.31	0.58	-1.16	0.55	-1.10
19post	3.80	0.84	0.31	0.50	-1.44	0.49	-1.32
115post	3.80	0.84	0.31	2.27	2.53	1.97	1.91

126post	3.80	0.84	0.31	0.44	-1.69	0.45	-1.50
1pre	3.70	0.74	0.31	0.70	-0.75	0.66	-0.77
54pre	3.70	0.74	0.31	1.56	1.37	2.26	2.38
77pre	3.70	0.74	0.31	0.53	-1.37	0.60	-1.00
90pre	3.70	0.74	0.31	1.26	0.75	1.12	0.42
115pre	3.70	0.74	0.31	1.32	0.88	1.18	0.54
67pre	3.60	0.64	0.31	0.28	-2.61	0.28	-2.39
88post	3.60	0.64	0.31	0.45	-1.70	0.43	-1.69
90post	3.60	0.64	0.31	1.14	0.48	1.04	0.22
26pre	3.50	0.55	0.30	1.40	1.06	1.36	0.94
107pre	3.50	0.55	0.30	0.38	-2.02	0.39	-1.91
124pre	3.50	0.55	0.30	2.63	3.12	2.62	2.97
52pre	3.40	0.46	0.30	1.06	0.29	1.08	0.33
56pre	3.40	0.46	0.30	1.24	0.70	1.19	0.59
60pre	3.40	0.46	0.30	0.79	-0.48	0.74	-0.60
126pre	3.40	0.46	0.30	1.62	1.49	1.64	1.50
139pre	3.40	0.46	0.30	0.43	-1.79	0.57	-1.15
9post	3.40	0.46	0.30	1.50	1.27	1.66	1.53
64pre	3.20	0.28	0.30	0.88	-0.20	0.94	-0.03
91pre	3.20	0.28	0.30	1.99	2.13	2.09	2.26
100pre	3.20	0.28	0.30	0.92	-0.08	0.90	-0.12
82pre	3.10	0.19	0.30	0.56	-1.21	0.60	-1.04
96pre	3.10	0.19	0.30	1.16	0.51	1.15	0.50
99pre	3.10	0.19	0.30	1.06	0.27	1.03	0.21
125pre	3.10	0.19	0.30	2.59	3.01	2.97	3.44
134pre	3.10	0.19	0.30	1.68	1.58	1.68	1.57
49pre	2.90	0.01	0.30	1.61	1.42	1.65	1.49
88pre	2.90	0.01	0.30	1.48	1.18	1.44	1.08
106pre	2.90	0.01	0.30	0.70	-0.71	0.66	-0.82
12pre	2.80	-0.09	0.31	0.47	-1.53	0.45	-1.56
44pre	2.80	-0.09	0.31	1.47	1.16	1.50	1.20
12post	2.80	-0.09	0.31	1.70	1.57	1.78	1.69
59pre	2.70	-0.18	0.31	1.16	0.50	1.10	0.38
101pre	2.70	-0.18	0.31	1.52	1.24	1.73	1.58
58pre	2.50	-0.38	0.32	1.47	1.11	1.64	1.40
84pre	2.50	-0.38	0.32	1.27	0.74	1.30	0.77
Mean	4.44	2.36	0.89	1.02	0.07	0.97	0.03
SD	0.63	1.48	0.65	0.43	0.89	0.48	0.83

Note. The items are presented in Measure order, from high to low. Pre refers to pretest and post refers to posttest.