

The Role of Solfège Hand Signals for Developing Singers Pitch Matching Skills: A Document Analysis Approach

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Contents:

Page:

<u>Project proposal</u>	4
• Context	4
• The justification	4-5
• The intended impacts	5
• The outlined intentions	5
Methodology	5-6
Methods	7
Reflective practice	7-8
Preliminary literature review	8
Coding	8
• Proposed project timeline	8-10
• Insider research	11
• The ethics	11
• The personal learning outcomes	11-12
<u>Project Report</u>	12
• Introduction	12
Context	12
Justification	12-13
Intended impacts	13
Expected learning outcomes	13-14
• Methodology	14-15
• Insider Researcher	15-16

• Ethical Considerations	16
• Methods	16
Preliminary literature review	16-17
Pitch control in singing	17
Solfège hand signals	17-20
Coding	20-21
• Reflective practice	21-22
• Overview of research	22
Data collection	22
Online search strategy	22-23
Inclusion and exclusion criteria	23-25
Screening methods	25
Screening results	25
Study characteristics	25-28
Document and study details	29-31
Consideration to grey literature	32
Grey literature documents	32-33
Withdrawn documents	33
Coding	34-35
Synthesis results	35-36
• Findings	36-37
Data presentation	37
Pedagogy articles	37-39
a) Findings for the pedagogy documents involving pitch	39-41
b) Findings for the pedagogy documents involving solfège systems	41-42
c) Findings for the pedagogy documents involving solfège hand signals and pitch combined	42-44
d) The effectiveness of Curwen hand signals for pitch	

acquisition	44-46
e) The effectiveness of Kodály hand signals for pitch acquisition	46-47
f) Findings for the pedagogy documents involving movable and fixed do systems	48-49
g) Findings for the pedagogy documents involving interval training	49-50
Physiology articles	51-52
Psychology articles	52-56
Characteristics articles	56-57
Findings from the grey literature	57-58
• Limitations	58-60
• Discussion	60-62
• Conclusion	62
• References	63-91
• Appendices	92
Appendix 1. Reflective Journal	92-97
Appendix 2. Colour coded document	98-216
Appendix 3. Grey literature guidelines	217-218
Appendix 4. Grey literature colour coded document	219-222
Appendix 5. Open coding results / initial codes	223-228
Appendix 6. Ethics form	229-245
Appendix 7. Permission letter	245

Project proposal

The context

I am an established vocalist with aspirations to become a vocal coach with my own singing studio to train both male and female adult singers. Pitch control is a fundamental and foundational skill required for accurate and optimal singing (Wang, 2022). My aim is to ascertain whether training future students using solfège hand signals will assist them in pitch matching. Solfège hand signals are gestures or symbols that correspond to different notes of the music scale (Bowyer, 2015; Ferreira and Haworth, 2021). To teach successfully in the future, I need to enhance my current knowledge of solfège hand signals and syllables and fully understand how to teach pitch. Furthermore, my intentions are to explore other studies which test the use of solfège hand signals to see if these techniques could be useful for my practice.

The justification

Many scholars advocate for using solfège hand signs to develop ear training, stating that this technique can positively improve pitch, rhythm and memory (Luen et al., 2017; Luen et al., 2019). However, Cox (2016) argued the case, reporting little or no change to the skills after investigations were completed. Therefore, this study will provide further exploration to better understand whether using solfège hand signs could be an efficacious method for developing pitch ability. Furthermore, Ye and Chen (2024) discussed the benefits of using established teaching methods as a new teacher and stated they may be helpful because they are supported by the research.

Training and learning pitch matching skills is fundamental for singers and it is something that many students struggle to comprehend (Estis, Dean-Claytor, Moore and Rowell, 2010). Understanding solfège hand signals might help students to identify pitching issues and guide them in correcting them (Steenstrup et al., 2021).

The justification for conducting a document analysis (DA) is that this style of study facilitates a review of the research to establish if the teaching methods would be effective for my practice as well as highlighting gaps in the research. A DA also provides a systematic approach to the investigation rather than experiential (Ayranci and Baskan, 2021). To further justify the DA choice, I have limited student access due to not having an established practice, which produces logistical challenges when recruiting participants and collecting data.

The intended impact

Upon completion of this study, I intend to have built a strong foundation for future teachings by gaining a better understanding of what solfège hand signals are and if and how they can be used conjointly when teaching pitch. Also, I aim to source some teaching strategies to incorporate into lessons to positively impact my students and enhance my teaching skills. Furthermore, as Lumbantorun (2018) defines solfège as a niche subject, expanding my knowledge may help to increase the number of students who enroll within my academy due to its specialism.

Additionally, some wider implications of this research may include assisting other singing teachers to enhance their teaching skills by providing information of solfège hand signals and highlighting the benefits and drawbacks of incorporating them into pitch training, which they may be able employ within their own practices.

The outlined intention

Methodology

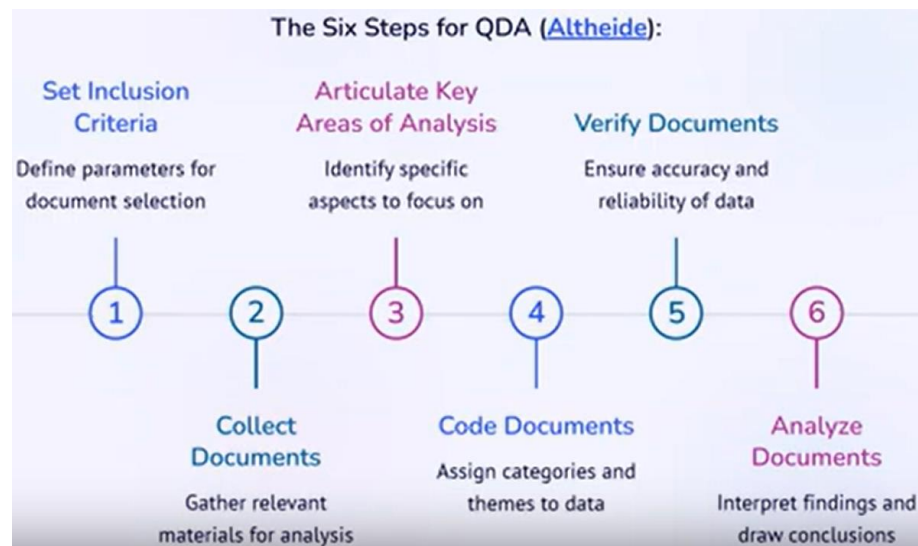
The methodological approach for my study will employ the interpretivist paradigm. Alharahsheh and Pius (2019) explain that interpretivism is a sociological method which aims to analyse the societal beliefs and norms of an event or occurrence, and it focuses on understanding meanings and educational practices rather than measuring the cause and effect. Therefore, this study aims to explore why solfège hand signals work within a teaching context rather than in a quantifiable way. However, it is important to acknowledge the issues from engaging in qualitative analysis such as the lack of measurable outcomes and susceptibility to biases (Almeida, Faria dn Queiros, 2017). This will be mitigated by conducting rigorous analysis which will help to avoid any personal bias, and the use of multiple sources will provide a stabilised view.

Document analysis is a process of evaluating literature to establish and extract themes and patterns which enables the researcher to understand the text comprehensively (Kayesa and Shung-King, 2020). Morgan (2022) stated that this method suits interpretivists as it is also qualitative and focuses on sociological documents due to their content being rigorous which offers insights to the perspectives of other authors and researchers. Document analysis was deemed a suitable method to answer my research question because I will not be involving human participants and, as Wach (2013) explains, the researcher can access lots of data which can be easily organised and critically analysed.

The inclusion criteria for the DA will be studies that focus on solfège hand signals and pitch control for adult singers which have been produced within the last ten years. This timeframe has been selected through acknowledgement that research has evolved, and so older studies may not provide valid and relevant results for this present-day study (Markulin et al., 2022). The aim is to select at least fifteen documents; however, this figure is subject to change depending on the number of studies available. Despite the challenges I may face due to lots of research involving child participants, I will only seek studies involving the age of 18 and above as my future intentions are to work with adults only.

To support the DA, a thematic analysis 6-step framework created by Altheide (1996) will be used to guide the process (see figure 1, pp. 6). This was selected due to its contextual consideration to how documents are produced and the way they shape social practices. Thematic analysis is an adaptable framework which allows the researcher to find and identify patterns within the data and better understand the beliefs of other researchers (Rosairo, 2023). Therefore, due to their similarities, this method will work collaboratively with the document analysis and interpretivist approach.

Figure 1. Altheide's six step analysis framework (Altheide, 1996).



Methods

Reflective practice

Reflection in research is paramount for personal growth, further knowledge acquisition and better understanding of not only the study topic but the learning process (Sani, Kurniawati

and Nurwanti, 2017). For this study, the experience, reflection and action model (ERA), created by Jasper (2013) is a suitable option as it is simple yet a precise way to reflect (see figure 2, pp. 7) Other frameworks were disregarded such as Kolb (1984) due to being suited for experiential learning and so not as compatible for a DA and Gibbs's (1988) model was rejected because it does not focus as much on theoretical and pedagogical reflections which is needed when exploring existing literature.

Figure 2. Jasper's ERA model (Reflective writing tips, 2024)



Furthermore, to help the reflective practice, journalling will be adopted to enable me to record my learning experience. This will promote understanding of the impacts of the research, comprehend my newfound knowledge and highlight any changes to be made in future studies (Tay and Jain, 2019). Farrah (2012) states, it does this by recording ideas and analyses data which helps to develop concepts. A reflective journal also aligns with the qualitative nature of this research, Altheide's (1996) analysis framework in relation to the reflexivity and Jaspers (2013) reflective model, as journalling involves actions and experiences which leads to reflection (Sudirman et al., 2021).

Preliminary literature review

A preliminary literature review helps to familiarise yourself with a specific topic, narrow the focus and define the criteria of the research (Lwani and Ilegbedion, 2024). Furthermore, Ivancic, Vuksic and Vugec (2018) explain that conducting a preparatory scope helps to gain a comprehensive understanding of the existing knowledge, identifying any gaps in the

research and developing research questions and methods. The aim of this research is to locate relevant and reliable primary studies such as questionnaires, interviews, focus groups and observations but depending on the volume of studies available. Ajayi (2023) describes primary research as the analysis of original data which has been acquired firsthand. I will also consider the use of secondary data which is information that has not been collected by the primary researcher including published materials and online sources (Pederson, 2020).

Coding

To assist my study, a thematic coding process developed by Strauss and Corbin (1990) will be used due to its qualitative approach which involves open, axial and selective coding. Open coding is the first stage which identifies initial themes within the data, axial follows which is where connections between the initial themes are found and deeper understanding of the data develops, and finally selective coding finishes the process establishing the core theme (Mohajan and Mohajan, 2022). Kampira (2021) explains, this method allows the researcher to discover themes within the text and sentences, enabling them to subcategorise the findings. Ba (2021) stated that the use of open, axial and selective coding is best suited to a document analysis due to its structured approach which helps to identify themes within the data. However, this process could present challenges such as being time consuming and complex (Mcleod, 2024). This could be mitigated by using clear research questions and reflection to identify any issues or biases (Holton, 2010).

Proposed project timeline

Scheduling time during research is paramount to assist the flow and enable the prioritising of various sections required for the study (Chaudhari, 2022). Ramachandran (2019), Hirakata et al (2022) and Perry et al (2024) advocate for the use of Gantt charts due to their visual presentation and assistance with planning, organising and tracking of a task. However, this method can be challenging for complex large projects with many dependencies (Ballesteros-Perez, Larsen and Gonzalez-Cruz, 2018). Considering my study is small with one clear subject area, it will employ a Gantt chart (Table 1).

Table 1. Gantt chart to show the proposed timeline for the project

	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB

Watch the tutorial and read handbook																	
Find a study topic																	
Agree topic with the tutor																	
Select methodological approach																	
Complete project proposal																	
Literature review																	
Select documents for inclusion																	
Analyse and code documents																	
Write up my findings																	
Write my critical reflection																	
Write my conclusion																	

Proofread																
Draft submission to my Tutor																
Presentation tutorial																
Re-writes																
Prepare presentation slides																
Jump start presentations																
Final Submission																
Rehearse Presentations																
Present presentation																

Insider researcher

There are many advantages to being an insider researcher such as, developing a greater understanding of the subject, influences the process of the research instead of the outcomes and benefits from pre-established relationships between researcher and participants (Fleming, 2018). However, there is a potential for bias and assumed understanding of the research topic (Saidin, 2017). Linnenberg (2019) explained that coding can mitigate these issues as it provides a structure, raises awareness of bias issues and helps to maintain objectivity. Furthermore, journalling can also assist plagiarism issues by integrating the data and helps to raise self-awareness. (Crawford, Sellman and Joseph, 2021).

The ethics

Ethics are a set of principles which should be implemented to carry out a study with integrity, respect and safety and a researcher has a duty to work ethically (Resnik, 2013; Bartneck et al., 2021). Maurya and Margam (2023) highlight plagiarism issues within research. To mitigate this, every time another author's work is used, accurate citations will be provided to give attribution to the original creator. Mirza, Bellalem and Mirza (2023) discuss bias issues in their study, and state research should be approached impartially to allow the opportunity for new knowledge to be found. To further mitigate bias, Zagarelou-Mackieson, Shlonsky and Connolly, (2018) explains that the researcher should choose an array of varied documents, employ a coding system, be transparent and critically analyse the findings. Data integrity should also be considered to assure the information used is accurate and valid, documents should be checked for peer review status and data should be kept securely and confidentially then disposed of appropriately upon completion (Condon, Simpson and Emanuel, 2022). Furthermore, to work ethically, journalling should be honest, respectful, accurate and transparent with avoidance of any conflicts of interest (Young and Joffe, 2004).

The personal learning outcomes

My personal aims for this study are to:

- Further develop my understanding solfège hand signals and syllables and pitch control skills
- Understand how a singing teacher can incorporate hand signals into lessons when ear training singers
- Build my knowledge and theoretical understanding of teaching methods to be able to provide specialist solfège teaching during
- Build and improve on my pre-existing academic skills including document analysis and reflective writing.

The Project Report

The Role of Solfège Hand Signals for Developing Singers Pitch Matching Skills: A Document Analysis Approach

Introduction

Context

I am a vocalist of twenty-five years singing predominantly contemporary commercial pop music (CCM) but my aspiration is to become a singing teacher, teaching the same style music to adult singers within a private studio. During a previous master's degree module in voice pedagogy relating to hand gestures when singing, I attained some basic knowledge of solfège hand signs, and I would like to establish if I could use these as part of my practice. Solfège is a method that assigns a musical note with a syllable and hand signal to assist the singer's comprehension of note identification when singing (Schramm, Souza Nunes and Jung, 2016).

Justification

Considering my previous research was about hand gestures and their impacts on singing it has led me to today's study of solfège hand signals. My future intentions are to teach students using the solfège method, and so I aim to explore if and how solfège hand signals can benefit singers when teaching pitch matching skills. To achieve this, I also need to establish if the solfège method is an accessible, reliable method to justify teaching it. Pitch is a fundamentality to singing and as many scholars state, without pitch there is no singing voice quality (Schmidt, 2025). For that reason, I chose to focus my study on pitch as well as solfège hand signals.

A further justification is the potential to increase student numbers by offering the solfège hand signaling as a teaching strategy. Zydney et al (2012) explain that solfège is a niche area of learning which other teachers and practices may not provide. Niu and Wang (2016) agreed in their study that providing a unique selling point to your business assists in boosting clientele as well as the opportunity to earn higher profit by offering something other competitors cannot. Furthermore, if one chooses to teach solfège within a school setting or educational setting, qualifications in teaching are usually required in the United Kingdom (Faultey, 2020). Yang (2023) states however, that to teach solfège privately, no qualifications are required but a high level of knowledge and expertise would be advantageous to teach effectively and safely. Therefore, this justifies the need to expand my knowledge of the solfège method.

Intended impact

This study will investigate whether solfège hand signals will be an accessible technique for me to use in my studio when teaching pitch. Lumbantoruan (2018) highlights the benefits to using solfège hand signaling, stating that it enhances musicality, builds confidence and communicatively provides a common language between teachers and students and so this technique could positively impact students singing ability as well as develop a teacher's teaching skills.

Gaining new knowledge of this topic will improve my confidence and empower me when teaching as well as benefit me academically by developing my research experience and writing skills. Furthermore, as Hiebert et al. (2022) expressed in their study, research helps other researchers, so a wider impact is for fellow voice pedagogues who can review my research to find potential use within their own practices.

Expected learning outcomes

I endeavor this study will enable me to achieve the following outcomes:

- Enhancing my academic writing and reflective skills by critically investigating the literature
- Develop knowledge for undertaking a document analysis successfully
- Develop knowledge to execute solfège hand signals successfully
- Develop knowledge of pitch training skills
- Broadening my current knowledge of how solfège hand signals can impact or affect pitch control
- Future implications might include developing teaching strategies to incorporate solfège hand signals into vocal lessons
- Highlight any issues when teaching solfège hand signals during lessons and how to mitigate them

Methodology

This study is a document analysis (DA) and is best suited for this research as it allows me to identify and then extract the data, analyse it and distill the findings to answer my research question (Chandra, 2021). Kutsyuruba's (2023) explains that a DA reviews and analyses a vast range of documents to establish meaning, provide alternative insights and improve understanding in attempt to answer a research question. Lukianova (2015) also defines a DA as a meaning-making process and so full extraction of the data, followed by a detailed analysis needs to be employed to provide adequate information and full perspective so a

research question can be answered. Furthermore, Okorie et al (2024) explained that a document analysis can mitigate some ethical issues in comparison to other qualitative methods. They explain this is due to its usual practice of analysing pre-existing studies, which eliminates the ethical challenges from the interaction between researcher and participants. A DA further reduces ethical concerns such as privacy and consent issues as the data is readily available and provides anonymity to any participants involved in the preexisting studies (Morgan, 2022). Considering my study does not involve human participants, a DA is suitable as the data will be found within research previously conducted and not performed experientially myself.

My epistemological approach for this study was interpretivism. Alharahsheh and Pius (2019) explain that interpretivists believe that reality is based on individual experiences and aims to understand a phenomenon from the individuals involved. The interpretivism paradigm is best suited to my study due to the data being produced via research which investigates individual experiences of solfège and pitch ability for singing students. Furthermore, my research adopted qualitative methods and not quantitative due to the study investigating social phenomena and personal experiences instead of data, which is measured, numerical and quantifiable (Ugwu and Eze, 2023). The qualitative methods of this study included the document analysis which focused on people's experiences and perceptions and the coding process produced labels and themes enabling me to identify interconnections within the data.

Thematic analysis will be adopted for this study as it aligns with qualitative research which involves the identification and organising of themes within the data. This technique was selected due to its similarities to the intentions of a document analysis which means they will work together and complement each other as well as aligning with the interpretivism paradigm chosen for this research.

Altheide (1996) created the following six step thematic analysis framework to aid the document analysis process:

1. Define parameters for document selection
2. Collect documents
3. Articulate key areas of analysis
4. Code documents
5. Verify documents
6. Analyse documents

This 6-step tool provides a flexible and inductive approach to a study and despite being 28 years old, it is still a favourable framework for current research (Altheide and Johnson, 2011). I chose to employ this tool for my study to offer guidance to my document analysis and I favoured it due to its self-explanatory, simple method.

Insider Researcher

Conducting research as an insider creates values of shared experiences between other researchers and the insider researcher themselves and it helps to develop a deeper understanding of a certain topic and guides the research process instead of influencing the results (Fleming, 2018; Wilkinson and Kitzinger, 2013). Furthermore, as Berthet et al. (2023) explains, employing a data coding system or following a specific research framework as an insider researcher provides organisation, structure and enhances analysis validity. However, it is important to acknowledge that being an insider researcher can pose bias issues and a loss of objectivity (Greene, 2014). Berkovic et al. (2020) explained a successful way to mitigate is to ensure the research is carried out with an open mind despite any prior knowledge.

Ethical Consideration's

Ethics in research is paramount to ensuring the safety and treatment of all involved is fair, respectful and free from risk (Bartneck et al., 2021). Even though this study did not involve human participants, there are still various ethics to consider including plagiarism and bias situations (Soundararajan et al., 2022). For mitigation, I clearly referenced any literature used by fellow researchers and scholars to reduce the risk of plagiarism and ensured I conducted the research with an open mind allowing new information to be absorbed to avoid the risk of bias. It is also important to acknowledge that I do not currently possess any specific solfège training and so it would be unethical to advise or engage in teaching solfège until personal training has been achieved.

Further ethical consideration will be given to copyright laws by ensuring the use is minimal and transformative and requesting permission from copyright holders if a substantial amount of their work is needed for the research (Emruli, Nuhuiu and Kadriu, 2016). Ethical challenges regarding cultural and social contexts can also be mitigated by conducting a meticulous literature review to gain understanding of cultural variations by using diverse research teams and always considering the possible data biases (Gordon et al., 2011)

Methods

Preliminary Literature review

To gain a better perspective of the theoretical framework, a preliminary literature review was important. The document analysis process itself is the key component of a literature review but by initiating an initial scope, it can provide a foundational understanding of the subject area before analysis begins (Wills, 2022). Various sources were investigated as part of the preparatory review of literature, such as peer-reviewed journals, books, articles and conference papers with a view to discover information which is credible, relevant and reliable. Chigbu, Atiki and Plessis (2023) state that to achieve this, factors should be considered such as why the study was undertaken, who conducted the research, how the data was collected, as well as investigating the sample sizes and whether the study utilises primary or secondary data.

Pitch control in singing

Pitch when singing can also be defined as singing in tune or intonation and relates to the ability to accurately match the notes required within the music (Pop and Filip, 2022). Pitch accuracy can be trained through extensive listening to the music and repetition until the pitch is precisely achieved (Mauch, Frieler and Dixon, 2014). However, Ziv and Radin (2022) highlights the different levels of pitch training including relative pitch (the identification of notes in relation to other notes) and absolute pitch (identification of notes without reference to other notes) and states that adults and children learn pitch differently and so should be taught individually. Bradley and Hell (2016) conducted a study which highlighted the benefits to pitching through interval training. This technique trains singers to recognise different notes based on other presented notes and enables the performer to establish connections within the notes (Bissmeyer et al., 2022). Interval training can be both beginner friendly or for a more advanced student method as it can be tailored to the individual (Wong, Chen and Lim, 2020).

Solfège hand signals

Solfège hand signs are specific gestures assigned to different syllables of the music scale (Luen et al., 2019). This method enables the singer to identify the notes and pitch cognitively, promoting enhanced singing ability (Fournier, O'Neill and Moreno Sala, 2020). This skill is also known by alternative names such as solfa or solfeggio (Zhu, Kankanhalli and Gao, 2004; Baragwanath, 2020). They can be traced back to the 11th century where theorist Guido D'Arezzo attributed the method to simplify and accelerate the teaching of

The image shows a page from a historical manuscript, likely a lute tablature book. It features a large, stylized drawing of a right hand with fingers spread, positioned over a lute. The fingers are numbered 1 to 5. Each finger has a series of frets marked with black squares. Next to each finger, there is a list of musical notes (G, A, B, C, D, E, F) corresponding to the frets, often with a small number indicating the fret position. The notes are written in a medieval script. The background is aged parchment with some staining and wear.

Hand Diagram and Fret Markings:

- Thumb (Digitus Primus):** 1. Gama ut, 2. A-re, 3. B-mi.
- Index (Digitus Secundus):** 13. E-la mi, 14. F-fa ut, 15. G-sol re ut.
- Middle (Digitus Tertius):** 12. D-la sol re, 19. D-la sol, 16. A-la mi re.
- Ring (Digitus Quartus):** 11. E-sol fa mi, 18. E-sol fa, 17. B-fa-b-mi.
- Pinky (Digitus Quintus):** 10. B-fa-b-mi, 9. A-la mi re, 8. G-sol re ut, 7. F-fa ut, 6. E-la mi.

Text in the center:

Il modo di leggere. La mano
segnata per numero, comin-
cando dal numero .i. et segui-
tando. Le chiane rosse sono
quelle, che si segnano nel canto
fermo; il nome loro, et modo
di leggerle, e scritto di nanci
allestite chiani fa qz bella
mano. come uedete al tuo-
go suo. &c.

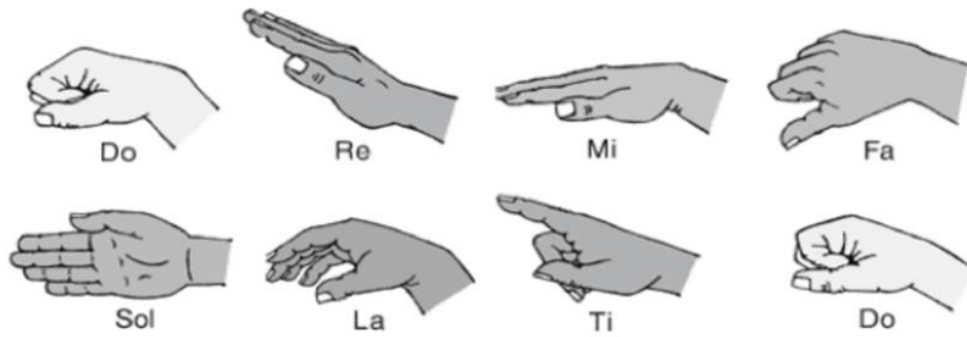
Text on the right side (continued from the previous page):

B. quadio acuto.
4. re mi fa
5. mi la sol fa
6. B-fa-b-mi
7. A-la mi re
8. G-sol re ut
9. A-la mi re
10. B-fa-b-mi
11. E-sol fa ut
12. D-la sol re
13. E-la mi
14. F-fa ut
15. G-sol re ut
16. A-la mi re
17. B-fa-b-mi
18. E-sol fa ut
19. D-la sol re

In the 19th century, the English music teacher Sarah Ann Glover invented the notation system named the Norwich Sol-fa which associated syllables to notes or pitch (Brukman et al., 2016). This system was useful as it assists in hearing the music internally and enables you to identify each note's function and relationship to one another. Further 19th century creations came from Giovanni Battista Martini, who was credited for the fixed do solfege system which means each solfege syllable (Do, Re, Mi, Fa, Sol, La, Si) is always associated with note 'C' regardless of the pitch (Utne-Reitan, 2022). In 1853, an English congregationalist minister named John Curwen went on to adapt the Norwich Sol-fa creating the Curwen hand signs (see figure 2) to encourage his choir to sing on pitch (Freya-Clark, 2017). Curwen introduced a new concept opposite to the fixed do option, called 'movable do' where the 'do' syllable always represents the starting and finishing note (known as the tonic note) of the key. This method made it easier for students to learn and sing in different keys (Oravec and Steffens, 2021).

A study by scholars Sager, Gurpinar and Zahal (2013) explain that fixed do is better suited to those attempting to achieve accurate pitch due to the notes always remaining the same. Kis Zuvela (2018) conducted a study into fixed do solfège by questioning 196 adult participants who all had ear training exam success. The research found that the members who had previous fixed do solfège training displayed better pitch accuracy and tonal context. However, the study did highlight many areas of ambiguity within the solfège systems and called for more research to determine the impact of incorporating solfège into vocal coaching. Gordon (2004) favours the use of the movable do method and documents in his study its benefits towards effective tonality, enhanced memorisation and replication skills. However, this study was focused upon child students and so raises the question of whether the advantages would be the same for adult singers. The literature review failed to provide substantial studies into the pros and cons of specifically incorporating the fixed and movable do solfège systems when pitch training adult students. This opens the door to further research which would be lucrative in the future.

Figure 2. Curwen hand signs (Fortuna, 2022)



Furthermore, Hungarian composer Zoltan Kodály invented a way of teaching music through singing, incorporating hand signs and syllables which assisted students to learn to read music internally (Harrison, 2021). This was named the Kodály method and took influence from both Glovers and Curwen's per-existing systems to produce his technique (Luen and Ayob, 2019). Despite the Kodály method focusing primarily on early years and children it can be used to develop music skills at any age (Hiney, 2022). Mabini (2024) stated that research had shown that the Kodály method was just as efficacious for adults as it was for children and affirmed that it aided pitch, rhythm and music literacy.

Coding Process

A coding framework chosen for this study was a six-step thematic method created by Braun and Clark (2006) (see table 1, pp. 21). This selection was made due to its explanatory, detailed and step by step system which I found appealing and achievable. However, the possible drawbacks to this framework include bias issues and it may encourage an organisational approach instead of analytical (Javardi and Zarea, 2016). Mitigation would include providing clear, articulated themes, with sufficient evidence sourced directly from the data whilst remaining amenable to developing concepts and re-reading documents numerous times to analyse the data adequately (Sulaiman et al. 2021). Another coding framework was considered by Saldaña (2016) which uses a first and second cycle coding system. However, this option did not seem as digestible or easy to use in comparison to the Braun and Clark's (2006) model and so was disregarded.

This coding method gave me an opportunity to code by hand. Hand coding is the manual technique of scrutinising and analysing qualitative data which enables the researcher to absorb the material comprehensively (Elliot, 2018). Isangula, Kelly and Wamoyi (2024) advocate that coding by hand provides the researcher with full control and the opportunity to customise the entire composition. However, Heracleous and Fernandes (2019) stress that

manual coding like this can pose challenges such as bias and risk of human errors as well as being a time-consuming process. To mitigate, researchers should keep detailed reports of the study journey, stay open minded, scrutinise and re-read the documents or literature several times and allocate sufficient time to complete the process (Galdas, 2017).

Table 1. Six step thematic coding framework (Braun and Clarke, 2006)

Step	Instruction
1	Familiarising data
2	Generating Codes
3	Searching themes
4	Reviewing themes
5	Defining and Naming Themes
6	Producing report

Reflective Practice

Reflective practice takes place during the research and at the end once the study is complete (Sudirman et al., 2021). Having the ability to reflect upon one's experience strengthens the research and allows a continuum of improvements and development (Indrasiene et al., 2023). For this study, a framework by Jasper (2013) was employed to assist the reflection process as it focuses on experience, reflection and action. The experience derived from conducting a document analysis for the first time which enhanced my research knowledge, and the reflection was produced via a reflective journal which was maintained throughout the study (see appendix 1).

There are two reflective actions, in action and on action (Ćirković-Miladinovićity and Dimitrijević, 2020). Gordon (2016) defines reflection in action as alterations that are made to the learning presently, whereas reflection on action refers to alterations that are made after the research is complete and for future learning. An on-action approach better suits this document analysis due to the data extraction process and the need to obtain the full scope

before determining the conclusion and Jaspers (2013) reflective model complies to this method.

As mentioned, a reflective journal was kept (see appendix 1) by taking notes on my desktop whilst I conducted the research. A reflective journal enables a researcher to look back upon the experience through reflection to better understand the impacts, advantages and drawbacks to the information found (Wallin and Adawi, 2017). Furthermore, the coding framework employed by Braun and Clarke (2006) as mentioned earlier, also emphasises the importance of reflexivity, which aligns with my reflective journal.

Overview of the research

Data collection

The decision was made to only investigate literature that has been published within the last ten years which makes the time criteria 2014 to 2024. This choice was made after acknowledging that research methods, testing and science have continued to evolve over the years (Rankin, 2020). This suggests that comparing older studies to more recent data could produce unreliable, conflicting results due to the research process being different (Lantelme, 2017). Additionally peer-reviewed sources were the focus of the search. Velterop and Tennant (2015) explain that peer-review ensures the research is accurate and valid. However, these sources still carry some risk such as bias and reviewer misconduct, the review process should be checked to mitigate these issues (Simundic, 2013). Despite grey literature (documents produced outside of traditional publishing) not being peer-reviewed it will also be considered if the data is deemed valuable to the research.

To establish as much literature possible which was suitable to the study, various research databases were perused. These included:

1. ResearchGate
2. UTWSD Library
3. Google Scholar
4. Journal of Voice
5. Sage Journals
6. Music Education Books

Online search strategy

To assist locating the data, keywords were also implemented (see table 2, pp. 23). This method narrows the search to source relevant and specific documents, reducing the time needed to explore the information (Sezer et al., 2022). Whilst exploring the literature, it was clear that some of the elements being researched are known by different names. Luen (2019) and Zhang (2022) address solfège as solfa or solfeggio, and as previously mentioned pitch can be known as intonation or singing in tune (Geringer, Macleod and Sasanfar, 2015). All the possible titles were included in the key words. Moreover, during a previous study I established studies by Freya-Clark (2020) and Mehmet and Acinci (2024) which introduced me to the solfège systems Curwen and Kodály which incorporate hand signals and so these were also included in the key words criteria.

Table 2. Search terms / keywords

	Document Type	Key words searched
1	Pitch training specific	Pitch, intonation, interval training, singing in tune.
2	Solfège hand signals specific	Solfège hand signals, Kodály, Curwen, Solfa hand signals, Solfeggio hand signals.

Document inclusion and exclusion criteria

Once the databases, sources and keywords were established, the next step was to identify and select which documents were suitable for analysis. The inclusion and exclusion criteria presented below (see table 3) show which sources of the target topic can or can not participate in the document analysis (Patino and Ferreira, 2018).

Table 3. Inclusion and exclusion criteria for selected peer-reviewed documents.

Inclusion Criteria	Exclusion Criteria
Documents published after 2014	Documents publishes before 2014
English documents	Non-English documents
Peer-reviewed sources	Non-peer-reviewed sources
Sources will full access	Documents with restricted access
Involving only adult singers	Studies with child participants

Primary studies	Non-primary studies
Pitch training related to singers	Sight singing
Intonation training related to singers	Vocal health
Curwen hand signals	Online ear training software
Kodály hand signals	Scales in singing
Solfège hand signals	Rhythm training related to singers
Moveable and non-moveable solfège	
Interval training	
Empirical and theoretical data	

To keep the study focus, the decision was made not to include sight- singing data and vocal health as this is a large section of training which may benefit from an independent study and will ensure my data analysis is manageable. A further justification to exclude sight-singing, is this skill involves reading rather than singing and so broadens the scope of the research too much, I aim to keep the focus on singing skills. Also, I am familiar with some online pitch training software, but again these were excluded as I do not intend to use technology-based training methods for future teachings. The exclusion also keeps the focus on teacher-led approaches which is a key factor of this research. Furthermore, even though rhythm and scales are closely connected to pitch in singing, rhythm is meter, tempo and beat and is different to pitch perception and reproduction and so they have been excluded.

A choice was made to include empirical data (derived from observation or experimentation) as well as theoretical data (derived from reasoning) which both align with the chosen reflective framework by Altheide (1996). Empirical studies provide objective evidence, enabling the researcher to infer conclusions from analysing the documents which strengthens the rigor of the study (Jasti and Kodalu, 2014). The sources are managed as textual sources instead of highlighting the numerical findings (Ogienko and Kim, 2014). Therefore, for this study, the statistics are not used as a source of data, but instead, the documents are analysed for description and justification of using solfège hand signals as a training tool for learning to pitch match. Theoretical data is the process of intense analysis of existing theories within a topic and its aim is to develop new theoretical frameworks and abstract models by concentrating on why and how something happens (Navascues and Budroni, 2019). Therefore, theoretical data will be used in this document analysis to draw

out different theories which already exist about pitch matching and solfège hand signaling, with a view to produce new theories.

The collaboration of the two methods provides a much more thorough understanding of the topic (Mangone, 2022). However, consideration was given to the challenges of using empirical studies alongside participant-based studies. An issue known as double-counting (using the same data more than once) can occur when employing both sources (Ku et al., 2020). This was mitigated by scrutinising the extracted information over and over to ensure no overlapping of data and prioritising the most valuable study when information is duplicated across the documents.

Screening methods

To ensure a systematic approach, the screening process began with an online search to identify potential sources using the keywords selected for this study using the resources mentioned in the data selection section which aligns with Altheide's (1996) thematic analysis framework. Once the research was located, the abstract and conclusions were reviewed to gain better understanding of its relevance to my research. As per Altheide's (1996) flexibility step, consideration was given to the fact abstracts may not always provide clear or accurate information and so verification was then sought from the methodology and findings of the study. If the literature was deemed pertinent, the full text was then scrutinised to check they matched the inclusion criteria and examined to ensure they did not include any of the exclusions. Once certain, an in-depth review and deeper analysis was then carried out.

Screening results

A total of twenty-two documents were chosen including empirical, reviews and participant-based studies which all matched the inclusion criteria and are presented in the table below (table 4, see pp. 23) There was no restricted access to these documents, which made the process easier.

Study characteristics

The twenty-two documents went through the same screening process and the samples and details from each document are presented in table 4 and table 5 (pp 29). The samples were placed into relevant categories to identify their focus. These categories included documents that discussed the teaching methods of pitch or solfège, physiological involvement which

affects pitch such as vocal motor skills, cognitive and psychological factors of pitch control or solfège hand signals and other characteristics such as age, gender and level of training. The boxes highlighted in red represent the categories in which the documents correspond to.

Table 4. A synopsis of the peer-reviewed documents

	Author	Article title	Year	Source type	Pedagogy	Physiology	Psychology	Characteristics
1	Agbenyo	The Effect of solfège syllable Indications on sight-reading skills of undergraduate music majors	2021	Article				
2	Bottalico, Gratezer and Hunter	Effect of training and level of external auditory feedback on the singing voice: Pitch inaccuracy	2017	Article				
3	Eroglu	Solfège teaching in higher music education in Turkey: instructors' Perspectives	2021	Article				
4	Freya-Clark	Pitch systems and Curwen hand signs: A review of literature	2017	Article				
5	Greenhead	Aural training in the Dalcroze practice	2013	Article				
6	Hutchins, Larrouy-Maestri and Peretz	Singing ability is rooted in vocal-motor control of pitch	2014	Article				
7	Kervin	The Key to singing off-key: The Trained singer and pitch perception distortion	2023	Article				
8	Kilpatrick	Movement, gesture, and singing: A review of literature	2020	Article				

9	Kis Zuvela	When the fixed do tends to move: The ambiguity of the solfège syllabary	2018	Article				
10	Kutlimu-ratovich	The use of Kodály method in teaching music	2024	Article				
11	Mete and Dundar	The effect of Kodály method on the musical knowledge and skills of preservice teachers	2020	Article				
12	Okeyo, Shathandi and Kanake	Determining the impact of the use of Kodály pedagogical approach (KPA) on teacher trainees' performance (TTP) in basic music skills	2022	Article				
13	Okeyo, Shithandi and Kanake	Relationship between the use of Kodály approach of teaching music	2020	Journal				
14	Reifinger	Teaching pitch notation–reading Skills	2020	Article				
15	Reisenweaver	Guido of Arezzo and his influence on music learning	2012	Journal				
16	Ristow, Thomsen and Urista	Dalcroze's approach to solfège and ear training for the undergraduate aural skills curriculum	2014	Article				
17	Sha	International journal of education and humanities internal listening and musical	2024	Article				

		creativity: A study of brain function						
18	Steenstrup et al.	Imagine, sing, play- combined mental, vocal and physical practice improves musical performance	2021	Article				
19	Tabuena	Carabo-Cone, Dalcroze, Kodály, and Orff Schulwerk methods	2021	Article				
20	Wei and Wei	Kodály music teaching method develops in music education in local colleges and universities	2022	Article				
21	Wolf and Kopiez	Development and validation of the musical ear training assessment	2018	Article				
22	Zhao	Research on application of Orff teaching method in solfeggio ear training class	2024	Article				

Document and study details

Table 5 outlines the specifics from the studies such as the study type, details of the participants (if any) and other additional information pertinent to the research. Documents defined as data are studies that do not involve participants, instead they focus on literature reviews or reviews of teaching methods.

Table 5. Document and study details

	Author	Study Type	Study Task	Sample Size	Age/mean age	Sex	Training / education	Additional information
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1	Agbenyo (2021)	Participant	Experiment	32	18 and above	Male and female	Undergraduate	
2	Bottalico, Graetze and Hunter (2017)	Participant	Singing experiment	20	19-32	Male and Female	Professional and non-professional	
3	Eroglu (2021)	Participant	Questionnaire	37	Not known	Male and Female	Professional instructors	Turkey
4	Freya-Clark (2017)	Data	Literature review	Not known	Not known	Male and Female	Higher education	Nonparticipant study
5	Greenhead (2016)	Data	Literature review	Not Known	Not known	Not known	Not Unknown	Nonparticipant study
6	Hutchins, Larrouy-Maestri and Peretz (2014)	Participant	Singing experiment and recording	22	18-30	Male and Female	Non-professional	One year or less of any kind of training and no formal training
7	Kervin (2023)	Participant	Survey	115	18 and above	Male and Female	Professional	English speaking participants only. Participants were anonymous Took place during the pandemic
8	Kilpatrick (2020)	Data	Literature review	Not known	18 and above	Male and Female	Professional and non-professional	Nonparticipant study
9	Kis Zuvela (2018)	Participant	Questionnaire	196	21.3	Male and Female	Undergraduate students	Average ear training grade 3.8. Average years of training 12.2. Croatia

10	Kultimuract -ovich (2024)	Data	Teaching method review	Not known	Not known	Not known	Not known	Review of teaching a method not a review of other participant studies
11	Mete and Dundar (2020)	Participant	'The music hearing test' and 'The basic music knowledge test' (Gurgen, 2007)	97	Not known	Male and Female	Music teachers	Turkey Separated into and experimental and control group
12	Okeyo, Shithandi and Kanake (2022)	Participant	Experiment Questionnaire Interviews	344	18 years and above	Male and Female	Teacher trainees	Quai- experimental design (not randomised) Kenya Full age range not specified
13	Okeyo, Shithandi and Kanake (2020)	Participant	Experiment Questionnaire Interviews	170	18 years and above	Male and female	Teacher trainees	Quai- experimental design (not randomised) Kenya Full age range not specified
14	Reifinger (2020)	Data	Teaching method review	Not known	Not known	Not known	Not known	Nonparticipant study
15	Reisenwea ver (2012)	Data	Teaching method review	Not Known	Not known	Not known	Not known	Nonparticipant study
16	Ristow, Thomsen and Urista (2014)	Data	Teaching method review	Not Known	Not Known	Not Known	Not Known	Nonparticipant study

17	Sha (2024)	Data	Literature review	Not known	Not known	Male and female	Professional	Nonparticipant study
18	Steenstrup et al. (2021)	Participant	Experiment and questionnaire	50	23	Male and female	Professional	
19	Tabuena (2021)	Data	Teaching method review	Not known	18 years and above	Male and female	Not known	Nonparticipant
20	Wei and Wei (2022)	Data	Teaching method review	Not known	Not known	Male and female	Not known	Nonparticipant study
21	Wolf and Kopiez (2018)	Participant	Questionnaire and experiment	393	41.9	Male and female	Professional	Germany
22	Zhao (2024)	Data	Teaching method review	Not known	18 years and above	Male and female	Professional	Nonparticipant study

Consideration to grey literature

During the search for peer-reviewed samples, additional pieces of grey literature were explored and due to their relevance to solfège and ear training, they were also considered for review for this study. Grey literature can be defined as information not published in the traditional ways, sometimes evading the peer review process (Adams et al., 2016). This type of literature can still be lucrative to research as it can produce findings other studies have not, can be presently and lead to access to other diverse authors and researchers (Cooper et al., 2019). However, as Aloia and Naughton (2017) stressed in their study, even though using grey literature may prove beneficial, it is good ethical practice to acknowledge and remember that grey documents may not be credible, and the researcher should strive to investigate its validity. Adams, Smart and Huff (2017) produced guidelines to follow when incorporating grey literature into research to assist the process of this information optimally, successfully and safely (appendix 3).

Grey Literature documents

A conference proceedings paper was sourced (see table 6), which is considered grey literature because they are not usually published via the traditional commercial channels

which means they may not have undergone the same diligent peer-review process as other articles (Paez, 2017). This document also underwent the same colour coding system in the beginning stages of analysis (see appendix 4).

Table 6. Grey literature documents included in the study

	Title	Author details	Comprehensiveness	Credibility, accuracy and authenticity	Relevance to my research	Intended audience	Primary or Secondary sources
1	Brief analysis on multiple effects of solfeggio teaching and ear training on music and art education (Qinfeng, 2019)	The author is a professor of geographic sciences and has penned 35 publications, most of which have been peer-reviewed journals and articles.	Fully comprehensive and very detailed regarding the teaching of Solfeggio and its effects.	Highly credible considering the author's credentials, accurate due to other similar studies the author conducted and is authentic as the conference paper has been peer-reviewed.	This document is relevant to my research as it discusses pitch control whilst teaching solfège including with hand signals.	Singers and singing teachers. Music students and pedagogues	Produced firsthand due to the authors other published studies and experience within this field.

Withdrawn documents

Two documents were withdrawn from the research due to failing to comply with the inclusion criteria set for this study (see table 7).

Table 7. Documents withdrawn from the study

	Author	Date	Title	Document	Withdrawal reasons

1	Beaty, Burgin, Nasbaum, Kwapil, Hodges and Silvia	2014	Music to the inner ears: Exploring individual differences in musical imagery	Consciousness and Cognition	Involved child participants which is excluded from the study
2	Bradley and Van Hell	2016	Effects of musical ear training on lexical tone perception	Proceedings of the Linguistic Society of America	Not peer-reviewed or relevant to my research question

Coding Process

All the documents were subjected to open, axial and selective coding as per Strauss and Corbin's (1990) coding framework. The documents were initially subjected to open coding (see appendix 5) to gather initial themes. Axial coding then took place and was used to reorganise the themes into groups and categories, so the relationships could be analysed (Scott and Medaugh, 2017). Lastly, selective coding finished the process which enabled me to refine the data and establish a core theme. Challenges to consider when using this coding method included complications when applying the process, researcher bias, time-consuming and the risks of data being forced into a predetermined category (Kendall, 2000). To mitigate, I needed to be reflexive, as per Altheide's (1996) framework, to ensure I was aware of any personal biases to minimise any influence on the analysis. Employing an explicit research question will guide the coding process which will assist when selecting relevant codes and meticulously follow the Gantt chart to ensure the time consumption is planned effectively (Moghaddam, 2006).

To further assist the coding process, a visual organisational method was employed in the form of using colours for different themes (see table 8, pp.35) and after the documents were coded by colour they were copied and pasted into the appendix section (appendix 2).

Highlighting information in different colours is easy to differentiate and see the categories clearly (Bianco, Gasparin and Schettini, 2014). It also enables the researcher to add themes more easily as the data is continuously analysed (Liu et al., 2021). The categories were formed from the open coding process and the colours enabled me to visually and clearly see the initial themes beginning to emerge. Documents which discuss solfège hand signals

and pitching related to singing were given their own categories so they could be initially analysed separately. Any reports which involved teaching strategies relating to solfège hand signals and/or vocal pitch were categorised together. Physiology was given a colour for the literature that discussed any physiological involvement when achieving pitch or solfège hand signals. Level of training or number of years of vocal training were placed into a category, as were age and gender related information. Finally, research that considers moveable and fixed do solfège systems were also grouped together. The grey literature was also subject to the same open, axial and selective coding process. However, the findings are presented in their own section (see page 57).

Table 8. Research categories and their corresponding colours

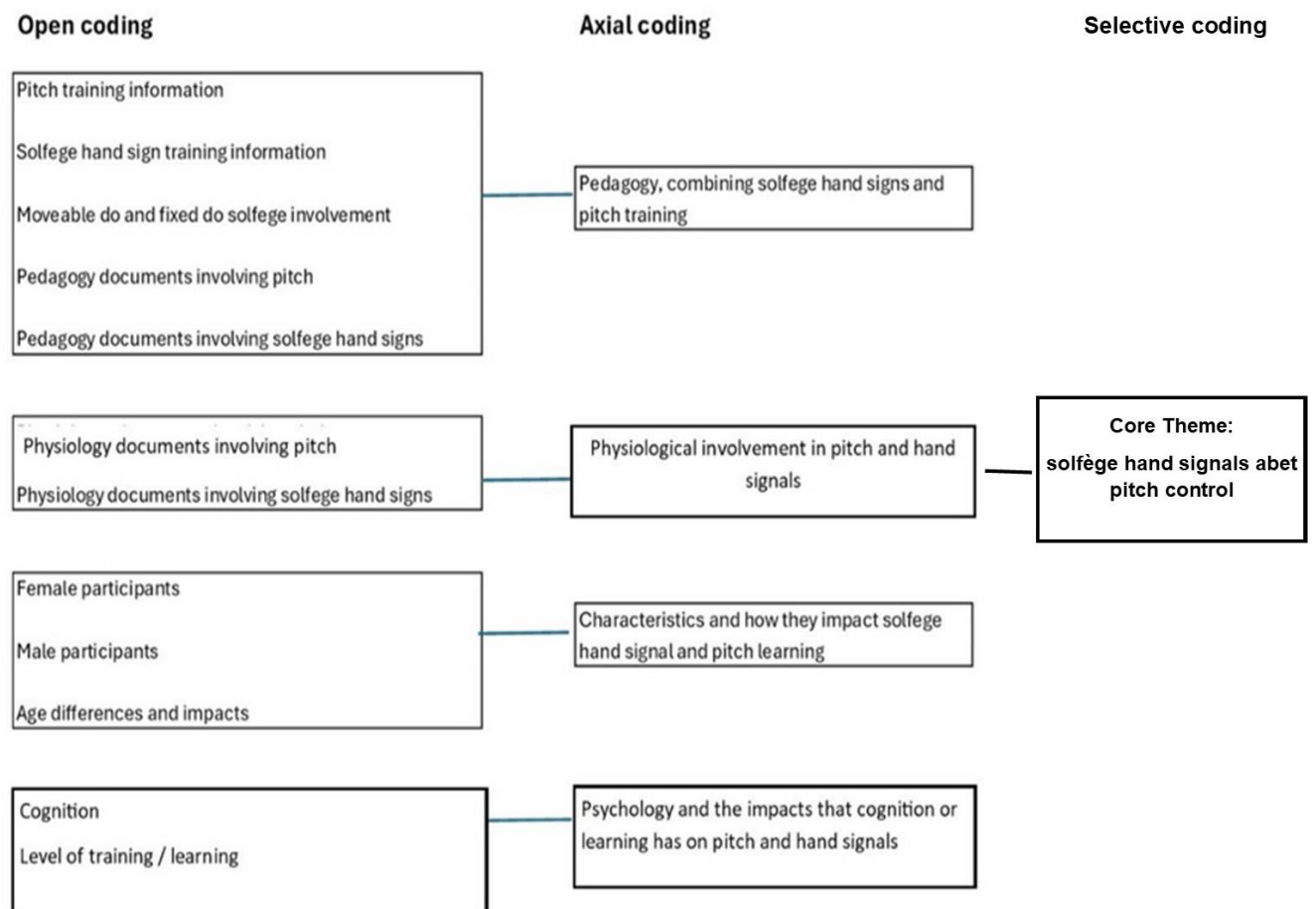
Category	Coded colour used
Solfège hand signs relating to singing pitch	Yellow
Pitch related to singing without hand signals	Light Green
Teaching pedagogy relating to solfège hand signals or pitch	Red
Physiological involvement when achieving pitch	Pink
Years of student experience	Purple
Moveable or fixed do system	Orange
Impacts of gender and the age of the adult	Grey

Synthesis results

Once open and axial coding had taken place, the results were synthesised (see figure 3, pp. 36). Firstly, the findings from the studies involving pitch training, solfège hand signal training, moveable do and fixed do solfège and teaching pitch or solfège hand signals were grouped together into a pedagogy category, combining solfège hand signal and pitch training information. Secondly, the findings from studies involving any physiological involvement when ascertaining pitch and solfège hand signals were synthesised into a new category. Thirdly, the findings from studies involving impacts from gender and the age of the adult participants when learning and training solfège hand signals and pitch were synthesised into a category named characteristics. Lastly, studies that discuss the impacts from the level of training and expertise, or cognitive involvement when learning solfège and pitching, were synthesised into a category combining cognition and solfège hand signals and pitch.

Selective coding was implemented after the synthesis process took place to identify the core theme that solfège hand signals abet pitch control (see figure 3, pp. 36).

Figure 3. Open, Axial and Selective Coding Results



Findings

This research analysed twenty-two peer-reviewed documents (see page 26-28) and 1 grey literature piece (see page 32-33). 11 studies were participant-based, involving sample sizes ranging from 11 to 344. Sample sizes were taken into account when analysing the research, as Lakens (2022) stresses the bigger the sample size the more reliable and valid the results are. The studies involved both female and male participants to whom ranged in age from 18 to 32, however some studies failed to disclose the age of participants instead they just referred to the members as adults.

The other 11 were data collections and literature reviews. This type of research is beneficial, as systematic reviews are regarded as a supreme method of evidence synthesis, however, as Rhoades and Ellen (2011) explain consideration should be given to the fact that these kinds of studies can sometimes result in biased or inaccurate conclusions. Great care and scrutiny took place upon selecting the documents to ensure validity and reliability to mitigate this issue.

Data Presentation

Pedagogy articles

There are 19 pedagogy documents included in this study (table 9).

Table 9. Pedagogy articles

	Author	Date	Title	Document
1	Agbenyo	2021	The Effect of solfège syllable Indications on sight-reading skills of undergraduate music majors	American Journal of Multidisciplinary Research & Development (AJMRD)
2	Eroglu	2021	Solfège teaching in higher music education in Turkey: Instructors' perspectives	International Online Journal of Educational Sciences
3	Freya-Clark	2017	Pitch systems and Curwen hand signs: A review of literature	Applications of Research in Music Education
4	Greenhead	2013	Aural training in the Dalcroze practice	Journal of Music Theory Pedagogy

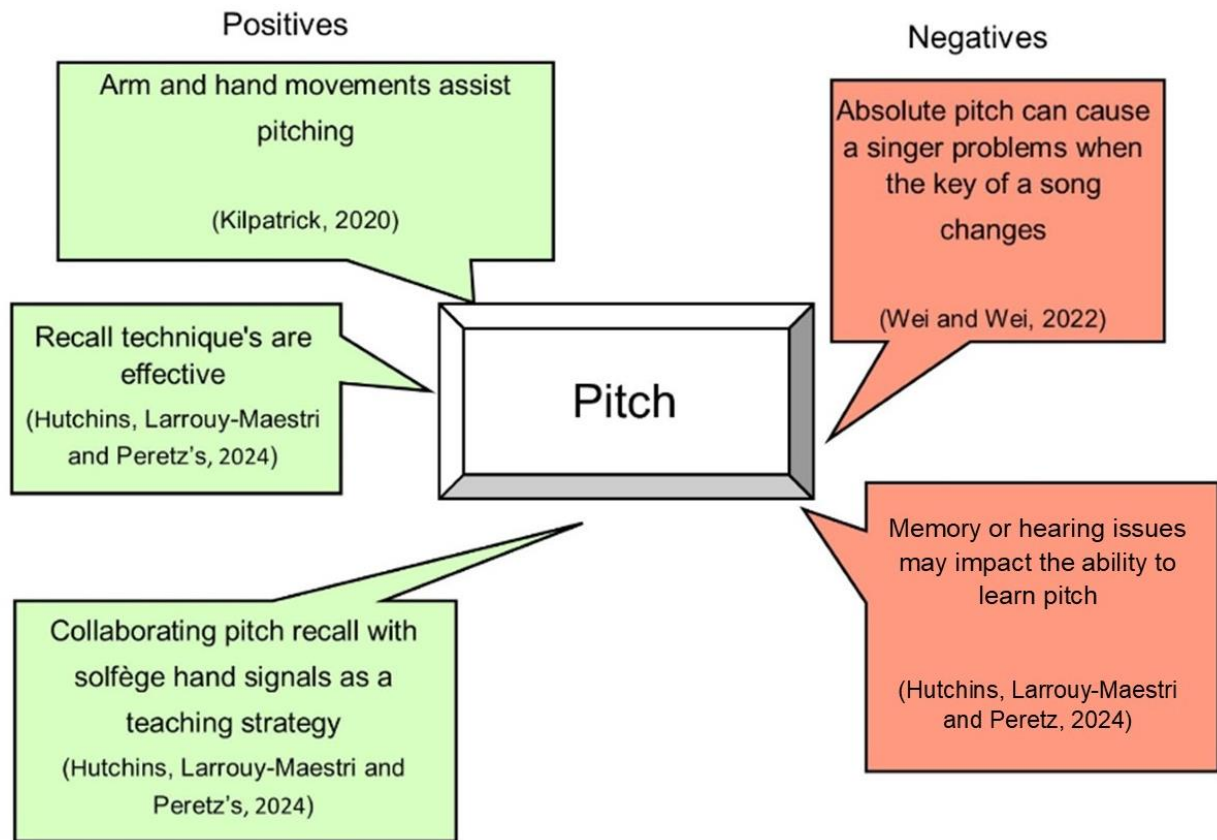
				Journal of Music Theory Pedagogy
5	Hutchins, Larrouy-Maestri and Peretz	2014	Singing ability is rooted in vocal-motor control of pitch	Attention, Perception, and Psychophysics
6	Kervin	2023	The key to singing off-key: The trained singer and pitch perception distortion	Journal of Voice
7	Kilpatrick	2020	When the fixed do tends to move: The ambiguity of the solfège syllabary	Applications of Research in Music Education
8	Kis Zuvela	2018	When the fixed do tends to move: The ambiguity of the solfège syllabary	EBSCO Information Sciences
9	Kutlimuratovich	2024	The use of Kodály method in teaching music	International Journal of Pedagogics
10	Mete and Dundar	2020	The effect of Kodály method on the musical knowledge and skills of preservice teachers	Elementary Education Online
11	Okeyo, Shathandi and Kanake	2020	Relationship between the use of Kodály approach of teaching music	American Journal of Humanities and Social Sciences Research (AJHSSR)
12	Okeyo, Shitandi and Kanake	2022	Determining the impact of the use of Kodály pedagogical approach (KPA) on teacher trainees' performance (TTP) in basic music skills	Journal of Education and Learning
13	Reifinger	2020	Teaching pitch notation-reading skills	General Music Today

14	Reisenweaver	2014	Guido of Arezzo and his influence on music learning	Musical Offerings
15	Ristow, Thomsen and Urista	2014	Dalcroze's approach to solfège and ear training for the undergraduate aural skills curriculum	Journal of Music Theory Pedagogy
16	Steenstrup, Haumann, Kieber, Camarasa, Vuust and Petersen	2021	Imagine, sing, play-combined mental, vocal and physical practice improves musical performance	Frontiers in Psychology
17	Tabuena	2021	Carabo-Cone, Dalcroze, Kodály, and Orff Schulwerk methods: An explanatory synthesis of teaching strategies in music education'	International Journal of Asian Education
18	Wei and Wei	2022	Kodály music teaching method develops in music education in local colleges and universities	Journal of Education and Training Studies
19	Zhao	2024	Research on application of Orff teaching method in solfeggio ear training class	Journal of Education and Educational Research

a) Findings from the pedagogy documents involving pitch

The findings collated from the pedagogy documents which discuss pitch are presented below (figure 4, pp. 40). This image highlights the positives and negatives of different teaching methods, and these points are explained further in the following section.

Figure 4. Positives from the different teaching methods (green boxes) and the negatives (red boxes) found in the pedagogy documents involving pitch



Hutchins, Larrouy-Maestri and Peretz's (2014) study tested two pitch matching teaching strategies one using a slider instrument and the other using a computer. Participants were asked to match the sounds that were generated. They were then asked to repeat the notes from memory. The results showed that using a system of recall where the notes are physically heard first helped the singers to match the pitch more accurately. They also explained this teaching method could be carried out using a piano or any music making instrument. The use of solfège hand signals works in a similar way but visually, so the singer recalls the signs for each note being sung. Therefore, pitch acquisition could be strengthened by the combination of both pitch matching techniques and solfège hand signals.

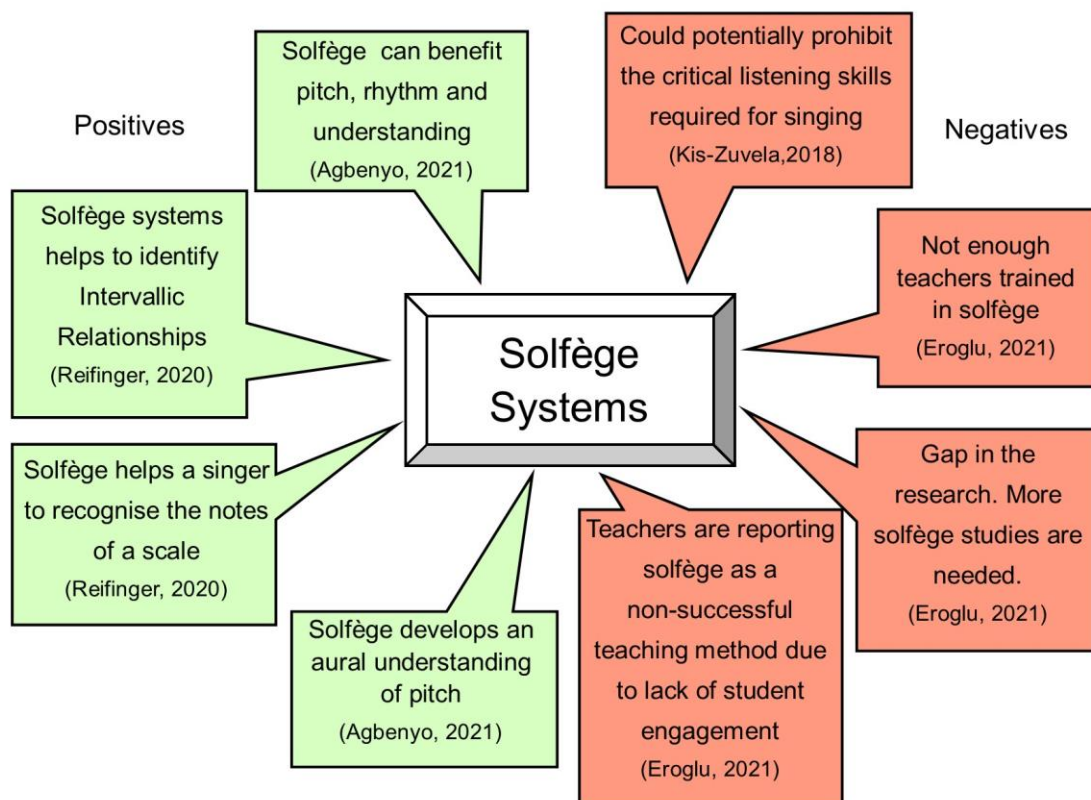
A review by Kilpatrick (2020) emphasised the use of the whole-body during singing to aid pitch and intonation as well as melody and rhythm skills and determined that this strategy was effective. More specifically, he explained that a participant-based study

conducted by Brunkan (2016) stated that hand gestures and circular arm movements were the most efficacious for pitch control and matching. The study concluded that body movements provided a kinesthetic (through movement) perception which assisted in achieving more precise singing. Considering solfège uses hand signaling this study would suggest the outcome would be similar.

b) Findings from the pedagogy documents involving solfège systems

The findings collated from the pedagogy documents which discuss solfège systems are presented below (figure 5). This image highlights the positives and negatives derived from the use of solfège, and these points are explained further in the following section.

Figure 5. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving solfège systems



Abenyos (2021) study said conclusively that the use of solfège hand signals when teaching singing students was greatly beneficial and his testing showed that it improved the

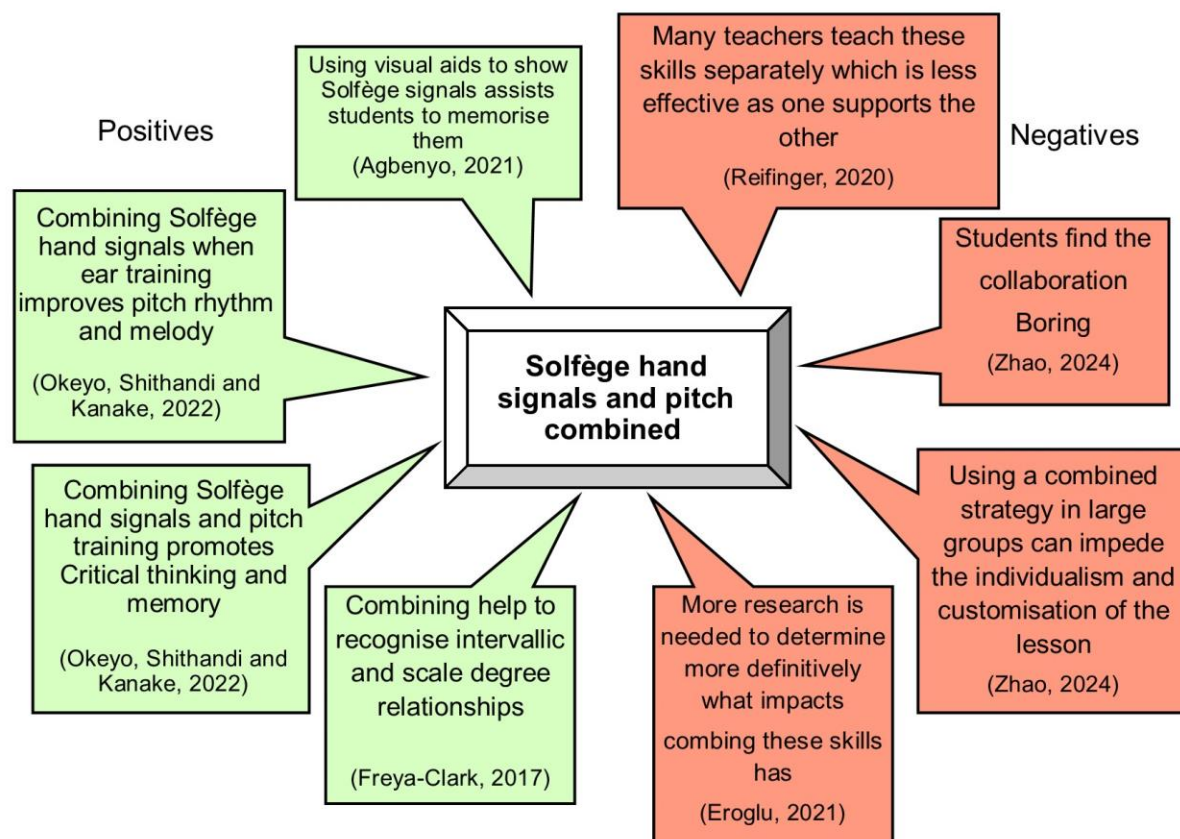
participants understanding, rhythm and pitch skills as well as promoting better engagement. Reifinger (2020) agreed, expressing that his literature review produced data from many studies which advocated for the use of solfège signs as a means of identifying relationships, understanding intervallic patterns and improving pitch recognition. Intervallic patterns in singing are the sequences of intervals within the music, or repeated sections of music and these skills are a fundamental part of music (Brown and Phillips, 2023).

Kis Zuvela (2018) however, argues that teaching solfège is not always useful, as there is the potential for prohibiting the development of listening skills which are crucial for singing and stresses the importance of ensuring the teacher is fully aware and trained in each solfège method. Eroglu, (2021) also draws attention to the lack of studies and gap in the research regarding teaching solfège systems and states that the technique is not well known or widely used enough, which means not enough singing teachers are trained in this method and so cannot deliver it to students effectively if at all. Furthermore, after questioning the teachers who participated in his study as to whether they found their personal teaching of solfège to be successful, the reports were negative with most saying achievability and implementation was minimal

c) Findings from the pedagogy documents involving solfège hand signals and pitch combined

The findings collated from the pedagogy documents which discuss solfège hand signals and pitch are presented below (figure 6, pp. 43). This image highlights the positives and negatives derived from the combined use, and these points are explained further in the following section.

Figure 6. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving solfège signals and pitch combined



Agbenyo's (2021) experiment evidenced positive pitch improvement when incorporating solfège hand signals and showed more specifically that the technique of printing out the syllable gestures as a visual aid proved the most efficacious teaching strategy. However, he also stressed that the reliability of the solfège techniques was still questionable as other studies he reviewed showed conflicting results and called for further research to determine the efficacy of its use. Okeyo, Shithandi and Kanake's (2022) study also emphasised the importance of incorporating solfège with ear training skills such as pitch, rhythm and melody, but more so with the integration of solfège hand signs to accompany the learning. They explain that collaboration is more profitable as it improves critical thinking, pitch accuracy, memory and overall academic performance. Reifinger (2020) agrees and highlights that music teachers seemingly train these two skills separately and deemed this method insufficient for superior music teaching as the purpose of one skill is to support the other.

Freya-Clark's (2017) literature review shows recommendations for the combined use of solfège hand signals when pitch training. The data she collected favoured this method,

stating that the hand signs provided better understanding of pitch, tone and rhythm and enabled the student to visualise the intervals and scale degree (the number given to each step of the scale) relationships of the music. Ristow (2014) agreed that the use of solfège hand signals encourages the student to think not only about the pitch of the note but function also.

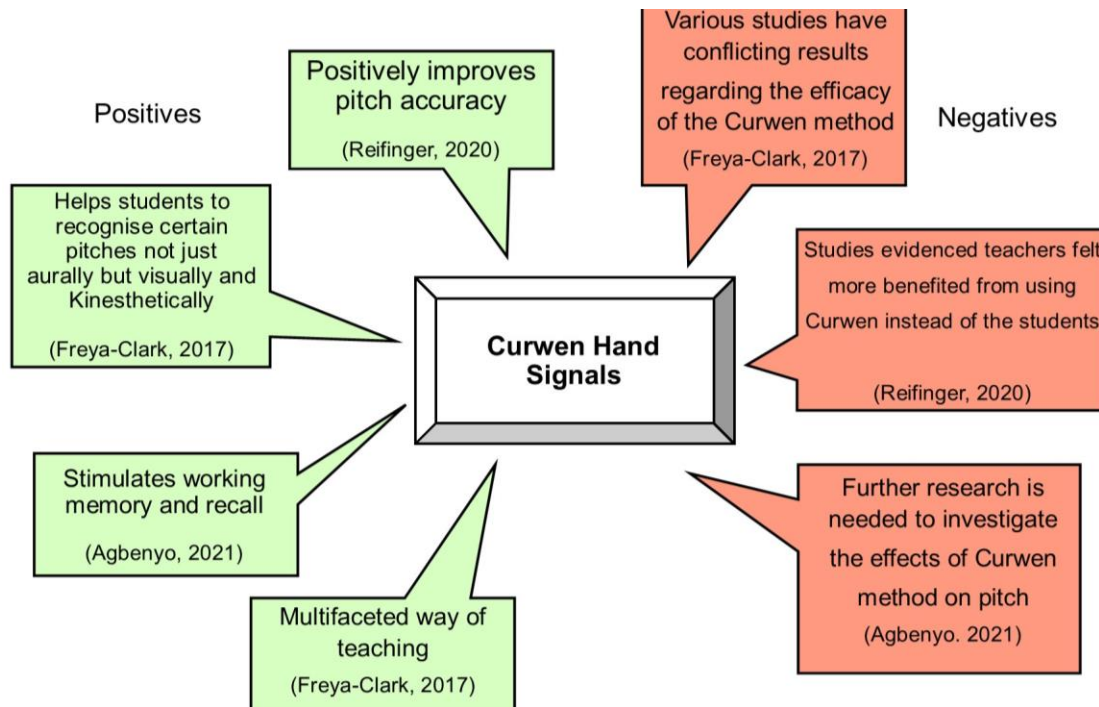
Zhao (2024) however, argues that combining solfège and pitch training could be challenging. The first issue discussed was that students found the collaborative curriculum boring and so became disengaged and distracted. Secondly, the approach to teaching these skills is individual to each student and working within a large group prevents the teacher from customising the lesson to suit these needs. Furthermore, Eroglu's (2021) study concluded that the motivation and overall interest of students learning solfège hand signals was the main contributor to the lack of success and emphasised that instructors lacked overall professional knowledge of solfège, meaning more training was required. Ristow, Thomsen and Urista (2014) discussed a teaching strategy to mitigate poor engagement in class which involved gamifying solfège teaching to make it more appealing for students. Wulan et al. (2024) explains that incorporating games when teaching improves engagement and motivates cognition.

The data extracted from Kilpatrick's (2020) study was not specific to solfège hand signals but does debate whole body movements including the hands which was still considered befitting to the research. The author expressed that gestures such as clapping and lowering or raising the hands enabled the performer to achieve better pitching which corroborates findings from other solfège research previously mentioned, which state that hand signals are beneficial to promoting and ascertaining accurate pitch. Therefore, this study strengthens the answer to the research question.

d) The effectiveness of Curwen hand signals for pitch acquisition

The findings collated from the pedagogy documents which discuss Curwen hand signals are presented below (figure 7). This image highlights the positives and negatives of using Curwen's signals, and these points are explained further in the following section.

Figure 7. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving Curwen hand signals



Reifinger's (2020) study strongly emphasised that the Curwen method can specifically assist a singer in ascertaining precise pitching. He explained that using this solfège technique teaches students how to recognise and produce certain pitches not just aurally but visually and kinesthetically. Frey-Clark (2017) did agree that it improves a singer's ability to achieve accurate pitching and can simplify aural tasks during ear training. However, despite defining Curwen hand signs as a multifaceted way to teach students, this author did also highlight that previous research had failed to produce notable benefits of its use and stated that other studies had found that Curwen hand signs did not significantly impact students' overall music literacy. Additionally, it was hypothesised that the people who benefited the most from its use were the teachers and not so much the students, as it offers an easier way to assess students' musical understanding.

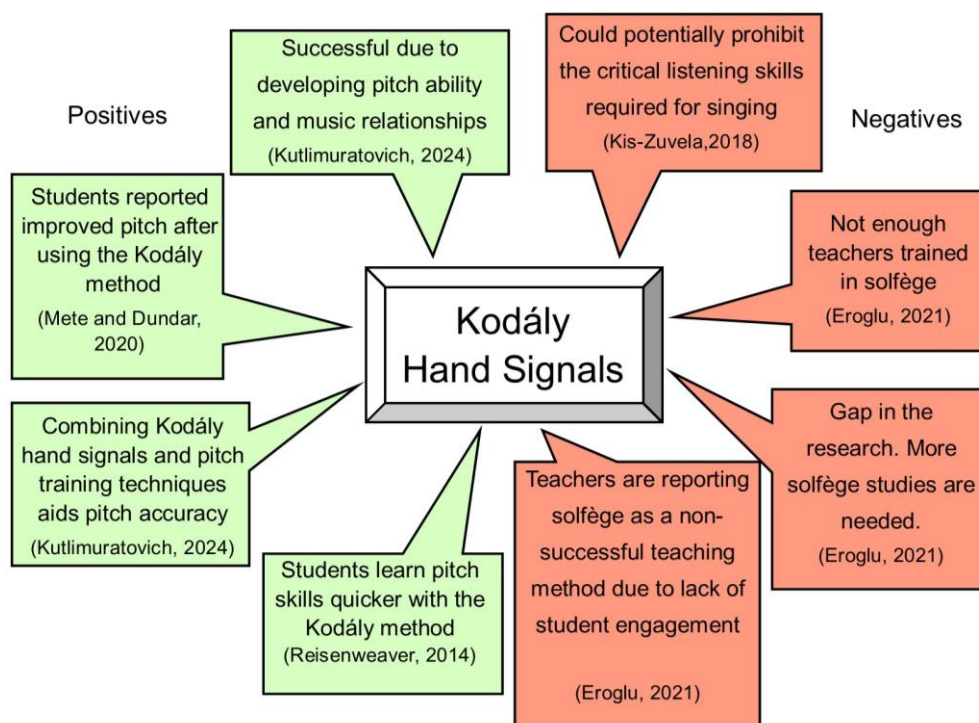
Agbenyo's (2021) study which also tested the use of Curwen hand signals on 32 undergraduate students presented similar confictions. The results reported that the students using Curwen signaling whilst phonating showed improved vocal notation responses and pitch accuracy. However, this study raised questions regarding the length of time used to test participants and as Bridgeman (2020) stressed, the longer a testing

method takes place the more reliable the result. Therefore, further studies that have a prolonged testing method to determine its efficacy would be advantageous.

e) The effectiveness of Kodály hand signals for pitch acquisition

The findings collated from the pedagogy documents which discuss Kodály hand signals are presented below (figure 8). This image highlights the positives and negatives of using Kodály signals, and these points are explained further in the following section.

Figure 8. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving Kodály hand signs



Tabuena, (2021) produced a comparative study looking at the dissimilarities between teaching strategies in music education. They focused heavily on the Kodály method and the use of hand signs. Once they had reviewed the literature, they concluded that the research had presented efficacious results by adopting a multimodal approach of using Kodály hand signals when pitch training. Similarly, Kutlimuratovich (2024) produced a review which stated that Kodály was a valuable system due to the development of pitch and relationships within the music via the use of solfège hand signals. Turkmen and Gonuc (2018) also

expressed that the Kodály hand gestures help students to visualise the movement of the notes whilst vocalising thus enabling them to envision the position and stay on pitch. Mete and Dunder's (2020) study corroborated this as after testing 97 participants by administering music hearing and knowledge tests both before and after the incorporation of Kodály hand signs, students reported an improvement specifically in their pitch ability.

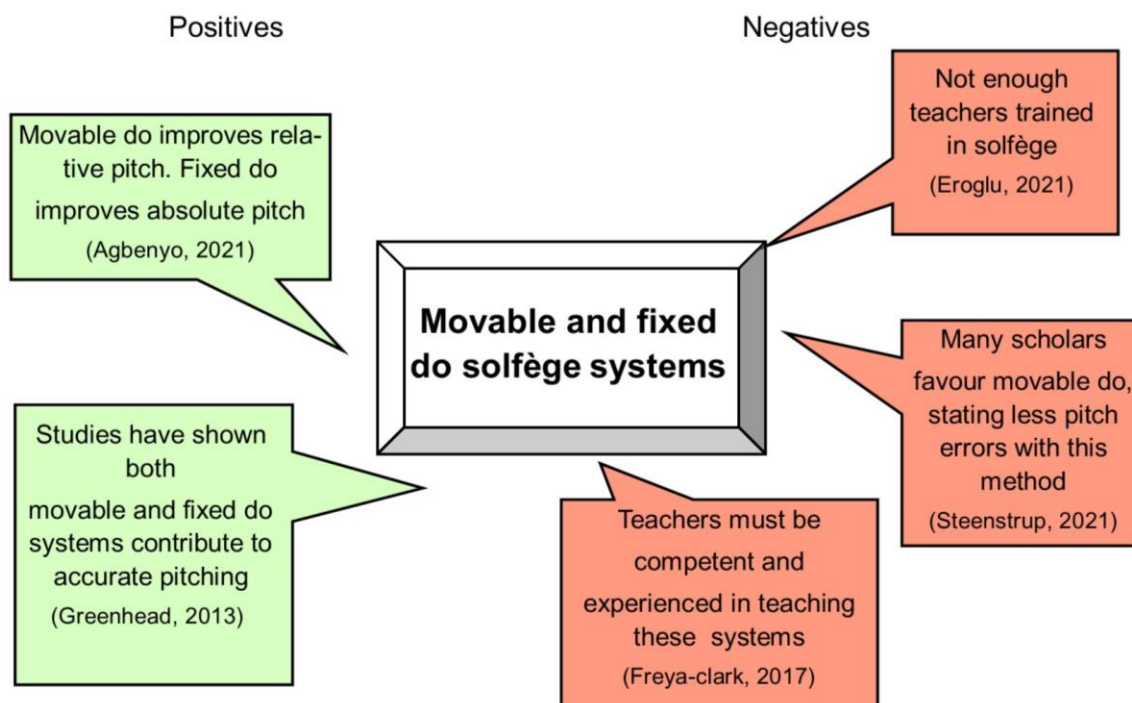
Kutlimuratovich (2024) affirms that a successful teaching strategy is one that combines both the Kodály method (with the involvement of hand signals) and ear training techniques such as pitch skills. Elaborating, he explains a collaborative curriculum should be devised which incorporates the Kodály principles, solfège hand signs, movement and singing, but does stress that teachers should be competent, well trained and the teaching model should be adaptable to suit all students and settings.

Further to these studies, Reisenweaver (2014) demonstrated that students learnt melodies and pitch matched quicker when using the Kodály method in comparison to not adopting Kodály. Okeyo, Shitandi and Kanake (2020) also determined that their participants reported an improved ability to achieve pitch when exposed to the Kodály hand signs. Most of the teachers involved in this study affirmed that they would introduce the Kodály teaching model to their students in the future. They did however, express that their literature review found numerous antithesis studies which failed to find significant data regarding the efficacy of using the Kodály hand signals and stated most results showed minimal impact. Wei (2022) spoke highly of the Kodály method, claiming that this teaching strategy encourages students all round singing perception. They explain that it not only develops pitch, but rhythm, confidence and performance, urging more educational settings to adopt the method.

f) Findings from the pedagogy documents involving moveable and fixed do solfège systems

The findings collated from the pedagogy documents which discuss movable and fixed do solfège are presented below (figure 9). This image highlights the positives and negatives of using these systems, and these points are explained further in the following section.

Figure 9. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving movable and fixed do solfège systems



Agbenyo's (2021) study evidenced that teaching moveable do solfège was more effective for singers who did not achieve absolute pitch as it accentuates the relationships between notes instead of relating specific syllables with fixed pitches. Absolute can be defined as the ability to identify the note accurately without a key tone (central or tonic note) for guidance and relative pitch can be defined as the ability identify the intervals between the key tone and the additional notes. Eroglu's (2021) study corroborates this by evidencing large increases in pitch accuracy when the singing teachers adopted a movable do solfège method in comparison to the fixed do system. However, Ristow, Thomson and Urista, (2014) explained that this could be due to the fixed method only naming pitches and not their functions. Steenstrup et al. (2021) argued that their study resulted in better aural skills including pitch ability and fewer pitch errors, when using the fixed do system.

Greenhead (2013) advocated for using the movable do option initially before learning the fixed do system, stating that pedagogically, this is a better teaching approach as it allows the singer to identify the relationships of the pitch first before moving onto the development of absolute pitch. Kis Zuvela (2018) argued that only one syllabary system is necessary or needed and teachers should determine which better suits their teaching style before deciding upon which method to use. Furthermore, this study stated that fixed do solfège does not always produce absolute pitching after conducting an experiment into the use of absolute solmisation (another term for solfège). His study showed that most participants

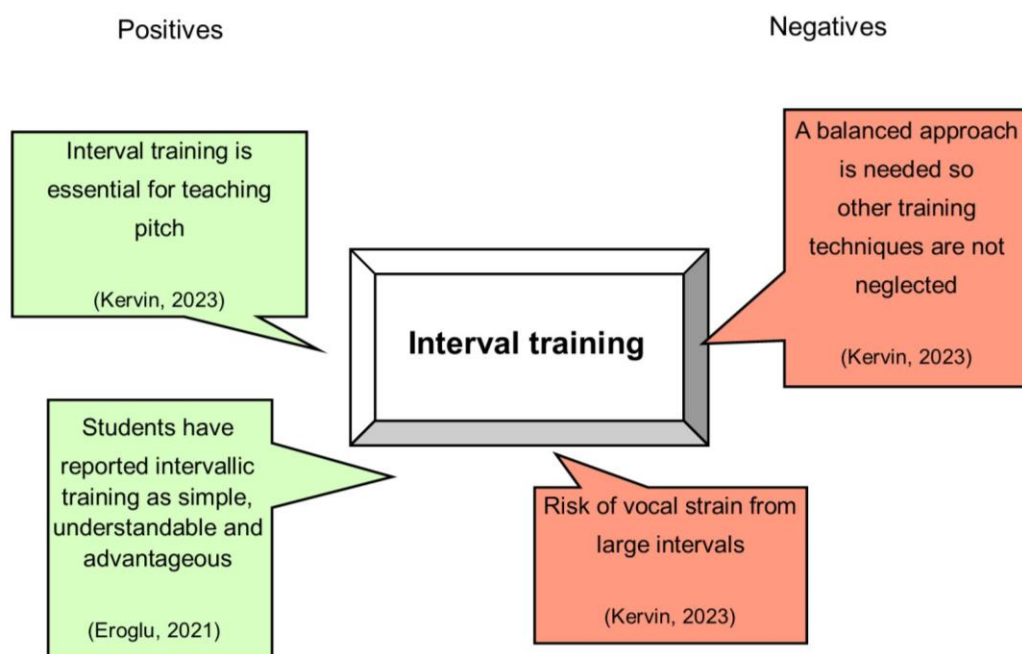
who could employ absolute solfège syllables failed to achieve absolute pitch. Thus, arguing that the fixed do system may not always be as lucrative for gaining pitch ability and questions if teachers should expect or encourage their students to acquire absolute pitch at all. Freya-Clark's (2017) review of Curwen hand signs also found that both movable and fixed do solfège have their own merits and so may be impossible to differentiate or favour one system.

Eroglu (2021) raised issues surrounding the lack of teachers who were knowledgeable and adequately trained to incorporate solfège techniques into lessons and called for solfège systems to be more accessible.

g) Findings from the pedagogy documents involving Interval training

The findings collated from the pedagogy documents which discuss interval training are presented below (figure 10, pp. 50). This image highlights the positives and negatives of using this teaching method, and these points are explained further in the following section.

Figure 10. Positives (green boxes) and negatives (red boxes) found in the pedagogy documents involving interval training



Kervin (2023) discusses intervallic training, and his study discussed the importance of this teaching strategy to assist in optimal pitching. He reviewed studies which showed a positive increase in pitch matching with the use of interval training methods and so deemed this technique crucial for teachers to adopt. Eroglu (2021) also claimed that students using intervallic training to assist with ascertaining accurate pitch, self-reported the techniques as being simple, non-challenging and advantageous. He concluded that teachers would benefit from incorporating intervallic exercises into lessons to enhance their student's music literacy.

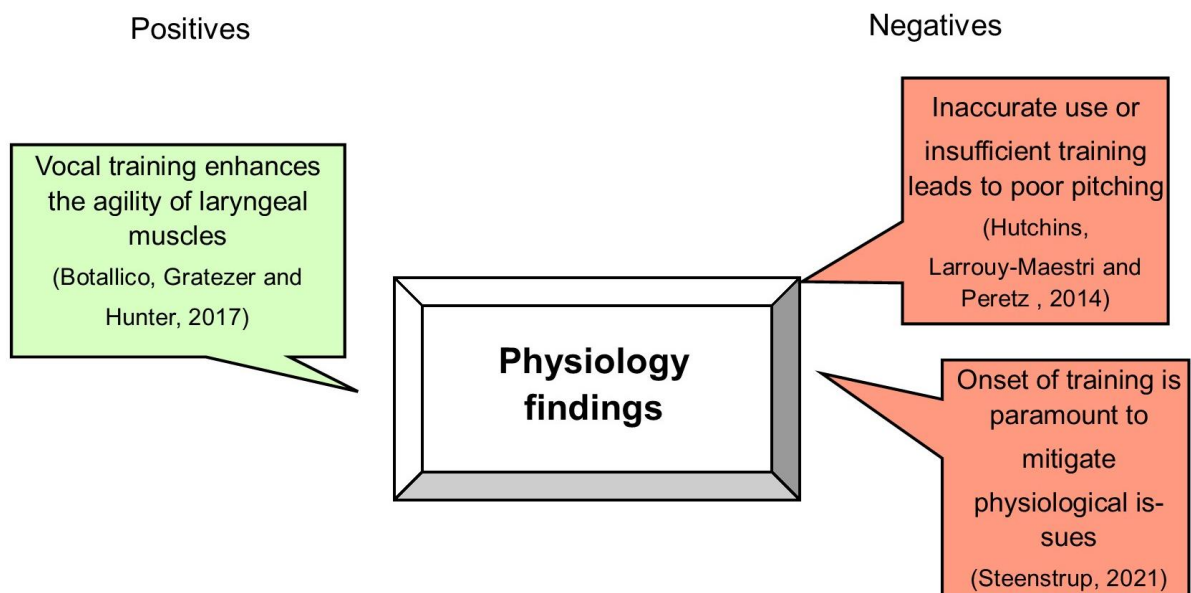
Kervin (2023) also highlighted the drawbacks to interval training, expressing the potential risks of vocal strain due to practicing large distances between pitches and risks of neglecting other useful singing techniques due to relying on intervallic training. These issues can be mitigated by practicing small intervals and progressing to larger, ensuring the use of appropriate breath support and employing a balanced approach to training techniques (Bradley and Hell, 2016).

Physiological articles

The findings collated from the documents which involved physiological factors when teaching and learning pitch or hand signals are presented below (figure 11). This image

highlights the positives and negatives of vocal use and training and how it impacts pitch ability.

Figure 11. *Positives (green boxes) and negatives (red boxes) found in the physiology documents*



There are 2 physiology documents relating to the teaching of solfège hand signals and pitch (table 10).

Table 10. *Physiological studies*

	Author	Date	Title	Document
1	Bottalico, Gratezer and Hunter	2017	Effect of training and level of external auditory feedback on the singing voice: Pitch inaccuracy	Journal of Voice
2	Hutchins, Larrouy-Maestri and Peretz	2014	Singing ability is rooted in vocal-motor control of pitch	Attention, Perception, and Psychophysics

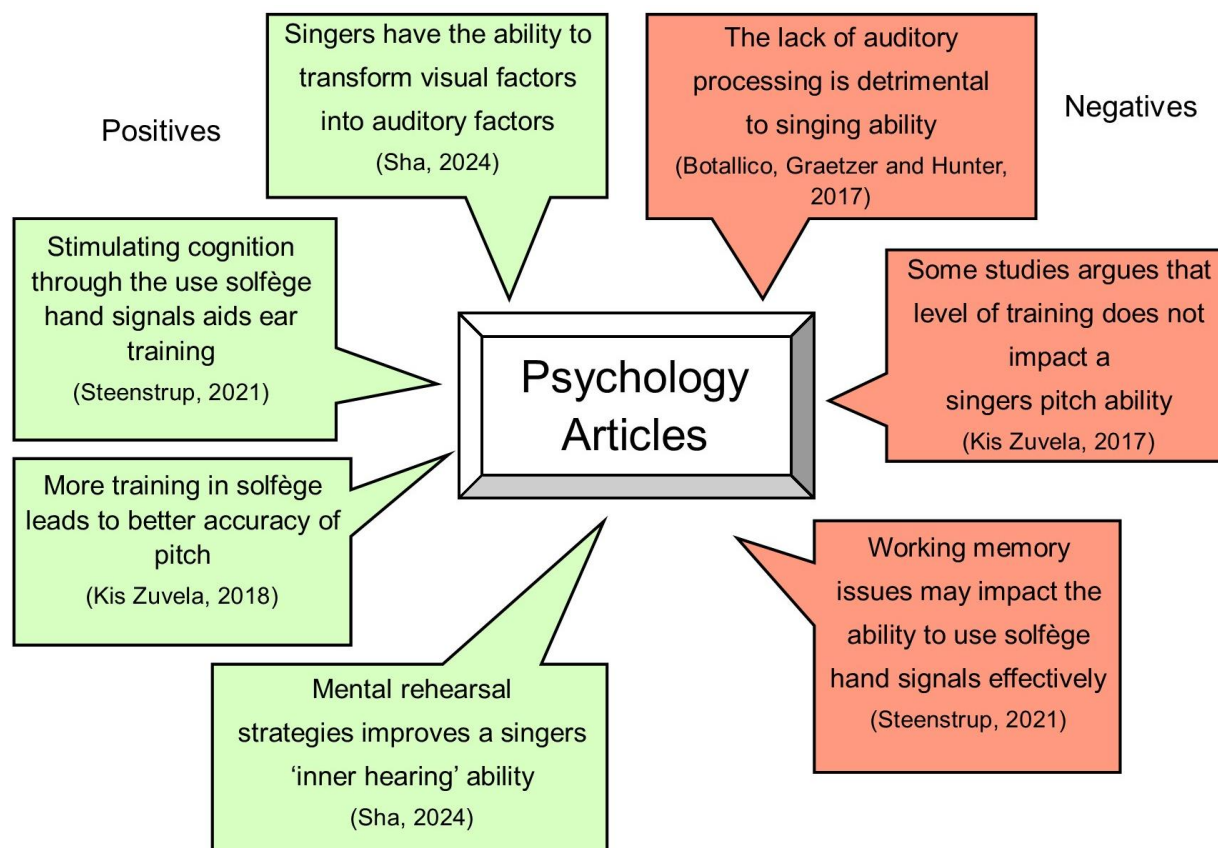
Hutchins, Larrouy-Maestri and Peretz (2014) discussed the vocal motor issues when attempting to pitch match during singing. Vocal motor skills are the ways in which the

vocal muscles are used to execute sound (Brand, 2021). Vallema et al (2018) discussed....and found that great consideration of vocal motor skills should be considered when pitch matching and stressed the importance of appropriate vocal training, more specifically from a young age to develop these motor tools efficiently into adulthood. Bottalico, Gratezer and Hunter's (2017) study also evidenced that vocal training enhances the agility of the laryngeal muscles accompanied by breath support, thus improving the accuracy of pitch when singing. This is due to trained singers maintaining consistent muscle tension throughout the phrases of the song.

Psychology articles

The findings collated from the documents which involved psychological factors when teaching and learning pitch or solfège hand signals are presented below (figure 12, pp. 53). This image highlights the positives and negatives of cognition when learning pitch and solfège hand signals.

Figure 12. *Positives (green boxes) and negatives (red boxes) found in the psychology documents*



There are 7 Psychology documents relating to the teaching of solfège hand signals and pitch (table 11).

Table 11. Psychology documents

	Author	Date	Title	Document
1	Botallico, Gratezer and Hunter	2017	The Effect of solfège syllable indications on sight-reading skills of undergraduate music majors	Journal of Voice
2	Eroglu	2021	Solfège teaching in higher music education in Turkey: instructors' perspectives	International Online Journal of Educational Sciences

4	Kervin	2023	The Key to singing off-key: The Trained singer and pitch perception distortion	Journal of Voice
5	Kis Zuvela	2018	When the fixed do tends to move: The ambiguity of the solfège syllabary	EBSCO Information Sciences
6	Sha	2024	International Journal of Education and Humanities Internal Listening and Musical Creativity: A Study of Brain Function	International Journal of Education and Humanities
7	Steenstrup et al.	2021	Imagine, sing, play-combined mental, vocal and physical practice improves musical performance	Journal of Education Learning

Sha (2024) explains that singers frequently transform visual indicators into auditory indicators and the prolonged use of these skills improves musical ability due to the collaboration of the motor and auditory cortex. Similarly, Eroglu (2021) elucidates that the ability to apply solfège hand signs into singing requires the brain to transmit the aural images that have been received which then assist the pitch control. Steenstrup et al (2021) produced a study which investigated whether the combination of mental, vocal and physical practice improves musical performance including pitch ability. They explain that research has shown that during singing, stimulating cognition by engaging solfège hand signs creates an aural image which enables a singer to identify the pitch. This study emphasises that the working memory greatly contributes to the effectiveness and success of ear training with solfège signals.

Kis Zuvela (2018) discussed the impacts of the level of solfège or ear training a student had received and concluded that previous training greatly influenced the participants pitch

ability. Steenstrup et al. (2024) study disagrees, claiming that any previous training including factors such as early onset training and accumulative years of training did not improve or affect the pitch accuracy of the participants. However, the disparity could be caused by different testing procedures.

Bottalico, Gratezer and Hunter (2017) stated that it is paramount for a singer to possess the cognitive skill of auditory processing and feedback, which is the ability to recognise sounds, hear your own voice externally and internally to be able to identify errors, as this technique allows the singer to hear, repeat and achieve accurate pitching. They also highlighted that the students who had previous vocal training achieved better pitch accuracy than those with no prior training. The number of years of training, however, was not impactful, any periods of training be it one year or ten were enough to increase pitch accuracy.

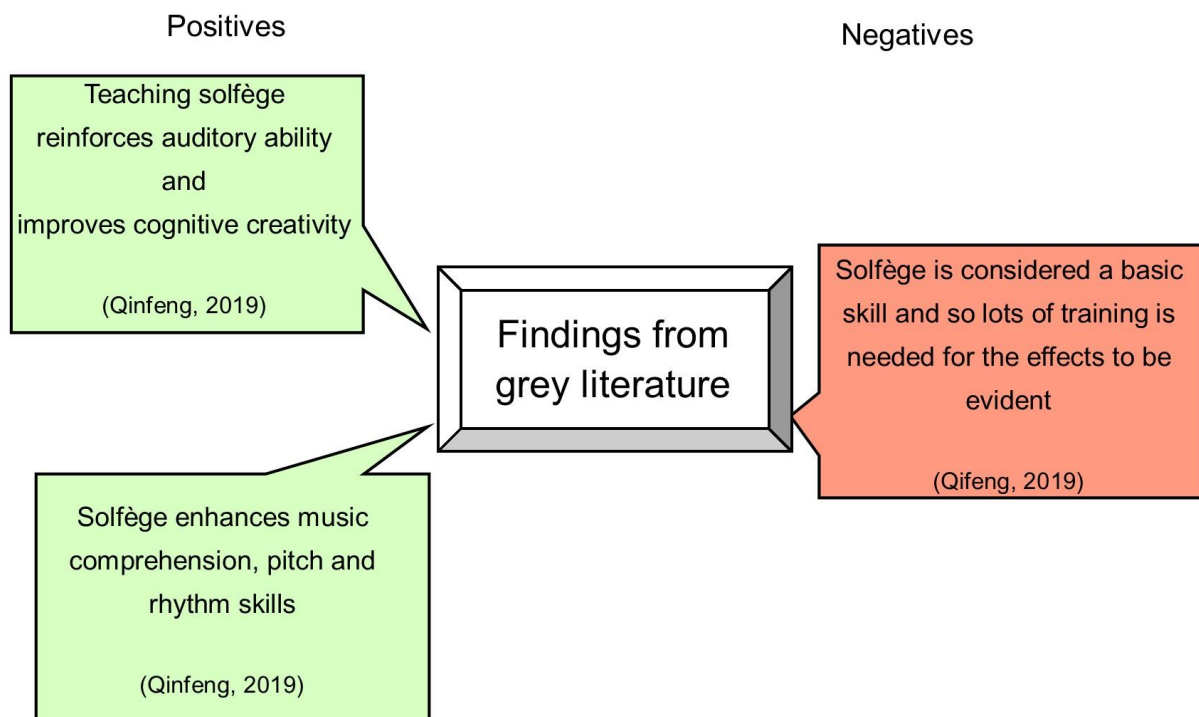
Kervin's (2023) study also investigated the effects of vocal training but argued the benefits of the extensivity. Their research predominantly focused on pitch perception distortion (PPD). PPD is the inability to identify whether a singer is singing in tune or not with music or instrument accompaniment (Bella, Berkowska and Sowinski, 2011). They concluded that the higher number of years or greater level in which the participants were trained the higher the prevalence of PPD. Furthermore, they stated that extensive training also resulted in reliance of kinesthetic techniques (body movement awareness and involvement), such as hand gesturing or moving the body to assist achievement of the pitch. This could therefore suggest that solfège and signals may also aid PPD.

Sha, (2024) discusses the phenomenon of inner hearing. This is the skill of hearing the pitch within one's minds without sound or music accompaniment (Tu and Mazlan, 2023). The study emphasises the use of mental rehearsal strategies to improve students' inner hearing. This teaching method consists of copying and repeating a song mentally without making any physical sounds which strengthens pitch recognition. Therefore, using the assigned solfège hand signs to the pitch being cognitively heard could assist in the inner hearing success.

Characteristics articles

The findings collated from the documents which involved characteristic factors such as gender or adult age are presented below (figure 13). This image highlights the positives and negatives of these factors when learning pitch and solfège hand signals.

Figure 13. Positives (green boxes) and negatives (red boxes) in found the characteristics documents



There are 2 characteristics documents included in this research relating to solfège hand signals and pitch (table 12, pp. 57).

Table 12. Characteristic articles

	Author	Date	Title	Document
1	Steenstrup et al.	2021	Imagine, sing, play-combined mental, vocal and physical practice	Frontiers in Psychology

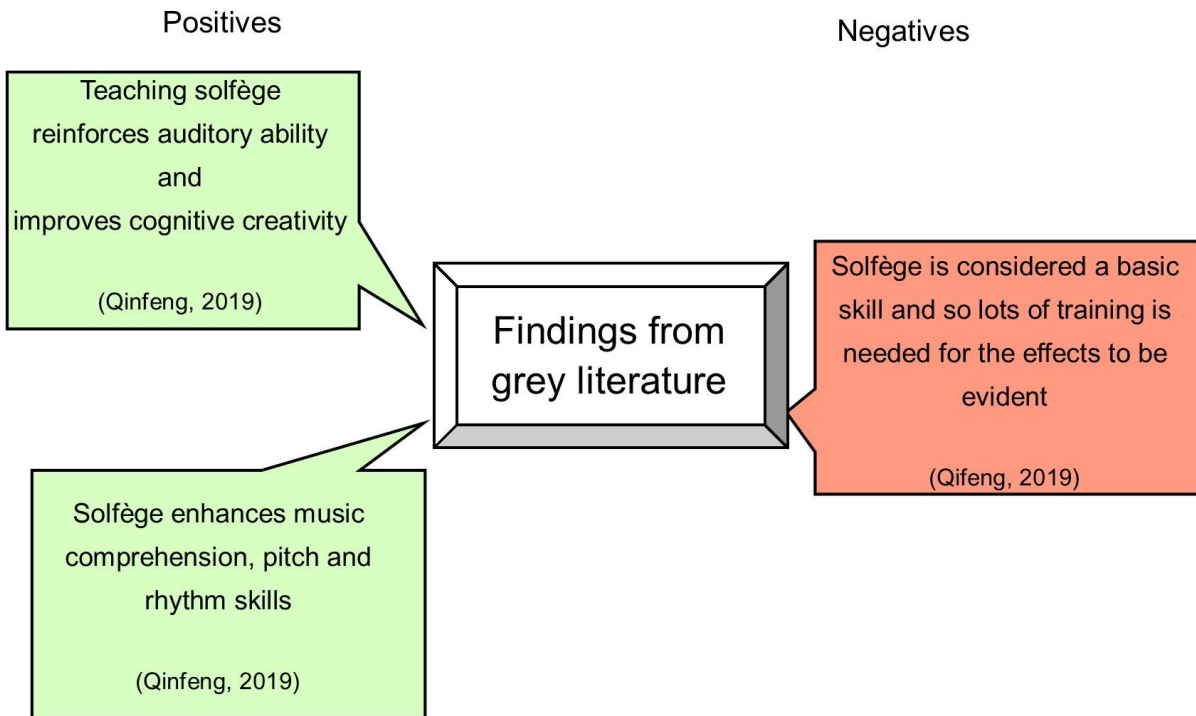
			improves musical performance	
2	Wolf and Kopiez	2018	Development and validation of the musical ear training assessment	Journal of Research in Music Education

Interestingly, Wolf and Kopiez (2018) conducted a study involving 393 professional and advanced amateur singers who were asked 25 questions about their overall ear training knowledge and experience which included pitch control and awareness. This quantitative, self-report method was used to determine correlations between factors such as age, gender and expertise. The research showed no differences in age or singing experience but did present dissimilarities in gender, resulting in men outperforming women in pitching, loudness and rhythmic tasks. With this information in mind, consideration should be given to the fact that gender could impact the learning process and progress of a student. Arguably, Steenstrup et al. (2021) determined that gender did not affect the performance outcome. However, the testing procedures were different for each study which could explain the disparity between the results.

Findings from the grey literature

The findings collated from the grey literature document are presented below (figure 14, pp. 58). This image highlights the positives and negatives of the information found within this study.

Figure 14. Positives (green boxes) and negatives (red boxes) found in the grey literature



Qinfehng (2019) expressed that the teaching of solfège reinforces a student's auditory ability as well as improving their creative minds which is important for musical expression and performance. This study stresses, however, that the level of training in solfège is paramount to sufficiently interpret music, therefore, it may take time and lots of training before solfège manifests itself as a successful aid when singing. It is also discussed that teachers should acknowledge individuality of their students and adapt their solfège training accordingly to teach effectively. Despite this research defining solfège and ear training as a basic foundational skill it also highlights the importance of it and how it enhances musical understanding, pitch and rhythm ability and hearing accuracy. This research may be considered grey literature which can sometimes raise questions of its reliability and validity, but this paper has been peer-reviewed and has provided useful points and important information relevant to my research question.

Limitations

There were limitations from incorporating literature reviews as well as participant-based studies. Extracting the data was time consuming as I needed to ensure I did not duplicate any findings. I had to scrutinise the documents multiple times, constantly referring to other data collections to check for overlapping results. Considering this is the first time conducting a document analysis, for future research, I would choose either empirical data or theoretical

and not a collaboration of both as this process was challenging, time consuming and often confusing.

One of the inclusion criteria for my study was documents that had been produced within the last ten years. Even though I did manage to locate some studies, there were plenty more available which could not be included due to the age of the publication. More recent studies of ear/aural training and or solfège hand signals seem deficient which highlighted a gap in the research. Moreover, it was evident that collaborative studies to how solfège hand signals impact pitching were far and few between and most of the data extracted was done so from separate research. Therefore, future research which specifically investigates solfège hand signals and pitch would be advantageous.

Furthermore, most of the studies relating to the teaching of solfège involved child participants or were child focused, especially Kodály method research. I have no doubt that these studies would have held valuable information regarding my research question, but my study focused on adults only and so again further research testing these methods and the correlations between solfège hand signals and pitch for adults is needed.

Time management has been a struggle through the course of this study. Gantt charts are an incredible useful tool to keep a study flowing and to ensure it does not fall behind or nothing is missed from the process. However, unforeseen circumstances are a challenge to navigate since they are unexpected. There were moments where my research was unable to follow the schedule as highlighted in my proposed Gantt chart which meant I had to source additional time to complete without allowing the study to miss its submission date. In the future, I will need to approach the research differently. Instead of following the Gantt chart precisely and literally, I need to see it more of a suggestive schedule. This means any spare time I have, dedicate it to studying even if that means becoming ahead of schedule or finishing early. Therefore, any unplanned issues that may arise will not affect the research end goal.

Accessibility has been an ongoing challenge during the course of my master's degree, and it was no different for this study. Despite Bawack and Nkolo (2018) discussing the success of the Open Access Movement (an act which aims to make scientific publications freely accessible and visible) there are still lots of documents which are inaccessible. I attempted to source the literature on many different platforms including the university library but sadly some were completely unobtainable. To avoid this problem in the future I could ask the

university for help accessing a document to see if they can intervene and invest by purchasing some subscriptions which then allow access.

Discussion

Altheide's (1996) framework was beneficial and helpful to this study as it allowed for flexibility in the analysis. It enabled me to consider a wide range of possibilities and enabled me to generate clearer insights by not being confined to an inflexible and rigid framework. The reflective practice was also useful as it allowed me to document my thoughts and issues which then enabled me to evaluate and reflect upon them.

Ear training and solfège has been described as a basic yet essential part of singer training (Hutchins, Larrouy-Maestri and Peretz's, 2014). Studies have also shown that solfège is an efficacious system which aids singers musical understanding, notation, pitch, rhythm and memory skills, with many scholars advocating for its use (Agbenyo, 2021). However, it is evident from the research that solfège and ear training complement each other, and, in some studies, they have been proven to be crucial for one another (Okeyo, Shithandi and Kanake, 2022).

This DA has shown that using hand signals helps a singer to remember each note through the visual aid of the hands and assigns them to the corresponding notes which in turn assists them to find the correct pitch (Kis Zuvela, 2018). Some of the research spoke generally about hand signs instead of specifically to solfège hand signals but this still provided insight to the positive effects using the hands has on singers and so it can be considered that solfège hand signals would provide the same outcome as general gesturing. The use of the Curwen and Kodály Methods also proved efficacious from the data analysed (Reifinger, 2020). However, Kodály seemed to be the preferred and frequently used technique (Tabuena, 2021). A study that focuses directly on Kodály hand signs and pitching could be advantageous as a follow on from this research and to strengthen the results found within this QDA. Furthermore, it was established that both movable do, and fixed do solfège systems have their own benefits and drawbacks, but testing has shown that movable do is better for early onset of solfège training and fixed do is seemingly more for advanced singers (Eroglu, 2021).

Memory and cognition play a large part in learning solfège, and pitch and so students need to be able to remember the different hand signs and which note they are associated with which could be challenging for anyone lacking in memory capability (Sha, 2024). This is

something that should be considered for every student before initiating the teaching of solfège hand signals.

The documents also analysed other factors including characteristics, interval training and physiology. Age, gender and level of training produced conflicting results, with some stating these characteristics did not affect the outcomes but others declaring that it did have an impact (Wolf and Kopiez, 2018). In relation to interval training, research showed this method is helpful for ear training, but more research is needed to establish its direct link to solfège hand signals (Kervin, 2023). Physiologically, research showed that vocal motor skills are essential for pitch matching and the correct use of the vocal muscles is paramount to achieve this (Bottalico, Gratezer and Hunter's, 2017). This once again highlights that singing is a multimodal skill that requires physiological involvement as well as psychological and pedagogical. Using the vocal apparatus efficiently with the assistance of cognition and good teaching strategies is required for optimal singing (Hutchins, Larrouy-Maestri and Peretz, 2024).

Some challenges were identified in the training of solfège, with some studies stating that teachers were either not trained sufficiently or they did not feel confident to teach the method despite being trained (Zhao, 2024). Furthermore, some research showed that some teachers did not know how to amalgamate ear training and solfège to provide a hybrid training method for students (Eroglu, 2021). Ristow, Thomsen and Urista (2014) also highlighted that student's found solfège training boring which lost their concentration and engagement. This is another issue that teachers need to mitigate by finding a way to make the lesson more appealing and interesting.

Upon completion of the DA, it was obvious that more research is necessary to fill the gaps in research found from this study and further research is needed to answer additional questions raised by the research already conducted. Despite some of the findings providing valuable information in relation to my research question, there are factors to consider upon conclusion of the data. Firstly, some of the testing methods were different across studies which could explain the disparities in the results. Mitigation would be to conduct further studies with the same methods to compare the findings. Furthermore, as per my inclusion criteria, studies ranged from ten years old to the present day. Even though some may consider ten years as still relatively new. Iliescu and Greiff (2021) explain that research can develop and testing methods can evolve and so this may have impacted the results, therefore this factor should be considered when analysing the data. Additionally, the

duration of the studies was not mentioned in many of the review studies. This could affect the outcomes of the studies, therefore, in future, when conducting research, consideration to the study durations should be given (Feely et al., 2020).

Conclusion

My study was an investigation into whether using solfège hand signals could be a useful strategy to help develop pitch matching. After analysis, the data has shown that solfège hand signaling positively impacts pitch achievability. Results emphasised the importance of a synthesised teaching strategy which engages both solfège and ear training, as well as highlighting that assistance of visual aids and memory task involvement is also beneficial.

However, it did also demonstrate some drawbacks. The studies have emphasised that teachers need to ensure they are competent and confident when it comes to delivering a solfège system for their students and that the selected system is suited to the teacher and students alike with frequent monitoring and adaptations as students learn differently and independently (Felder and Brent, 2024). Overall, despite being confident that the research question was answered appropriately, more research specifically testing solfège hand signals and pitch would be advantageous to provide clear, definitive results.

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Appendices

Appendix 1. Reflective diary

Table 1. Reflective diary entries

Date:	Reflective diary entry:	Comments
July 2 nd 2024	I watched a tutorial session on document analysis.	This introduced me to Altheides (1996) six step method for conducting a document analysis which was very helpful.
July 2 nd 2024	I read information to familiarise myself with the document analysis process (Downe et al., 2019; Wood, Sebar and Vecchio, 2020; Morgan, 2022)	This document was useful and gave me all the information needed to begin my document analysis.

July 8 th 2024	A decision was reached on the research title and subject.	This was completed with the involvement and advise from my Tutor.
July 10 th 2024	Today I constructed my project proposal.	I familiarised myself with proposals from other modules to ensure the layout and flow was correct, which refreshed my memory of what is expected from this section.
July 12 th 2024	I made a Gantt chart to schedule my research.	I did not feel comfortable using a different time management tool for this study as I am used to the Gantt option.
July 18 th 2024	I began to introduce my project report.	I used the project proposal as a basis for the introduction to guide it.
July 22 nd 2024	Today, I started a brief literature review to investigate ear training and solfège and hand signals.	This gave me the basic knowledge to which I expect the document analysis later will build upon.
July 28 th 2024	I created tables to show the databases that I will access during the document analysis and thought of some key words which will guide the document search.	Using tables enables me to see the information clearly and concisely, it has been a useful way to navigate the data.
August 1 st 2024	Conceived the inclusion and exclusion criteria for my study.	This is based on what I know now, and I anticipate this may change as the research progresses
6 th August 2024	Now I have my inclusions and exclusions, I began exploring the literature to find documents which were compliant.	This process was overwhelming. There was so much to see and was easy to get carried away into studies

		that were not pertinent to my research question. I had to continually remind myself of what that was whilst locating data.
10 th August 2024	Documents used for my document analysis. have been presented in a table.	I have not yet read these documents meticulously and so some may not provide relevant data for my research, but they will remain in the study and discussed separately.
11 th August 2024	Now that I have located the document for analysis, I have chosen to use the six-step thematic method created by Braun and Clark (2006). As well as colour coding the data so it is visually easy to see and extract.	I have implemented this style of coding before and being familiar helps the process and the colours help me to easily differentiate the subsections.
20 th August 2024	I began reading all the documents for analysis.	This is a very time-consuming process but the use of colours to code was helpful.
24 th October 2024	Tutorial with tutor	Helpful session highlighting lots of issues.
13 th November 2024	A decision was made to submit a draft due to lack of confidence in the document analysis process due to not undertaking this type of study before.	My tutor highlighted many issues and explained that my current procedure was not correct for a document analysis and advised to revisit the document analysis tutorial to better understand the process.
20 th November 2024	I revisited the tutorial on document analysis and researched deeper for better understanding.	This was helpful and enabled me to fully understand what is meant by a document

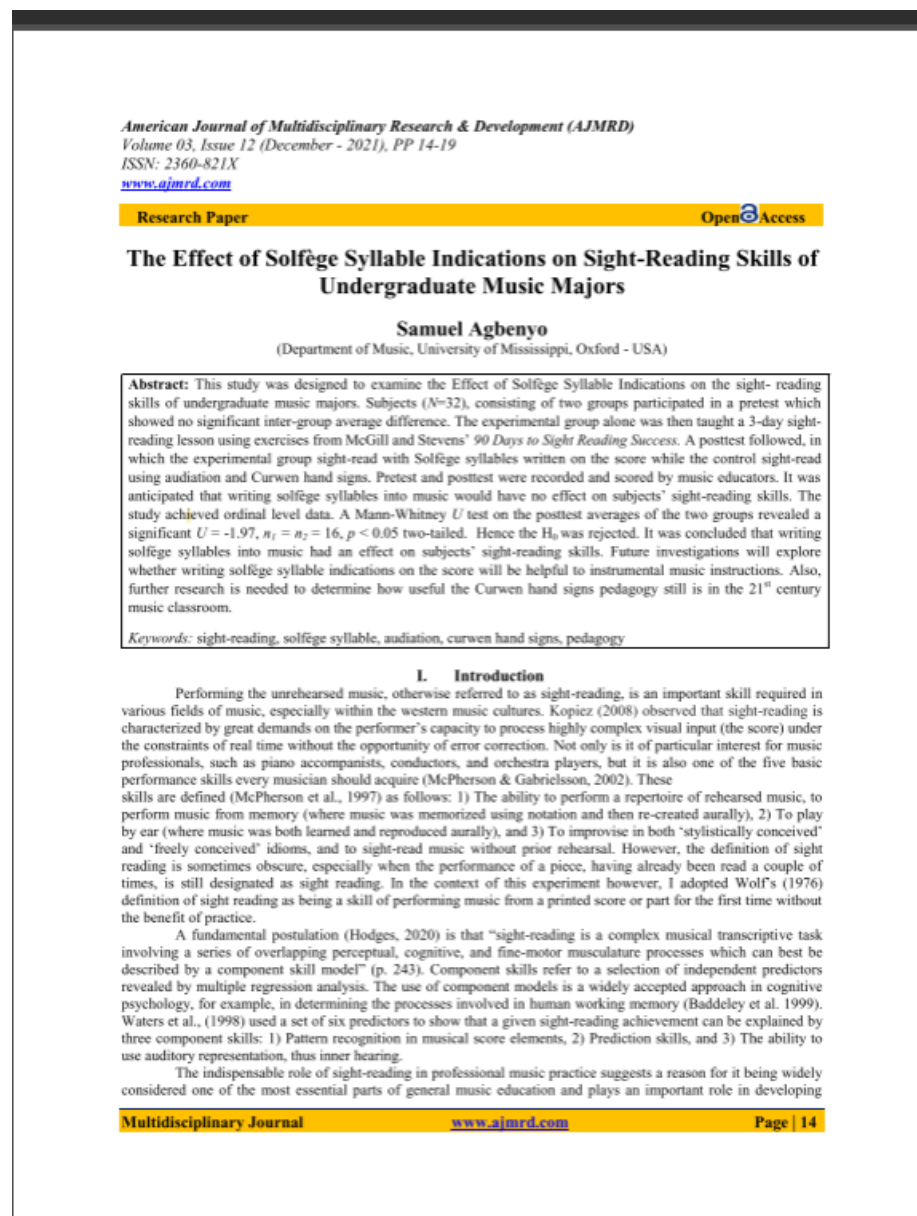
		analysis, however this did highlight many flaws in my current study.
22nd November 2024	I revised my research title today making it more specific and fluent to enable a more precise analysis to take place. This led to sourcing some different documents for the study and removing others that were no longer relevant.	Being more specific in my research title meant a more detailed document search could take place. This allowed me to narrow down and exclude non-pertinent data sources.
6 th December 2024	Tutorial with tutor	Confirmed the new title and pathway was suitable.
7 th December 2024	Today I began reading each document and highlighting the information in different colours .	This was a lengthy process, and I had to revisit the colours and themes as more information was being extracted which changed the subsections or added to them.
18 th December 2024	I now did a secondary pass on the documents reading them all carefully again	This proved lucrative, as I missed some information on the first read. This also highlighted new terminology that I was not aware of.
19 th December 2024	I searched the databases for other studies with the new terminology I had learned from the included documents and added them to the inclusion criteria table.	This really expanded my knowledge as I was learning lots of new information, terms and techniques with these new studies.
28 th December 2024	I read the document one last time to begin extracting the findings which I wrote up for the assignment.	This was quite confusing at times as I was typing up the findings from each individual document but once I read through them all I could see

		they then needed putting together and retyping to enhance the flow of the assignment.
29 th December 2024	I revisited the findings to ensure I gave ethical consideration throughout.	At times I found this challenging and sometimes had a memory block, but I researched ethics again and read literature to help me refocus and find the ethics within my research.
1 st January 2025	I wrote up my limitations that I experienced during the assignment.	I noted down some limitations during the process as I stumbled across different issues in different areas of the research. It was useful to document these as they were identified as I may have forgotten them late in the study.
8 th January 2025	Tutorial with tutor	Checked over my progress, advise given on presentation which was addressed.
11 th January 2025	Today, I wrote my critical reflection to discuss what I would do differently in future research.	Previously, I had struggled with this section in other studies, but this assignment enabled me to reflect well on the process.
12 th January 2025	I produced the conclusion of my assignment today.	I was able to answer my research question which was fulfilling.
14 th January 2025	Tutorial with tutor	Advice given on adding some visuals which were addressed

		and inputted into the assignment.
20 th January 2025	Because the assignment was completed, I used the extra time to revisit the essay and check that I had no grammar or spelling issues. I ensured the font, spacing and titles were correct, and I also checked the flow. Finally, I inspected whether I had employed the Point, Evidence, Explain, and Link technique (Atac, 2015).	
27 th January 2025	Draft assignment was submitted.	I am feeling confident about this assignment but fully expect re-writes to be needed.
28 th January 2025	I began creating my slides for presentation.	I did a little catch-up session from watching a tutorial provided by the voice study to recap on making a slideshow.
30 th January 2025	Re-writes begin.	I was given lots of constructive criticism which will help to elevate my research.
1 st February 2025	Continuing the presentations slides.	
17 th February 2025	Final Submission	
25 th February 2025	Rehearsing the presentation multiple times.	This was done timed to ensure I can finish it accordingly.

Appendix 2. Colour coded documents

Figure 1. Agbenyo (2021)



independent music learners (Collins, 2008). It is therefore, a good indicator of music achievement (Hayward & Gromko, 2009) since it is believed that better sight-readers tend to be better performers (Lehman & McArthur, 2010). Furthermore, sight-reading is one of the core skills mentioned in the National Association for Music Education's Core Music Standards (NAfME, 2015). In many states and countries across the world, sight-reading is a required constituent of musical contest participation as it is for all-state choir auditions in the United States of America (Henry, 2011). A variety of opinions exist, however, as to the best method of teaching sight-reading in the general music classroom (Arthur et al., 2020; Henry, 2001; Orton, 1929; Salzberg, 1989).

Although myriad approaches are being used by music educators to help learners develop sight-reading skills, Kim et al., (2021) the most commonly used melodic pitch systems according to McClung (2001) include interval names, letter names, fixed-do, scale-degree numbers, and moveable-do. Research regarding the best teaching method has so far been inconclusive (Demorest & May, 1995), yet averred that singers using moveable-do solfege achieved significantly higher scores in sight-reading than those using fixed-do syllables and other related techniques. They contended that a focus on targeted pitch instruction will improve sight-reading skills, making reference to Rohwer and Henry's (2004) finding of a significant increase in sight-reading ability of students after a twelve-week duration of targeted pitch instruction. Furthermore, Boyle and Lucas (1990) found that sight-reading scores were significantly higher when the sight-reading performance included a harmonic accompaniment.

Also, according to Lovorn (2016), educators have experimented with removing rhythm from sight-reading exercises to improve pitch accuracy, and found that pitch accuracy of a passage that was sight-read was not affected by the presence of rhythm tasks, even when the tasks were of varying levels of difficulty. Rather, teachers lack time and other resources for regular sight-reading assessment. Similarly, Daniels (1986) argued that sight-reading ability was not directly related to curriculum and had more to do with attitude of the music teacher toward the skill. If the teacher finds sight-reading important, then the students sight-read at higher levels, and vice-versa. This correlates with Demorest's (1998) study that found that proper attention to individual testing is a useful technique in aiding the development of sight-reading skills.

Studies in neuroscience have led us to an understanding that music experiences are processed in several areas of the brain (Hayward & Gromko, 2009). Research has also been conducted on visual, spatial, and kinesthetic learning tools when teaching sight-reading (Hutton, 1953) revealing that the use of visual materials simplifies the learning process and diminishes the effort required to understand abstractions. So, one of the tools strongly recommended in the Kodály way of music instruction is the use of solfege syllables (Choksy, 1998). When using this Kodály-inspired instruction, solfege syllables are usually printed spatially on unlined paper or within note heads on staff paper. The use of moveable syllables, often reinforced kinesthetically with hand signs, is a commonly researched method. (Bentley, 1959; Bridges, 1982; Frey-Clark, 2017; Harris, 1918; Vajda, 1991). While Killian and Henry (2005) argued that students performed with higher accuracy while sight-reading individually using hand signs. Meanwhile, McClung (2008) found the opposite result, contending that the use of Curwen hand signs did not have any significantly different effect.

The use of shape-note notation was another tool found to be useful in music reading as found by Martin (2014) that placing the note heads or letter representations of syllables at varying heights on cards did improve student sight-reading performance. In a comparative study of the use of audio-visual materials in sight-reading instruction, Hutton (1953) revealed that students who learned with the aid of flash cards, musical games, and slides scored significantly higher than the students who received no visual aids during instruction. Meanwhile, the use of color-coded notation on 5th and 6th grade beginning instrumental players' sight-reading ability showed no significant advantage for the experimental group who had been taught to read with the color-coded notation over the control group that was instructed with normal un-colored notation in Rogers' (1991) study. Nonetheless, the students in the experimental group seemed to be dependent on the color-coded notation, scoring the lowest scores when reading regular black and white notation. Furthermore, in a latter experiment Rogers (1996) found instruction involving the addition of color to standard rhythmic notation positively affected the performance of students on the tasks of vocalizing and clapping rhythms at sight.

Research conducted in music education has shown that sight-reading is improved through teaching approaches that integrate auditory, visual, and kinesthetic processing (Hayward & Gromko, 2009). One of the tools which music teachers use is making learners write solfege syllables into the music score. Several music educators believe that the action of writing is used to reinforce the learner's ability to pair each note to its solfege syllable. It is also common to have the learners write the solfege syllables next to the note to try to reinforce the spatial positioning of the notes on the staff (Harris, 1918). By this practice, effort is made to combine auditory, visual, and kinesthetic skills to sight-read a piece (Martin, 2014).

The purpose of this study was to investigate the effectiveness of writing solfege syllables into music as a mean of developing learner's sight-reading abilities. The H_0 was that writing solfege syllables into music would have no effect on subjects' sight-reading skills.

II. Method

This experiment was modeled after Lovorn's (2016) *The Effect of Writing Solfege Syllables into Choral Repertoire on the Sight-Reading Ability of High School Choir Students*. However, unlike the extant model, my experiment was conducted on undergraduate subjects being general music teacher trainees in the University of Education, Winneba (UEW) - Ghana. Other significant differences in my work include the sample size, sampling procedure, the duration of the experiment, the testing instrument, as well as my H_0 instead of research questions, among others. I have designed two sight-reading melodies similar to exercises from "Week 13" in McGill and Stevens' *90 Days to Sight Reading Success* (2003) as cited in Lovorn, (2016). Each melody was nine measures long, in the key of G major, in simple duple meter, and on the treble staff as shown in the Appendix. I did much to ensure that both melodies were of similar difficulty by using the same number of rhythmic changes and the same intervals.

Undergraduate students ($N = 32$) in the department of music education, UEW were sampled to participate in the study. This department hosts three different music programs, with ten levels (classes) of students. These include (1) Two-year Diploma in Music (levels 100 and 200), Bachelor of Arts in Music Education (levels 100 - 400), and Bachelor of Music (levels 100 - 400). Each class had a separate interactive group whatsapp platform, with some faculty members included. Having worked in the department for five years I was still on many of those group whatsapp platforms in good rapport with both students and faculty. Therefore, with prior permission of the departmental Chair, I invited the students via their group platforms to participate voluntarily in the study by showing their consents on the group platform, or to my personal phone number or through email.

A pre-test was conducted to determine the baseline sight-reading abilities of subjects prior to the start of experiment. Subjects were then randomly assigned to sight-read either melody A or melody B. In each group, half of the participants were pretested with melody A while the other half did melody B. Participants were given one minute to chant through the melody. At the end of the chant period, the tonic chord was played and subjects were instructed to sing the melody.

Each pre-test was recorded and scored from the recording. Subjects received a point for every correctly sung pitch with a maximum score of 20. An independent expert music educator analyzed 55 % of the pretest recordings randomly selected from group. A Mann-Whitney U test conducted revealed a z -score, $z = 2.3$, $p < 0.5$, indicating that there was no statistically significant difference between the means of the two groups.

When the pre-tests were completed, both group A and group B were taught a 30-minute sight-reading lessons for three consecutive days on zoom. Each lesson contained a melody from the *90 Days to Sight Reading Success* book. Lessons from day one through day three corresponded with "Week 8 through week 10" respectively in the book. Group A ($n = 16$) was given a new melody for each lesson and given 40 seconds to write solfege syllables on their score. Half of the group wrote the solfege syllables next to the note head and the other half wrote the solfege syllables under the staff. Subjects then chanted through the melody three times followed by pitching it on the tonic of the key and singing the melody three times.

Group B ($n = 16$) was as well given a new melody - same melody as group A was given for each new lesson, and were asked to chant through it three times using solfege syllables (without writing the solfege syllables on the score). After that the tonic chord was played and subjects were be given two minutes to audiate the melody individually. In the process of audiation, the students were instructed to hear the melody in their head while **mouthng solfege syllables and doing John Curwen hand-signs alongside**. At the end of the two minutes, the tonic chord was played again and subjects sung melody three times.

When the three-day instruction was completed, every participant took a post-test. In this test, subjects used the alternative melodies in their groups which they did not sing for the pre-test; thus, the opposite melody from their pre-tests in their respective groups. That means if a participant did the pre-test with melody A then they did posttest with melody B. All participants were given two minutes to chant through the melody. At the end of the chant period, the tonic cord was played followed by instruction for the subjects to sing the melody. Just like the pre-test, each post-test was recorded and scored from the recording. Every subject was awarded one point for each correctly sung pitch with a maximum score of 20 points. Two music educators from the same department assisted me in conducting the pre-test, the three-day lessons, and the post-test. Scoring was done by the expert music educators who scored the pre-test with 96% reliability.

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A pre-test was conducted to determine the baseline sight-reading abilities of subjects prior to the start of experiment. Subjects were then randomly assigned to sight-read either melody A or melody B. In each group, half of the participants were pretested with melody A while the other half did melody B. Participants were given one minute to chant through the melody. At the end of the chant period, the tonic chord was played and subjects were instructed to sing the melody.

Each pre-test was recorded and scored from the recording. Subjects received a point for every correctly sung pitch with a maximum score of 20. An independent expert music educator analyzed 55 % of the pretest recordings randomly selected from group. A Mann-Whitney U test conducted revealed a z -score, $z = 2.3$, $p < 0.5$, indicating that there was no statistically significant difference between the means of the two groups.

When the pre-tests were completed, both group A and group B were taught a 30-minute sight-reading lessons for three consecutive days on zoom. Each lesson contained a melody from the *90 Days to Sight Reading Success* book. Lessons from day one through day three corresponded with "Week 8 through week 10" respectively in the book. Group A ($n = 16$) was given a new melody for each lesson and given 40 seconds to write solfege syllables on their score. Half of the group wrote the solfege syllables next to the note head and the other half wrote the solfege syllables under the staff. Subjects then chanted through the melody three times followed by pitching it on the tonic of the key and singing the melody three times.

Group B ($n = 16$) was as well was given a new melody - same melody as group A was given for each new lesson, and were asked to chant through it three times using solfege syllables (without writing the solfege syllables on the score). After that the tonic chord was played and subjects were be given two minutes to audiate the melody individually. In the process of audiation, the students were instructed to hear the melody in their head while **mouthed solfege syllables and doing John Curwen hand-signs alongside**. At the end of the two minutes, the tonic chord was played again and subjects sung melody three times.

When the three-day instruction was completed, every participant took a post-test. In this test, subjects used the alternative melodies in their groups which they did not sing for the pre-test; thus, the opposite melody from their pre-tests in their respective groups. That means if a participant did the pre-test with melody A then they did posttest with melody B. All participants were given two minutes to chant through the melody. At the end of the chant period, the tonic cord was played followed by instruction for the subjects to sing the melody. Just like the pre-test, each post-test was recorded and scored from the recording. Every subject was awarded one point for each correctly sung pitch with a maximum score of 20 points. Two music educators from the same department assisted me in conducting the pre-test, the three-day lessons, and the post-test. Scoring was done by the expert music educators who scored the pre-test with 96% reliability.

Effect of Training and Level of External Auditory Feedback on the Singing Voice: Pitch Inaccuracy

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Summary: Background. One of the most important aspects of singing is the control of fundamental frequency. **Objectives.** The effects on pitch inaccuracy, defined as the distance in cents in equally tempered tuning between the reference note and the sung note, of the following conditions were evaluated: (1) level of external feedback, (2) tempo (slow or fast), (3) articulation (legato or staccato), (4) tessitura (low, medium, or high), and (5) semi-phrase direction (ascending or descending). **Methods.** The subjects were 10 nonprofessional singers and 10 classically trained professional or semi-professional singers (10 men and 10 women). Subjects sang one octave and a fifth arpeggi with three different levels of external auditory feedback, two tempi, and two articulations (legato or staccato). **Results.** It was observed that inaccuracy was greatest in the descending semi-phrase arpeggi produced at a fast tempo and with a staccato articulation, especially for nonprofessional singers. The magnitude of inaccuracy was also relatively large in the high tessitura relative to the low and the medium tessitura for such singers. Contrary to predictions, when external auditory feedback was strongly attenuated by the hearing protectors, nonprofessional singers showed greater pitch accuracy than in the other external feedback conditions. This finding indicates the importance of internal auditory feedback in pitch control. **Conclusions.** With an increase in training, the singer's pitch inaccuracy decreases. **Key Words:** singing voice—pitch accuracy—voice training—external auditory feedback—internal auditory feedback.

INTRODUCTION

Singers are typically required to sing with a high magnitude of precision in their fundamental frequency (f_0). This requires constant self-monitoring of vocal output and frequent small corrections in thyroarytenoid and cricothyroid muscle activity. In the context of singing, it is important that pitch accuracy be maintained even when singers cannot hear their own voices, so that their performance is not impaired by a loud orchestral accompaniment or by the choral sound of fellow singers.

During a performance, a singer will often perform in several different locations, in which the acoustic conditions and the balance with the orchestra will differ. Hence, with (classical) training, a singer will learn to rely not only on external auditory feedback, that is, the sound that the singer perceives of his or her own voice via air conduction, but also on proprioceptive feedback associated with internal (pallesthetic and kinesthetic) sensitivities. The main source of pallesthetic feedback is internal auditory feedback resulting from skull vibrations (bone conduction). Vibration of the vocal folds gives rise to a concomitant vibration in the bones of the skull, which stimulates the cochlea. There is also a perception of thoracic, facial, and other skeletal vibrations.^{1,2} The most relevant receptors of kinesthetic feedback are the laryngeal sensory receptors.⁴

The significance of external and internal feedback to pitch control has been considered in a few previous studies. It has been found that, in the absence of auditory feedback, pitch accuracy

typically decreases.²⁻⁷ Hence, Ternström et al argued, "proprioceptive feedback plays a less important role than the auditory feedback in the [f_0] control by singers."^{10(p1)} Elliot and Niemoeller⁸ and Schultz-Coulton⁹ found that external auditory feedback was vital to pitch accuracy, especially for adults without voice training (cf. Watts et al⁵).

There is some evidence of greater pitch accuracy for trained than untrained singers.^{8,9,10} However, self-reported singing talent in untrained singers appears to compensate for a lack of training.^{9,11}

In a partial replication of the Ward and Burns² study, Mürbe et al¹² found that the pitch accuracy of 28 singers who were at the beginning of their professional solo singing education decreased in the following conditions: (1) when auditory feedback was masked by noise at 105 dB(A) presented via headphones, (2) when a staccato vs. a legato articulation was used, and (3) when a fast vs. a slow tempo was used. In a second study, conducted immediately after the same subjects had completed 3 years of professional singing education, Mürbe et al¹² found the same trends with regard to masking noise, style, and tempo. They reported a smaller difference between masked and unmasked conditions in the slow (40 bpm) tasks in the second set of recordings, indicating a greater reliance on internal auditory feedback after the 3 years of education than before the education. There was no apparent effect of education on pitch accuracy in the fast tempo (160 bpm).

The effects of interval direction on pitch accuracy were reported by Edmonson.¹³ He analyzed the pitch accuracy of five groups of music students (vocalists, string instrumentalists, pianists, brass instrumentalists, and woodwind instrumentalists) on four intervals (the perfect fourth, perfect fifth, major sixth, and minor third). It was demonstrated that vocal pitch acuity on ascending intervals is much better than acuity on the same descending intervals.

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In the present study, the effects of the singers' level of training and the magnitude of external auditory feedback on pitch inaccuracy are investigated. In a previous study,¹³ the magnitude of the Lombard effect¹⁴ was investigated in the same 20 singers. It was found that trained singers were less responsive to changes in the level of the accompaniment than untrained singers, indicating less reliance on external auditory feedback. Therefore, the first prediction in the current study is that pitch accuracy is greater and less variable for trained than untrained singers across levels of external auditory feedback, tempo, articulation, and semi-phrase direction (ascending and descending) conditions. Second, it is predicted that pitch accuracy is better in an arpeggio produced at a slow tempo with a legato articulation and in the ascending semi-phrase than in an arpeggio produced at a fast tempo with a staccato articulation and in the descending semi-phrase. Finally, it is hypothesized that singers' pitch accuracy is reduced in the absence of external auditory feedback.

EXPERIMENTAL METHOD

Subjects

The use of human subjects for this research was approved by the Michigan State University's Human Research Protection Program (Institutional Review Board #13-1149). Ten female and 10 male singers (mean age 22.9 ± 4.5 years) volunteered to take part in the experiment. The sample was divided into two groups: the first comprised nonprofessional singers, and the second comprised professional classical singers. The age, gender, group, and voice type of the 20 subjects are reported in Table 1. The members of the nonprofessional group were mainly choristers in a *capella* choir, with a primarily popular repertoire. The professional

singers were predominantly Master's students in classical singing, with a primarily operatic repertoire and a mean number of years of singing lessons equal to 7.6.

Protocol

The experiment was conducted in a sound-treated booth (2.5×2.75 m and $h = 2.0$ m). In the first condition, this environment was unchanged (set normal). In the second condition (set panels), two reflective panels were placed in this room at 0.5 m from the singers, 45° from the mouth axis. In this condition, external auditory feedback was increased. In the third condition (set hearing protector), singers wore over-the-head, earmuff-style hearing protectors, which strongly attenuated external auditory feedback.

After an initial (guided) warm-up, consisting of five note scales covering the singer's range and a few repetitions of the arpeggio object of the study, singers performed arpeggi in three different external auditory feedback conditions. As a prompt, the first note was played on a keyboard before each arpeggio. The arpeggi were sung without musical accompaniment and without the use of falsetto. A metronome was displayed on a screen outside the sound booth and was visible but not audible.

A total of 12 tasks were recorded for each subject by means of a head-mounted microphone (Glottal Enterprises M-80 (Syracuse, NY, USA)), connected to a personal computer via a Focusrite (High Wycombe, UK) Scarlett 2i4 soundboard. The recording software used was Audacity 2.0.6 (U.S.). The order of set presentation was randomized, and the order of tempo and articulation conditions was randomized within each set. Tempo was varied between 40 and 160 bpm. Articulation varied between

TABLE 1.
Characteristics of the Sample, including Age, Gender, Group, Voice Type, Repertoire, Number of Years of Experience, and Number of Years of Classical Singing Lessons

Subject ID	Age	Gender	Group	Voice Type	Repertoire	Years of Experience	Years of Classical Singing Lessons
1	30	Female	Nonprofessional	Soprano	Choral classic	16	—
2	20	Female	Nonprofessional	Mezzo	Choral pop	10	—
3	21	Male	Nonprofessional	Baritone	Choral pop	10	—
4	19	Female	Nonprofessional	Soprano	Choral pop	12	—
5	20	Male	Nonprofessional	Tenor	Choral pop	4.5	—
6	29	Male	Nonprofessional	Tenor	Choral pop	12	—
7	19	Female	Nonprofessional	Mezzo	Choral pop	10	—
8	24	Male	Nonprofessional	Baritone	Choral classic	15	—
9	19	Male	Nonprofessional	Bass	Choral classic	10	—
10	19	Female	Nonprofessional	Soprano	Choral classic	10	—
11	19	Female	Professional	Soprano	Solo opera	4	3
12	25	Male	Professional	Tenor	Solo opera	12	10
13	19	Female	Professional	Soprano	Solo opera	7	2
14	32	Female	Professional	Soprano	Solo opera	14	12
15	21	Male	Professional	Baritone	Solo opera	12	12
16	22	Male	Professional	Baritone	Solo opera	12	6
17	24	Female	Professional	Soprano	Solo opera	7	7
18	26	Female	Professional	Mezzo	Solo opera	8	8
19	20	Female	Professional	Soprano	Solo opera	10	6
20	31	Male	Professional	Baritone	Solo opera	10	10

TABLE 3.

Means, Medians, and Standard Errors of the Distance in Cents Between the Note Produced by the Singers (Nonprofessional and Professional, Respectively) and the Reference Note by Articulation (Legato and Staccato), Tempo (Slow = 40 bpm and Fast = 160 bpm), and Semi-phrase (Ascending and Descending)

Group	Articulation	Tempo	Semi-phrase	N	Mean	Median	Std. Error
Nonprofessional	Legato	Slow	Ascending	174	27.6	25.7	1.4
Nonprofessional	Legato	Slow	Descending	145	31.6	31.1	1.7
Nonprofessional	Legato	Fast	Ascending	168	26.7	21.4	1.6
Nonprofessional	Legato	Fast	Descending	148	37.3	33.4	2.1
Nonprofessional	Staccato	Slow	Ascending	174	29.9	24.3	1.8
Nonprofessional	Staccato	Slow	Descending	144	37.3	35.4	1.9
Nonprofessional	Staccato	Fast	Ascending	176	44.4	39.2	2.2
Nonprofessional	Staccato	Fast	Descending	149	42.1	39.0	2.2
Professional	Legato	Slow	Ascending	180	16.8	14.9	0.9
Professional	Legato	Slow	Descending	150	21.5	19.0	1.3
Professional	Legato	Fast	Ascending	172	26.3	23.5	1.5
Professional	Legato	Fast	Descending	150	27.7	22.6	1.7
Professional	Staccato	Slow	Ascending	180	19.9	14.1	1.2
Professional	Staccato	Slow	Descending	150	23.4	22.1	1.2
Professional	Staccato	Fast	Ascending	180	33.7	26.9	1.9
Professional	Staccato	Fast	Descending	150	31.7	27.2	1.9

Note: N is the number of values in each condition.

semi-phrase direction, and interactions of tessitura and group, and interactions of set and group, and the random effects term was subject. The best of a set of nested models was selected on the basis of the Akaike information criterion and the results of likelihood ratio tests and were built using lme4 and lmerTest packages.

Fligner-Killeen median tests were used to test the null hypotheses that variances in pitch inaccuracy (distance in cents between the note produced by the singer and the reference note, on the basis of equal tempered tuning) were the same for the two or more levels of each of the following variables: group, tempo, articulation, and semi-phrase direction. The *P* values were corrected using the Benjamini-Hochberg false discovery rate method.

RESULTS

The means, medians, and standard errors of the distance in cents between the note produced by the singers (nonprofessional and professional, respectively) and the reference note by articulation (legato and staccato), tempo (slow = 40 bpm and

fast = 160 bpm), and semi-phrase direction (ascending and descending) are shown in Table 3. The means, medians, and standard errors of the distance in cents between the note produced by the singers (nonprofessional and professional, respectively) and the reference note by set (normal, panels, and hearing protector) are shown in Table 4.

Nonprofessional singers were found to have a mean pitch inaccuracy of 34.5 cents, and for professionals, a mean pitch inaccuracy of 25.0 cents. Mean inaccuracy was greater in the fast tempo (33.7 cents) than in the slow tempo (25.7 cents). Mean inaccuracy was greater in the staccato articulation (32.7 cents) than in the legato articulation (26.7 cents). Mean inaccuracy was greater in the descending semi-phrase (31.5 cents) than in the ascending semi-phrase (28.1 cents).

A generalized linear mixed model was run with a measure of pitch inaccuracy as the response variable, and the fixed factors (1) tempo (slow or fast), (2) articulation (legato or staccato), (3) group (nonprofessional or professional), and (4) semi-phrase direction (ascending or descending), and interactions of (5) group and tessitura (low, middle, or high) and (6) group and set (normal,

TABLE 4.

Means, Medians, and Standard Errors of the Distance in Cents Between the Note Produced by the Singers (Nonprofessional and Professional, Respectively) and the Reference Note

Group	Set	N	Mean	Median	Std. Error
Nonprofessional	Normal	414	35.3	30.7	1.3
Nonprofessional	Panels	438	35.0	30.3	1.2
Nonprofessional	Hearing protector	426	33.1	31.7	1.1
Professional	Normal	432	24.9	20.4	0.9
Professional	Panels	440	25.9	21.1	1.0
Professional	Hearing protector	440	24.2	19.0	0.9

Notes: The covariate is set (normal, panels, and hearing protector). N is the number of values in each condition.

TABLE 5.

Results of as Generalized Linear Mixed Effects Model including the gamma response variable of distance in cents between the Note Produced by the Singers and the Reference Note

Parameter	Estimate	Std. Error	t Value	P Value	
(Intercept)	0.794	0.019	41.73	0.001	§
ArticulationStaccato	-0.047	0.005	-10.33	0.001	§
TempoFast	-0.033	0.005	-7.32	0.001	§
GroupProfessional	0.005	0.026	1.82	0.069	*
Semi-phraseDescending	0.019	0.005	-4.19	0.001	§
GroupNonprof:TessituraMid	-0.004	0.008	0.62	0.532	
GroupProf:TessituraMid	0.014	0.008	1.76	0.079	*
GroupNonprof:TessituraHigh	0.006	0.008	-0.88	0.378	
GroupProf:TessituraHigh	-0.024	0.008	2.83	0.005	†
GroupNonprof:SetPanels	0.005	0.008	0.61	0.542	
GroupProf:SetPanels	0.006	0.008	-0.83	0.405	
GroupNonprof:SetHearProt	0.016	0.008	2.04	0.041	†
GroupProf:SetHearProt	-0.005	0.008	0.50	0.618	

Notes: The reference levels are articulation legato, tempo slow, set normal, group nonprofessional, semi-phrase ascending, and tessitura low. The fixed factors are articulation (legato or staccato), tempo (slow = 40 bpm or fast = 160 bpm), group (nonprofessional or professional), and semi-phrase (ascending or descending). The interactions are group:tessitura (low, middle, or high) and group:set (normal, panels, or hearing protection).

* P value <0.1.† P value <0.05.‡ P value <0.01.§ P value <0.001.

panels, or hearing protectors). Subject was included as a simple random effects term. Model estimates with associated standard errors and P values are given in Table 5.

Pitch accuracy tended to be better for the professional singers than for the nonprofessional singers at $P = 0.07$ (when singing in the slow tempo in the legato articulation in the normal set and in the ascending semi-phrase). As shown in Figure 2, the difference between the groups was especially apparent in the high tessitura ($P < 0.01$), in which the professional singers were most accurate (of the three tessitura), and the nonprofessionals were least accurate. Figure 3 illustrates that, for both groups, pitch inaccuracy was reduced in the slow relative to the fast tempo ($P < 0.0001$). As shown in Figure 4, inaccuracy was reduced in the legato relative to the staccato articulation ($P < 0.0001$), especially for nonprofessional singers. Inaccuracy was lower in the ascending semi-phrase than in the descending semi-phrase ($P < 0.0001$), once again especially for the nonprofessional singers (Figure 5). As illustrated by Figure 6, nonprofessional singers showed a lower inaccuracy in the set in which hearing protection was worn relative to the normal set ($P < 0.05$), whereas professional singers were not influenced very much by external auditory feedback.

Fligner-Killeen (median) tests with Benjamini-Hochberg corrected P values indicated that there was greater variance in pitch inaccuracy for the nonprofessional than the professional singers ($F-K X^2 = 77.23$, $df = 1$, $P < 0.0001$), for the fast than the slow tempo ($X^2 = 83.02$, $df = 1$, $P < 0.0001$), for the staccato than the legato ($X^2 = 53.47$, $df = 1$, $P < 0.0001$), and for the ascending than the descending semi-phrase directions ($X^2 = 5.76$, $df = 1$, $P < 0.05$). There was insufficient evidence that variances differed between tessitura ($X^2 = 5.89$, $df = 1$, $P = 0.053$) and sets ($X^2 = 1.18$, $df = 1$, $P = 0.55$).

DISCUSSION

The present study was carried out to assess the effect of training level on singing pitch accuracy and to quantify differences in pitch accuracy for vocal tasks differing in articulation, tempo, semi-phrase direction, and levels of external auditory feedback.

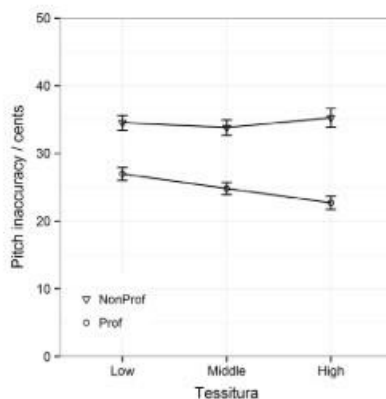


FIGURE 2. Means and standard errors of pitch inaccuracy (distance in cents in equally tempered tuning between the reference note and the sung note) by tessitura (low, middle, and high) per group (professional and nonprofessional).

The mean pitch inaccuracy of the professional group, equal to 25.0 cents, was lower than that of the nonprofessional group, equal to 34.5 cents. This means that, generally, in all conditions, the performance of the professional singers was more accurate in pitch. This result, even though different from that found by other researchers,⁵⁻¹⁷ is predictable because of the increased capability of the professional vocal instrument in terms of (1) agility in the use of the laryngeal muscles and (2) control in the breath support,¹⁸ both of which will allow the singers to achieve good pitch accuracy even in the high tessitura. A higher level of agility will lead to a lower pitch inaccuracy in the staccato articulation (38.3 cents for nonprofessional singers and 27.1 cents for professional singers) and in the fast tempo pattern (37.6 cents for nonprofessional singers and 29.9 cents for professional singers), whereas improved breath support will lead to a lower pitch inaccuracy in the legato articulation (30.5 cents for nonprofessional singers and 22.9 cents for professional singers), in the slow tempo (31.3 cents for nonprofessional singers and 20.2 cents for professional singers), and in the highest notes (or high tessitura; 35.3 cents for nonprofessional singers and 22.7 cents for professional singers).

The direction of the pattern in a melody, whether ascending or descending, has been shown to be one of the factors affecting pitch accuracy. Lower values of pitch inaccuracy were found for the ascending semi-phrase (32.2 cents for nonprofessional singers and 24.1 cents for professional singers) than for the descending semi-phrase (37.1 cents for nonprofessional singers and 26.1 cents for professional singers). Although there has been some disagreement between studies on the relative accuracy of ascending and descending directions, our finding is consistent with that of Edmonson.¹⁴ Better pitch accuracy was found by Edmonson for undergraduate Music students singing different intervals in the ascending direction than in the descending direction. The reason for this phenomenon could be an increase in psychological and muscular relaxation after the achievement of the highest note(s) or *climax* of the pattern performed. Professional singers are usually trained in maintaining a consistent muscular tension associated with the breath support during the entirety of the musical phrase, which is consistent with the smaller difference in pitch accuracy between the two semi-phrases for professional than for nonprofessional singers (2.0 cents and 4.9 cents, respectively).

It was hypothesized that pitch inaccuracy would be greater when external auditory feedback was reduced (set 3) than when under normal conditions (set 1). However for non-professional singers, even if of a smaller quantity than the just notable difference of the human ear (5 cents),²⁰ pitch inaccuracy was reduced when external auditory feedback was strongly attenuated by means of hearing protectors (33.1 cents in the condition with hearing protectors, 35.0 cents when feedback was increased by reflective panels, and 35.3 cents in the normal condition). Different results were found for the professional group, who did not appear to be influenced by the level of external auditory feedback (24.2 cents in the condition with hearing protectors, 25.9 cents when feedback was increased by reflective panels, and 24.9 cents in the normal condition).

The present results are somewhat different from the findings of Mürbe et al.^{12,13} In both of the studies of Mürbe and colleagues, the masking effect of white noise at 105 dB(A) presented via headphones resulted in a decrease in pitch accuracy, and the size of this effect did not differ according to the level of training. This apparent difference between the present study and those of Mürbe et al.^{12,13} is arguably related to the difference in protocol. In the studies of Mürbe et al.,^{12,13} the introduction of noise at a high level in the ear could have affected internal auditory feedback,¹ which results from the transmission of laryngeal vibrations to the skeletal framework by means of extrinsic laryngeal muscles. In particular, the pressure variation introduced by the noise could have been large enough to greatly reduce the internal vibrations. Mürbe et al. stated in their earlier publication¹² that only two of the 28 singers reported being able to hear themselves, and only in their highest notes. Hence, it is possible that the use of masking noise delivered via headphones in these studies strongly attenuated both the external and the internal feedbacks. During the present experiment, only the external auditory feedback was modified by the wearing of hearing protectors or the use of the reflective panels, and the internal feedback was preserved. In fact, it could be argued that the internal auditory feedback was emphasized because of the strong attenuation of the background noise by the hearing protectors. This emphasis of the internal auditory feedback improved the pitch accuracy of the nonprofessional group, but did not affect the pitch accuracy of professional singers, whose internal auditory feedback perception is likely to have been better developed by means of training. Indeed, in a previous paper,¹⁵ the current authors argued that professional singers rely less on external auditory feedback and more on internal auditory feedback than do non-professional singers, as reflected by sound pressure level and singing power ratio. This finding suggested that the quality of the professional singers' performance is less dependent on the environmental conditions in which they are singing.

CONCLUSIONS

It has been shown that pitch inaccuracy in singers is affected by the level of training, the tempo, articulation, semi-phrase direction (ascending or descending), tessitura (low, medium, or high), and the level of the external auditory feedback. Mean pitch inaccuracy was as high as 58 cents for the nonprofessional singers in staccato, fast arpeggi in the high tessitura, and in normal external auditory feedback conditions; and as low as 13 cents for the professionals in legato and slow arpeggi in the high tessitura. An interesting finding concerning the role of internal and external auditory feedback in pitch accuracy was that when external feedback was strongly attenuated, there was an increase rather than a decrease in accuracy for nonprofessional singers. This increase may have been caused by the masking of external feedback, which arguably encouraged greater reliance on internal auditory feedback, which was preserved. Future research will better address the roles of external and internal auditory feedback in singers' pitch accuracy in a more realistic setting. Additionally, a study comparing the results of various methods for the computation of pitch accuracy, such as methods evaluating interval precision or sharpness and flatness, will be conducted.

Brown (1974, p. 52) describes music reading as a means to an end, not a skill to be acquired for its own sake. Just as the ability to read spoken language opens up the world of literature, assists in the interpretation and understanding of current events, and serves to elucidate a multitude of life situations, so the ability to read music increases the opportunity and the capacity to interpret, to understand, and to become beneficially involved in experiences with music.

The concept of music literacy consists of fundamental skills required for a musician, a music researcher and a music teacher. These skills can be listed as sight-singing, dictating and creating melodies. Sight-singing is defined by The Harvard Concise Dictionary of Music and Musicians as "the ability to accurately perform on first reading musical sounds represented by notation" (Kuehne, 2007, p. 115). Walker describes sight-singing as a multifaceted task engaging both cognitive processes and physical skills (Reifinger, 2012, p.27). According to Wunsch (1973, p. 55), a musician needs more than just sensory organs with which to hear. The ear receives soundwaves, but it cannot interpret these vibrations. Even the most sensitive ear can only act as a transmitter to the brain, the nerve center that recognizes and interprets these messages: according to established images. In order to record an aural impression, the brain must perceive and coordinate the sounds delivered by the ear.

A research by Norris' (2003) has shown that sight-singing and dictation are related skills. The purpose of dictation, as Michael Rogers states, is "not to produce correct written transcriptions, but to produce a certain kind of listener who can hear sound as a meaningful pattern." Students need to be taught how to listen and for what to listen. "Many aural skills texts have focused on the drill-and-repetition aspects of learning to hear. The weakness of this approach centers on a failure to distinguish between sound events (requiring just ears) and musical events (requiring ears and minds) (Sisley, 2008, p. 1).

Demorest states that, there are numerous pitch systems in teaching sight-singing skills. One system is movable do, which means that do may change depending upon the key of the piece. A similar system utilizes numbers that correspond to the scale degrees changing with the key of the piece. A third system is fixed do, which always keeps do on note C regardless of the key of the piece. Other systems include singing pitch letter names (A, B, C) or singing the pitches on a neutral syllable (e.g., la) (Floyd & Bradley, 2006, p. 70).

In his research, Daniels (1986) investigated the relationship of sight-reading success with other variables. It is concluded that there is not a correlation between the used solfege system and sight-reading success. However, it is clear that there exists a significant relationship between sight-reading success and instructors' attitude towards solfege teaching.

It is impossible to say that any one solfege system is superior to another. Specific solfege systems should be chosen for specific students, for specific educational objectives, and for specific repertoires. And every solfege system has the honor of being the best system for at least one given purpose (Larson, 1993, p. 115). Music performers and music educators should know the merits and demerits of all systems. If the music education majors had the chance to learn both major solfege systems, and if they were familiar with both systems equally well, they would be able to choose one depending on the situation (Komiya, 2011, p. 21).

Solfege Instruction in Turkey

In Turkish higher music education programs, courses which aim to provide music literacy skills are named variously as 'Solfege', 'Musical Hearing-Reading-Writing', 'Western Music Theory and Practice', 'Basic Music Theory and Solfege'.

In Apaydın's view (2006, p. 12), solfege instruction is the most essential field of professional music education with its structure aiming behavioral changes related to music theories, musical hearing, musical writing, musical analysis and musical creating. Nart (2013, p. 414) also states that solfege instruction is the

most important field in music education since the learning outcomes of solfege courses consist of prerequisite skills for other major courses of music education. In their study, Sağer, Gürpınar and Zahal (2013) support this view and conclude that student success in Musical Hearing-Reading-Writing course has a positive effect on their success in other major courses. Karahan (2014, p. 1269) also emphasizes that students' success level in Musical Hearing-Reading-Writing course is an important indicator of their professional achievement.

Even if the importance of solfege instruction is commonly accepted in Turkey, there is a limited number of studies on planning, implementing and evaluating of these courses. Özdemir (2019: 62) highlights that there is a huge discrepancy among instructors on teaching solfege due to the lack of relevant research. Additionally, in Öztürk's view (2010, p. 80), solfege teaching methods are not well-known, and unsystematic solfege teaching cannot go beyond 'note reading' at institutions of higher music education. Özalutunoglu (2003, p. 43) also states that most of the music educators serving at Turkish universities are regarding solfege teaching as just 'note reading'.

The results of the previous studies on solfege teaching in Turkey show that the students' music literacy skills are not sufficient in higher music education. In his research investigating the resources and methods followed in solfege teaching at conservatories, Yazan (2007) determined that 55% of the student participants find music dictation very difficult. In a study conducted by Tufan (2012), the students' Musical Aptitude Test scores are compared with the scores from the same test they took after six terms of Musical Hearing-Reading-Writing course. It is seen that there is not a significant difference between the averages of pre-test and post-test scores. In another study, Sağer and others (2013) compared major course scores of music education students and determined that Musical Hearing-Reading-Writing course score average is the lowest with 55 points. In a research by Karahan (2016), it is figured out that significant number of the students failed Musical Hearing-Reading-Writing course. The main reason for failure is determined as the insufficiency of the students' out-of-classroom studies. Karkan and Bağ (2016, p. 200) also indicate that student achievement levels in solfege and musical dictation are very low in Turkey and it is necessary to research and resolve this problem.

The purpose of the present study was to explore the professional knowledge, practices and opinions of solfege instructors in Turkey. For this purpose, answers to the following questions were sought:

- How much do instructors know about solfege systems and teaching methods, and which ones do they use in teaching?
- Are the instructors following an instruction plan in their teaching?
- What are the resource books, materials and technological tools used in solfege instruction?
- What are the practices that instructors include in their teaching and which ones are challenging for students?
- What are instructors' views on the achievement level of solfege instruction and the negative factors?

Method

'Descriptive model' is used in this quantitative study to explore the professional knowledge, practices and opinions of solfege instructors in Turkey. Descriptive model is suitable for research that aims to describe a past or present situation as it is (Karasar, 1999).

Participants

The research population includes the instructors teaching solfege at institutions of higher music education in Turkey. By searching the websites of all Turkish universities in May 2019, the number of the solfege instructors is determined as 90 in 51 universities and e-mail addresses of all instructors are collected. Since it is possible to reach all of the research population easily, there is no need to select a sample and all of

the instructors are included into the study. The data collection form is sent to the instructors via e-mail and 37 of them completed and replied the form appropriately.

Twenty-three of the participants are graduated from Faculty of Education, 8 of them are graduated from State Conservatory, 3 of them are graduated from Faculty of Music and Performing Arts, 2 of them are graduated from Faculty of Fine Arts and one of them is graduated from another faculty. Twenty-four of the participants have doctoral degree, 8 of them have master's degree, 2 of them have proficiency in art degree and 3 of them have bachelor degree. Sixteen of the participants are Assistant Professors, 11 of them are Lecturers, 4 of them are Associate Professors, 4 of them Research Assistants and 2 of them are Substitute Instructors. Seventeen of the participants are serving in Faculty of Education, 8 of them are serving in Conservatory, 6 of them are serving in Faculty of Fine Arts, 4 of them are serving in Faculty of Music and Performing Arts and 2 of them are serving in other faculties. Nine of the participants for 1-5 years, 7 of them for 6-10 years, 5 of them for 11-15 years, 14 of them for 16-20 years, 1 of them for 21-25 years and 1 of them for more than 25 years have been teaching solfege at higher education.

Data Collection and Analysis

The research data is collected through questionnaire form designed by the researcher. While designing the form, information and views which need to be obtained are determined through literature review and the opinions of two field experts. Afterwards, questions which will provide these information and views are arranged consulting with the field experts. Ultimately, the response options for questions are designed in accordance with relevant literature and the questionnaire form is finalized through expert opinions.

Instructions about how to complete the questionnaire form and definitions of terms included are given on the first page of the form. In the first section, there are 7 questions about personal information of the participants. In the second section with 15 questions, it is aimed to receive the instructors' views and information about solfege systems and teaching methods they use, planning and evaluating their instruction, resource books and technological tools they use, the practices they apply in the classroom, achievement level of their teaching and the factors that prevent their teaching from being more effective.

The questionnaire form is sent via e-mail to all relevant instructors (n=90) serving in Turkish universities and 24 of them are replied initially. The form is resent to the instructors who have not replied after one month and 13 forms more are collected. Finally, 37 of the instructors completed and sent the form back.

It is assumed that content validity of the data collection tool is provided as a broad literature review is done and expert opinions are received at each stage during the preparation of the questionnaire. It is accepted that the collected data in the research has enough reliability due to the fact that the results are consulted with the field experts and are mostly in line with the previous research results.

At the data analysis stage, frequency and cross-tabulation analysis are applied on the data collected from questionnaire forms replied by the instructors. The findings are interpreted comparing with the previous research results.

Findings

The first research question of this study asked: 'How much do instructors know about solfege systems and teaching methods, and which ones do they use in teaching?' A hundred percent of the participants have detailed information about the Fixed Do system, 73% have about the Movable Do system, 35% have about the Movable Numbers system. A hundred percent of the participants learned Fixed Do system in their undergraduate education, 32% learned Movable Do system and 14% learned Movable Numbers system. Ninety-two percent of the participants are using Fixed Do system in their teaching, 30% are using Movable Do system and 24% are using Movable Numbers system. Eighty-four percent of the participants learned Interval

Memorization method in their undergraduate education, 70% learned Tonal Degrees method, and 68% learned Solfege Memorization method. Eighty-seven percent of the participants are using Interval Memorization method in their teaching, 83% are using Tonal Degrees method and 60% are using Solfege Memorization method.

The second research question was whether the instructors following an instruction plan in their teaching. Fourteen percent of the participants are not following an instruction plan in their teaching, 46% are following an instruction plan that designed by their own, 35% are following a plan that they prepared with their colleagues and 5% are following a plan designed by someone else.

The third research question asked what the resource books, technological tools and materials used in solfege instruction. As resource book used in the classroom, 89% of the participants are using solfege books by Lavignac, 49% are using books by Sun, 30% are using books by Özgür-Aydoğan, 19% are using books by Pozzoli, 14% are using books by Fontaine, 14% are using books by Allarme, 11% are using books by Yavuzoğlu, 11% are using books by Dandelot, 8% are using books by Ünal, 5% are using books by Sevgi and 3% are using books by Contemporain. Sixty percent of the participants are not using any technological tools in the classroom, 16% are using projectors, 14% are using computers, 8% are using interactive whiteboards, 5% are using speakers. Fifty-one percent of the participants do not suggest any websites or applications for students to use out of the classroom, 27% suggest Ear Master application, 16% suggest Ear Training application, 8% suggest Perfect Ear application and 8% suggest teoria.com website.

The fourth research question was: 'What are the practices that instructors include in their teaching and which ones are challenging for students'. As shown in Table 1, interval and chord practices are highly included in both lessons and exams. Additionally, 'Melodic Dictation' and 'Sight-singing' which are highly included in the lessons are also the most challenging practices for students. Rhythm practices are less included in the exams even if they are highly involved in the lessons. 23 participants (%62) declare that students do not have difficulty in 'Recognizing and Singing Intervals'. However, 17 of these 23 state that 'Sight-singing' is challenging and 14 state that 'Melodic Dictation' is challenging for students.

Table 1. The practices included in the lessons and exams and the challenging practices for students

	Practices included in the lessons		Practices included in the exams		Challenging practices for students	
	f	%	f	%	f	%
Recognizing and singing intervals	36	97	34	92	14	40
Recognizing and singing chords	37	100	33	89	23	66
Recognizing and singing scales	34	92	22	60	6	17
Reading rhythmic patterns	33	89	16	43	7	20
Rhythmic dictation	31	84	24	65	9	26
Singing melodic patterns written with degree numbers	10	27	2	5	3	9
Dictating melodic patterns with degree numbers	9	24	2	5	4	11
Singing non-rhythmic melodic patterns	17	46	4	11	2	6
Dictating non-rhythmic melodic patterns	16	43	7	19	4	11
Rhythmic reading with note names	33	89	19	51	3	9
Sight-singing	34	92	34	92	24	69
Memorizing solfege pieces by repeating	21	57	14	38	5	14
Melodic dictation	30	81	30	81	25	71
Melodic analysis	34	92	18	49	17	49
Creating melodies in tonal structure	24	65	5	14	9	26

Finally, the fifth research question asked what the instructors' views on the achievement level of solfege instruction and the negative factors. As shown in Table 2, 43% of the participants take the view that the overall achievement of solfege teaching in Turkey is at the medium level, 22% state that it is at the medium-high level. Forty-three percent of the participants hold the view that the achievement of their own solfege teaching is at the medium level and 38% state that it is at the medium-high level. Thirty-eight percent of the participants declare that the achievement level of their own solfege teaching is higher than the overall achievement level of solfege teaching in Turkey while 8% suggest vice versa.

Table 2. The cross-match of instructors' views on the overall achievement level of solfege teaching in Turkey and achievement level of their own solfege teaching

		Achievement level of your own solfege teaching				Total
		Very low	Medium-Low	Medium	Medium-High	Very high
The overall achievement level of solfege teaching in Turkey	Very low	0	0	1	0	0
	Medium-Low	1	2	5	1	0
	Medium	0	1	9	6	0
	Medium-high	0	0	1	6	1
	Very high	0	0	0	0	0
	No idea	1	0	1	1	0
Total		2	3	17	14	1
						37

As seen in Table 3, most participants declare 'student motivation' and 'student level' as the factors that have negative effects on the achievement. Almost all of the instructors assume that the factors that are related to themselves do not have negative effects on the achievement. Sixty percent of the participants state that the instructor level does not have a negative effect on the achievement, although they do not have sufficient information about the 'Moving Numbers' system.

Table 3. Instructors' views on the factors that have negative effects on the achievement of their own solfege teaching

	f	%
Course duration	16	44
Physical conditions	7	19
Resource books	3	8
Software and applications	9	25
Instruction plan	6	17
Student motivation	28	78
Instructor motivation	1	3
Student level	27	75
Instructor level	2	6

Discussion

The purpose of this study was to explore the professional knowledge, practices and opinions of solfege instructors in Turkey. In this section, the findings are discussed in the context of the relevant literature.

In their teaching, almost all of the instructors are using the solfege systems and teaching methods applied in their undergraduate education. Consistent with this result, it is concluded in Özdemir's study (2019) that great majority of the instructors do not take any pedagogic education on solfege teaching and they use the systems and methods applied in their undergraduate education. According to the results of the Işıldar's (2004) research on solfege teaching, instructors generally use traditional teaching methods and very few of them apply different methods.

'Fixed Do' system is the most used one both in the instructors' teaching process and in their undergraduate education. Although most of the instructors are applying 'Tonal Degrees' method in their teaching, very few of them use 'Movable Numbers' system which is quite suitable for this method. In Özaltunoglu's research (2011) with the students from Faculty of Fine Arts Music Department, the experimental group which practiced dictation with 'Movable Numbers' system showed higher success at a significant level than the control group practiced with 'Fixed Do' system. In parallel with this result, in his experimental study on comparing solfege systems, Öztürk (2010) determined that teaching with 'Movable Numbers' system provided a higher achievement than teaching with 'Fixed Do' system.

Most of the instructors are following an instruction plan in their teaching process. Nevertheless, it can be concluded that there are some deficiencies in planning solfege instruction due to the fact that less than half of the instructors are using the plan designed by their own. Also Özbek (2003, p. 1) states that there isn't a comprehensive instructional designing study on solfege teaching in Turkey and solfege instruction is usually based on superficial observation and personal experience.

As a classroom resource book, solfege books by Lavignac are much more widely used than the others. Also according to the Işıldar's (2004) research, books by Lavignac are mostly used classroom resource books in solfege teaching in music teacher training institutions. Also Özbek (2003) supports the same result in his research. It is remarkable that the solfege books by Lavignac are still used so widely as a resource book in solfege classes in Turkey today. It cannot be assumed that a solfege book prepared in another century and in accordance to the needs of another community is appropriate for music education in 21st-century Turkey.

Most of the instructors do not use any technological tools and materials in their teaching. Projection device is the most used one. The most suggested application for students to use out of the classroom is 'Ear Master'. Most of the solfege instructors who participated in Özdemir's research (2019) indicate that using technological materials in and out of the classroom will increase student success and facilitate learning. Özdemir also determined that the most preferred application by the instructors is 'Ear Master'. Although there are many similar applications, Ear Master has a Turkish language option and this may be the reason for its preference.

The most included practices in the lessons are 'recognizing and singing chords, intervals and scales', 'sight-singing', 'melodic analysis', 'rhythm practices' and 'melodic dictation'. The most used practices in the exams are 'recognizing and singing intervals', 'sight-singing', 'recognizing and singing chords' and 'melodic dictation'. Also according to Özdemir's study (2019), almost all of the instructors include melodic dictation and sight-singing in the exams. In addition, the fact that some of the practices – like rhythm practices – included much more in the lessons are included in the exams much less may mean that there are some deficiencies in the planning of solfege instruction.

According to the views of the participants, 'melodic dictation' and 'sight-singing' are the practices that students have the most difficulty in. Consistent with this result, results of the studies by both Ermiş (2009) and Yazan (2007) indicate that 'melodic dictation' is one of the most challenging practices for students. The reason for this may be the insufficiency of the theoretical and auditory background necessary for melodic dictation.

Nearly half of the participants state that, although 'recognizing and singing intervals' is not a challenging practice for students, they have difficulty in 'sight-singing' and 'melodic dictation'. This result may imply that, contrary to common argument, interval practices do not have a significant positive effect on 'melodic dictation' and 'sight-singing' success. However, Özdemir (2019, p. 51) claims that interval practices will make a significant positive effect on students' music literacy skills. The deficiency of this view is to ignore that the same intervals between different degrees of a scale (for example: in G major scale, 'sol-si' and 're-fa' major-third intervals) have different auditory effects.

Conclusion and Recommendations

Conclusion

Considering the results, it is clearly understood that solfege instructors generally have a lack of professional knowledge. Student level and student motivation are indicated as factors that decrease the level of success. Most instructors assume that factors related to themselves do not have a negative impact on achievement. However, it is evident from the results that most of the instructors do not plan their own teaching and do not search for different solfege systems and teaching methods. The majority of them neither develop their own materials and method books, nor search for different method books, technological tools and materials for a more effective teaching.

Recommendations

- There is a need for further studies searching solfege teaching in Turkey from different perspectives. Especially, studies on increasing the student motivation can play an important role to increase the overall achievement of music education. In addition, researches from the students' perspective are essential.
- Instructors should be motivated to study on different solfege systems and teaching methods and include these in their teaching. In order to raise awareness, presentations on this subject should be made in music education conferences and seminars should be organized for academic staff.
- Courses on solfege teaching should be included in master's and doctoral programs.
- Instructors also should be aware of the significance of instructional planning and learn how to design their courses.
- Technological tools and materials should be effectively included in teaching and solfege classrooms should be equipped so as to utilize technology.

Figure 4.Freya-Clakr (2017)

Pitch Systems and Curwen Hand Signs: A Review of Literature

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Implications

- Researchers have failed to identify a single superior pitch system. As such, a case can be made for choir directors using a system that is prevalent in the United States, namely movable *do* or scale degree numbers.
- Researchers have found that Curwen hand signs neither help nor hinder sight-singing accuracy. If students learn Curwen hand signs, it is recommended that they also learn each sign's mental effect, aligning with Curwen's original intent.

Abstract

Learning to sing from notation is a complex task, and accurately performing pitches without an external reference can be particularly challenging. As such, the use of mnemonic devices to reinforce tonal relationships is a long-standing practice among musicians. Chief among these mnemonic devices are pitch syllable systems and Curwen hand signs. This review of literature is intended to equip choral and general music educators with information on the (a) rationales, (b) classroom use, and (c) effectiveness of pitch systems and Curwen hand signs. Recommendations for educators include choosing a prevalent pitch system, namely movable *do* or scale degree numbers, and using Curwen hand signs in the manner originally intended by Curwen.

Keywords

choral music classroom, Curwen hand signs, elementary, music literacy, pitch systems, sight-singing

Performing music from notation is a complex task. For vocalists, the task involves (a) perceiving the music symbol, (b) forming an inner image of its sound, and (c) manipulating the vocal mechanism to produce that sound. The forming of an inner image may be particularly challenging as it requires the vocalist to retrieve tonal referents.

For centuries, music educators have been creating and using mnemonic aids to reinforce tonal memory and, in turn, further music-reading skills (Young, 1988). Chief among these mnemonic aids are pitch syllable systems and Curwen hand signs. Music theorists, educators, and researchers have produced a substantial body of literature on these mnemonic aids; access to this information may equip music educators to select tools that best meet the needs of their students. This review of literature is intended to provide educators with information about the (a) rationales, (b) classroom use, and (c) effectiveness of pitch systems and Curwen hand signs.

Pitch Systems

Musicians have been using syllables as tonal mnemonic devices since antiquity (Young, 1988). In the Western music tradition, these sets of syllables, or pitch systems, naturally divide into two categories: fixed systems and movable systems. Fixed systems are characterized by syllables that correspond with absolute pitches, such as fixed *do* and the singing of pitch letter names. Movable systems are characterized by syllables that correspond with tonal function, such as movable *do* and the singing of scale degree numbers. The relative merits of different pitch systems—particularly fixed *do* and movable *do*—have long been a source of controversy. According to T.

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A. Smith (1991). "Musicians have been unable to agree on this subject for six hundred years" (p. 1). Music educators may benefit from learning the rationales put forth by advocates and critics of each system.

Rationales for Using Pitch Systems

Music theorists and educators who advocate use of fixed *do* have cited several perceived benefits, including the ease of transfer from vocal training to instrumental training and to the study of music theory (Siler, 1956; Taggart & Taggart, 1994). Advocates have also asserted that fixed *do* is better suited to atonal repertoire (Bentley, 1959; Humphreys, 2006; Siler, 1956) and modulatory passages (Middleton, 1984; Siler, 1956), because the singer does not need to alter pitch names. Moreover, proponents of fixed *do* have noted the system's potential to function as a vocal placement mnemonic by associating each solmization syllable with a specific vocal registration (Middleton, 1984; K. H. Phillips, 1984; T. A. Smith, 1991). Finally, musicians who use the fixed *do* system have claimed it cultivates perfect pitch (Middleton, 1984; Taggart & Taggart, 1994).

Critics of the fixed *do* system have asserted that it fails to direct the ear toward tonal function (Bentley, 1959; T. A. Smith, 1991). According to T. A. Smith (1991), fixed *do* orients the ear toward pitch, which is merely an aural structure. T. A. Smith (1991) argued that "pitch itself is not music" (p. 3); to become music, it must be organized. As such, T. A. Smith (1991) suggested a solmization system should direct the ear toward tonal organization. Bentley (1959) claimed the fixed *do* system also fosters the assumption that the key of C is the normative, or "pure" key, leading students to erroneously perceive all other keys as variants of the key of C.

Advocates of the movable *do* system have praised its utility in directing the ear toward tonal function rather than pitch alone (Bentley, 1959; T. A. Smith, 1991). T. A. Smith (1991) claimed this orientation toward tonal organization may offer musicians an enhanced "aesthetic awareness" (p. 9), both as consumers and performers of music. According to Bentley (1959), movable *do* is also better suited to modulation as it requires both an awareness and understanding of key changes. It has also been noted that all keys are equally accessible in the movable *do* system, freeing the elementary educator to choose a key that accommodates the young beginner's tessitura rather than being bound to the key of C (Educational Council, 1925).

Critics of the movable *do* system have claimed that it is ill-suited to atonal music (Humphreys, 2006; K. H. Phillips, 1984) and modulation (Middleton, 1984; Siler, 1956). Humphreys (2006) referred to the system as "musically outdated," claiming it "imploded with the

advent of atonal music" (p. 186). Critics have also claimed movable *do* allows singers to bypass learning basic notational elements, like the significance of key signatures beyond aiding in locating *do* (Middleton, 1984; Roe, 1983).

Scholarly research addressing the use of scale degree numbers as a pitch system appears to be limited. As a movable system, scale degree numbers may share in the perceived advantages and disadvantages of movable *do* (Demorest, 2001). In comparing scale degree numbers with movable *do*, advocates of scale degree numbers have cited their compatibility with the study of music theory, in which scale degrees are consistently named using numbers (Taggart & Taggart, 1994). Critics of scale degree numbers have claimed that they are less "singable" than movable *do* (Giles, 1991, p. 28), lacking several desirable qualities such as monosyllabic phonemes, pure vowels, and syllables that do not end on a consonant (Demorest, 2001; T. A. Smith, 1991; Taggart & Taggart, 1994).

Classroom Use of Pitch Systems

Researchers have surveyed American choir directors about their primary pitch systems. The majority of directors have consistently indicated use of movable systems (Demorest, 2004; Floyd & Bradley, 2006; Kuehne, 2007; May, 1993; McClung, 2001; Nichols, 2012; Pembroke & Riggins, 1990; S. A. Smith, 1998). The prevalence of movable *do* versus scale degree numbers has tended to vary according to geographical location.

Floyd and Bradley (2006) found movable *do* was dominant among directors of the top-rated sight-singing choirs in Kentucky. Movable *do* was also dominant among middle school (Kuehne, 2007) and high school (S. A. Smith, 1998) choir directors in Florida, secondary choir directors in Texas (May, 1993), and middle school choir directors in an anonymous southwestern state (Nichols, 2012). In contrast, McClung (2001) found scale degree numbers to be dominant among All-State choristers in Arkansas, Georgia, Tennessee, and Mississippi.

Nationally, it remains unclear whether the majority of music educators use movable *do* or scale degree numbers (Demorest, 2001, 2004; Pembroke & Riggins, 1990). Pembroke and Riggins (1990) conducted a national survey of college and university music faculty and reported the majority of respondents taught scale degree numbers. Demorest (2001) conducted a national survey of choir directors and again found that, among the 158 respondents, scale degree numbers were the most prevalent system. However, after Demorest published these findings, an additional 78 choir directors completed the survey, tipping results in favor of the movable *do* system. Low response rates prompted Demorest (2004) to caution that results may not reflect the practices of the national choir

director population. As such, it remains unclear whether scale degree numbers or movable *do* is nationally dominant.

Effectiveness of Pitch Systems

In contrast to the somewhat ample research on classroom use of pitch systems, research on their comparative effectiveness is relatively limited, being composed of a few articles from peer-reviewed journals and a number of dissertations and theses. Several researchers have compared the effectiveness of movable *do* with sight-singing on a neutral syllable. Cassidy (1993) taught sight-singing to undergraduate nonmusic majors and found that students who learned movable *do* sight-sang more accurately than those who learned to sight-sing on a neutral syllable. However, Lorek and Pembroke (2000) taught undergraduate music majors and found no significant difference between the sight-singing scores of students who learned movable *do* and those who sang a neutral syllable.

Reifinger (2012) tested the effectiveness of movable *do* versus singing a neutral syllable, as well as the effectiveness of relating tonal patterns to learned repertoire. The researcher divided second-grade general music students into four groups: (a) related songs with movable *do*, (b) related songs on "loo," (c) unrelated songs with movable *do*, and (d) unrelated songs on "loo." The group that learned related songs on movable *do* performed significantly better than the remaining groups. Reifinger (2012) concluded that students had not mastered solmization to the level of generalization; rather, the students understood solmization syllables to be an additional set of lyrics to familiar songs, aiding in their recall of learned patterns.

Studies comparing fixed *do* and movable *do* are limited and inconclusive: While some investigations reported no significant difference between the two pitch systems (Henry & Demorest, 1994; Killian & Henry, 2005; Lorek & Pembroke, 2000), one investigation (Demorest & May, 1995) found movable *do* to be superior. Henry and Demorest (1994) tested the individual sight-singing accuracy of vocalists from two high school choirs that had earned superior sight-singing ratings at district competitions. One choir routinely used movable *do*, while the other used fixed *do*. The researchers found no significant difference between the scores of students who learned movable *do* and fixed *do*.

In a larger scale study, Demorest and May (1995) tested the individual sight-singing accuracy of vocalists from eight high school choirs. Again, half of the choirs routinely used movable *do*, while the other half used fixed *do*, and all choirs had earned superior sight-singing ratings at district competitions. Demorest and May (1995)

found movable *do* singers performed significantly better than fixed *do* singers. However, the researchers cautioned against assuming a causal relationship, noting that the discrepancy may have been caused by a lack of individual testing in the fixed *do* choirs, failure to match groups according to background variables, and/or inconsistency of method, since the fixed *do* choirs came from districts that used the movable *do* system in elementary grades.

Lorek and Pembroke (2000) employed a more rigorous experimental design in a series of four studies comparing pitch systems. The researchers divided undergraduate music majors into three groups matched on several variables. One group learned movable *do*, the second fixed *do*, and the third sang on a neutral syllable. After one semester of instruction, exams revealed no significant difference between groups. The following academic year, Lorek and Pembroke (2000) replicated their study with additional controls and a larger group of participants; again, they found no significant difference between groups. The researchers conducted yet another study to test performance in modulatory passages using movable *do* and a neutral syllable and again found no significant difference between groups. Finally, Lorek and Pembroke (2000) conducted a fourth study to compare movable *do* with scale degree numbers and once again found no significant difference. The researchers concluded that at the collegiate level, different pitch systems may be equally effective.

The literature on pitch systems certainly presents a broad and varied picture of their rationales, classroom use, and effectiveness. In particular, the limited and inconclusive research on effectiveness may be disappointing to educators in search of "the best system." However, the educational potential of pitch systems may be maximized when the strengths and weaknesses of each system are weighed in light of student characteristics and overall learning objectives. In short, selection of "the best system" may be contextual.

Curwen Hand Signs

Curwen hand signs, like pitch systems, function as a tonal mnemonic device intended to bolster vocal literacy through reinforcing tonal function. English pedagogue John Curwen created the hand signs to visually and kinesthetically reinforce movable *do* solmization syllables. Curwen incorporated the hand signs into his tonic solfa method, which spread throughout English schools in the 19th century when vocal music became a compulsory subject (Rainbow, 1979). The use of hand signs spread internationally in the 20th century when students of Zoltan Kodály incorporated them into the Kodály approach, with which they are associated today (Choksy, 1999).

Rationales for Using Curwen Hand Signs

Advocates of Curwen hand signs have cited their utility as a multimodal approach to music reading, noting that hand signs provide visual and kinesthetic reinforcement of solmization syllables (Apfelstadt, 1986; Demorest, 2001; Giles, 1991; McClung, 2008; Reifinger, 2013). A student using hand signs is thus equipped to feel and see the location of each scale degree and its intervallic relationship to other scale degrees (Choksy, 1999). Even aural learners may find that hand signs make learning more concrete in the lower elementary grades, when learners of all kinds may find aural tasks to be abstract and challenging (Apfelstadt, 1986).

Advocates have also claimed that hand signs can further tonal understanding by reflecting the unique character of each scale degree (Choksy, 1999; Landis & Carder, 1972). Curwen espoused a doctrine of mental effect, which held that each scale degree possesses distinct properties, such that *do* represents "home," *mi* is "calm," and *sol* is "bright and strong" (Bridges, 1982, p. 14). As such, Curwen intended each hand sign to reflect the character of its scale degree; a fist signifies *do* to reflect strength, while the signs for *mi* and *sol* also reflect stability. The sign for *fa* points downward to indicate the semitone pull to *mi*, while *ti* points upward to indicate the semitone pull to the tonic (Landis & Carder, 1972; Shaw, 1950). Thus, the student who learns hand signs may associate each sign with its scale degree as well as the character of that scale degree within the larger tonal context.

Curwen hand signs may also offer pragmatic benefits beyond the potential to improve vocal accuracy. For example, a teacher using hand signs can communicate pitch information without singing (Reifinger, 2013) or turning away to use the board (Demorest, 2001). Additionally, a teacher can use hand signs to dictate canons and harmonies, having one group of students follow the right hand, while a second group follows the left (Demorest, 2001). Moreover, hand signs allow teachers to instantly assess student understanding with a quick visual scan (Demorest, 2001; Reifinger, 2013).

While hand signs offer several potential benefits, there remains the possibility that hand signs may add an unwanted layer of complexity to the already complex task of music reading. The young beginner's motor skills may be limited, and successful completion of a sign may detract attention from reading notation, controlling the vocal mechanism, or listening attentively (Demorest, 2001; Martin, 1991). M. J. Phillips (2013) noted that "Teaching hand signs can be tricky, especially to students with dyslexia or other reading disabilities" (p. 62). Demorest (2001) wrote of observing a group perform with and without hand signs, stating "it often appears as though the signs are slowing them down" (p. 42).

Classroom Use of Curwen Hand Signs

Researchers have surveyed secondary choir directors about the frequency and nature of hand sign use, and have reported a range of results. For example, 65% of middle school choir directors in Florida indicated that they teach hand signs (Kuchne, 2007), compared with 46% of secondary choir directors in Kentucky (Floyd & Bradley, 2006), and 23% of middle school choir directors in a large southwestern state (Nichols, 2012). Yarbrough, Orman, and Neill (2007) observed 84 secondary choirs at a district contest as they prepared for sight-singing adjudication: 64% of choirs used hand signs while chanting solmization syllables and 37% used hand signs while audiating.

Though the use of hand signs among directors appears varied, directors have expressed a moderate level of agreement concerning the importance of teaching hand signs. Kuchne (2007) surveyed middle school choir directors in Florida and found that the majority believed students should learn to sight-sing using Curwen hand signs. Nichols (2012) presented middle school directors in an anonymous state with the same prompt and again found that the majority believed students should learn hand signs. Directors appear to ascribe some importance to this pedagogical tool.

Effectiveness of Curwen Hand Signs

In spite of the intended benefits of hand signs, researchers have failed to find significant gains in sight-singing accuracy. Martin (1991) tested the impact of hand signs on three groups of first-grade students: one group learned movable *do*, the second learned movable *do* with hand signs, and the third learned movable *do* with hand signs and letter representations of solmization. Posttest sight-singing scores revealed no significant difference between groups. Youngson and Persellin (2001) also tested the impact of hand signs on first-grade students: one group learned movable *do*, while the other learned movable *do* with hand signs. Again, posttest scores revealed no significant difference between groups. Yarbrough, Green, Benson, and Bowers (1991) tested the effects of hand signs on elementary and middle school singers who routinely struggled to match pitch. Once again, posttest sight-singing scores revealed no significant gains for students who learned hand signs.

While most researchers have focused on students in the elementary grades, Cassidy (1993) tested the effect of hand signs on the sight-singing accuracy of undergraduate nonmusic majors. After one semester of instruction, Cassidy (1993) found no significant difference between students who learned movable *do* solmization and those who learned movable *do* solmization with hand signs.

Autry (1976) deviated from the aforementioned studies by testing the impact of hand signs on group sight-singing rather than individual sight-singing. Six intact fifth-grade classes and eight intact college classes participated in the study. Each class completed a pretest, received 10 to 14 weeks of instruction, and completed a posttest. Posttest sight-singing scores revealed no significant difference between students who learned hand signs and students who did not.

Given the short-term nature of many experimental studies on Curwen hand signs, McClung (2008) conducted a study of high school students who had extensive experience with hand signs. Each participant performed two sight-singing exercises of equal difficulty, singing one with hand signs and one without. McClung (2008) found no significant difference in the sight-singing accuracy of participants while using hand signs. However, significant differences emerged when the researcher divided participants according to previous instrumental experience. When using hand signs, participants with instrumental experience performed significantly better than participants with no instrumental experience. Additionally, participants with no instrumental experience performed significantly better without hand signs than with hand signs. McClung (2008) speculated that students without instrumental experience may not have the kinesthetic experience necessary to render hand signs useful. For these students, hand signs may have functioned as a distraction rather than an aid.

From the elementary to the collegiate level, researchers have found that hand signs neither helped nor hindered vocal music literacy. However, hand signs may still offer pragmatic benefits to educators, such as the previously mentioned convenience of dictating drills while facing the class and assessing understanding through a quick visual scan. At the very least, educators may take comfort in the knowledge that, insofar as the current body of literature stands, they need not fear making the wrong choice concerning the inclusion of Curwen hand signs in vocal literacy instruction.

Implications

The literature on tonal mnemonic devices has several important implications for music educators. First, researchers have failed to identify a single most effective pitch system. As such, a case can be made for selecting a system that is prevalent in the United States, that is, movable *do* or scale degree numbers (Demorest, 2004; Floyd & Bradley, 2006; Kuehne, 2007; May, 1993; McClung, 2001; Nichols, 2012; Pembrook & Riggins, 1990; S. A. Smith, 1998). Given the rise in student transience (EPE Research Center, 2004) and the negative correlation between achievement and mobility (Isernhagen & Bulkin,

2011), the use of a pitch system that is nationally prevalent may aid transient students.

The literature on pitch systems also contains implications for the most effective use of a system. For example, Lorek and Pembrook (2000) noted a tendency among undergraduate music majors to perform correct pitches with incorrect solmization syllables, suggesting the syllables were cumbersome for students with extensive music experience and limited pitch system experience. Perhaps educators must introduce a pitch system early in a student's music education in order for the syllables to serve their intended function of aural association. Additionally, Reifinger (2012) noted that first-grade students successfully memorized solmization syllables to familiar songs but failed to generalize to unfamiliar material, suggesting that they perceived syllables as song lyrics. Teachers may need to explicitly direct the beginner's attention to the nature and function of solmization syllables, guiding students in transferring learned patterns to new exercises and repertoire. In the words of Shaw (1950), "The syllables have no magic in themselves, and solve no one's trouble unless charged with mental significance and association" (p. 18).

Future research on the comparative effectiveness of pitch systems might include statistical control of background variables that have been previously associated with sight-singing performance, such as years of piano instruction (Demorest & May, 1995; Henry & Demorest, 1994). The dearth of experimental studies on pitch systems may be symptomatic of the practical challenges inherent to the topic; teachers who incorporate vocal literacy instruction may not be amenable to randomly dividing students into groups for instruction in different pitch systems. Furthermore, proficiency in any pitch system is not typically attained in a short period of time, yet a long-term study may also prove impractical. If experimental control of the variables relevant to sight-singing is not within reach, statistical control would seem important. Perhaps such control would help clarify the relationship between pitch systems and individual sight-singing achievement.

About Curwen hand signs, discrepancies between their use and effectiveness are noteworthy; consistent failure to find gains in sight-singing scores does not appear to have affected teacher practices. The use of hand signs has deep roots in this nation; perhaps their continued use is a testament to the faith placed in tradition and the tendency among educators to teach the way they were taught. Alternatively, perhaps choir directors have noted benefits that researchers have not yet tested. Most researchers have tested the impact of hand signs on individual sight-singing accuracy, but the signs may offer benefits of a more communal nature. Amid the pressure of adjudicated sight-singing festivals, a visible gesture may unite students in

group solidarity, particularly during the potentially nebulous practice of audiating. Perhaps Curwen hand signs offer direct benefits for directors and, by extension, indirect benefits for students; by providing directors with visual evidence of student understanding, hand signs may equip choir directors to give more immediate and individualized feedback than singing without hand signs.

Educators who are invested in the use of hand signs may note that researchers have not found hand signs to be a hindrance. Deciding whether to teach hand signs may require continual monitoring, weighing the benefits of visual and kinesthetic reinforcement against the challenges of adding another task to the music-reading process. If educators choose to teach hand signs, it is recommended they also direct student attention to the character of each sign (as in the stability of the fist that signifies "do" and the pull of the downward thumb that signifies "fa"), maximizing its instructional potential by aligning with Curwen's original intentions.

Future research on Curwen hand signs might include interviews and/or surveys of educators who use hand signs to determine why they do so. It may be interesting to learn the extent to which educators incorporate hand signs for their pragmatic benefits, such as ease of dictating drills, versus pedagogical aims, such as the improvement of vocal accuracy. Future research might also include interviewing students who have used hand signs for different lengths of time to learn the extent to which they find the signs helpful. McClung's (2008) findings about the interaction of hand signs with previous instrumental experience warrant further investigation, particularly concerning the potential connection between hand signs and learning modality.

In summary, music theorists, educators, and researchers have produced a growing body of literature on tonal mnemonic devices. When making pedagogical decisions, it may be tempting for educators to exclusively consult experimental research on the relative effectiveness of tonal mnemonic devices. However, it is recommended that educators also consider the literature on the rationales behind these devices, as well as the literature on common classroom practices. With knowledge of the rationales, classroom use, and relative effectiveness of pitch system and Curwen hand signs, educators may be equipped to make informed decisions in order to cultivate musically literate singers.

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Figure 5.Greenhead (2013)

Aural Training In The Dalcroze Practice: Doh's fixed and moveable

Karin Greenhead

Aural Training (ear training, solfa or solfège as it is also sometimes called) is one of the three principle branches of Dalcroze Eurhythmics. Although often neglected today, the development of acute aural perception and the understanding of tonal relationships should be central to the training of all musicians.

When Dalcroze began his experiments and started to evolve his method, he was professor of solfège and harmony at the conservatoire in Geneva. The systems of aural training then in place were dry, academic and did not obviously connect to musical expression – a situation which still persists on some courses to this day.

Much influenced by Debussy's ideas on emotional expression, breath, gesture and space, Lussy's theories of rhythm, the dynamic aural training given to children by Marie Chassevant and the ideas of the neurologist and child psychologist Claparède (1875–1940) who had a special interest in teaching and memory, Dalcroze overthrew traditional theoretical approaches to teaching and started experimenting with aural training combined with exercises using space and rhythmical movement. Although at first the movement aspect of this training was focused on co-ordination, rhythm games, quick reaction exercises and the development of inner hearing, it was not long before Dalcroze added the connection of these aspects of musicianship to musical expression and theatrical performance, drawing on the talents of some of his students such as Annie Beck (much inspired by Isadora Duncan and responsible for much of the choreography for *Orpheus*) and Nina Götz (whose house can be found opposite Dalcroze's own in Hellerau).

Dalcroze connected all the aspects of music and the musical gesture to movement in space and his method of teaching music includes both gesture and locomotion. Pulse, accent, anacrusis, metre, rhythm pattern, cross-rhythm, phrase and dynamics all take place in time, have correspondences in the body and a spatial dimension so the study of them can best be approached through movement. This is well known to all teachers of rhythmics and also many teachers involved in music education who do not have a Dalcroze background, since many of his ideas have seeped into general music education. But music also includes pitch and harmonic relationships. If we think of pitch rising or falling we tend to think of movement in space. If we think of a harmonic texture as thick or thin or of certain kinds of harmonic progression as starting somewhere and leading us to somewhere else – a resting place, as in the approach to a cadence or movement to another tonality – we also think of and experience tension and release, anticipation

and resolution, travel and arrival and these all connect to physical sensations, spatial metaphors and embodied realities.

It is this element, the movement core of the Dalcroze work, that is often ignored in the sometimes steamy arguments surrounding the use of fixed and moveable Doh. It may even be absent or under-used in the aural training class where students can sometimes be found seated and reading, just as they are in many other methods.

Pitch recognition

At the most basic level, the training of aural perception begins with the awareness of sounds and the ability to distinguish between them: louder/quieter; higher/lower. There are many entertaining exercises that can be done in the rhythmics lesson to aid and refine pitch perception beginning with the identification of very high and very low notes and gradually moving towards a little higher and a little lower and finally the semi-tone. When these basic exercises are done with children they often involve stretching up tall for a high note and crouching down low for a low one or skipping to the teacher's playing – stopping if a low note is heard (even if the teacher goes on playing the skipping tune) and starting again at a high one. This can be followed by body-solfa (touching head, shoulders, knees, feet will provide a triad plus the octave) or head, shoulders, tummy might provide a triad and lead to sight-singing and inner hearing exercises, or a short melody may be stepped out on the floor with the forward direction corresponding to rising tones, descending tones being shown with a step backwards. **Handsigns, as used in the Curwen and Kodály methods, also provide general and spatial ways of teaching pitch recognition and the development of inner hearing.** Other ways of developing the ability to identify and pitch intervals include filling them with rhythm patterns corresponding to the size of the interval and placing two people next to one another, one representing the higher note, the other the lower one: they must show which note moves when a new interval is played in which one note remains the same and one changes. Is the altered note closer to or further away from the note that does not move and how far does it move? The recognition of harmonic changes can be shown by using body-shape, gesture and travelling to different parts of the room.

Karin Greenhead



A frequent guest teacher in Europe, North America, Australia and Asia, Karin has a background in performance as a singer, pianist, harpsichordist and violinist. Her work has focused on the teaching of performers in music and dance and on the professional training of Dalcroze practitioners. She currently teaches regularly at the Royal Northern College of Music, Manchester, UK and other British conserva-

toires of music and dance and is Director of Studies for the Dalcroze Society UK, joint Director of Studies for the Dalcroze Eurhythmics International Examination Board and member of the College of the Institut Jaques-Dalcroze, Geneva whose Diplôme Supérieur she holds. Karin has started to present regularly at conferences, the most recent being ISME 2012 in Thessaloniki, Greece and is much sought after for her original applications of Dalcroze principles to the rehearsal and performance of the concert repertoire, solo and ensemble, known as Dynamic Rehearsal. She is currently working towards a doctorate for which she is undertaking a phenomenological investigation into her own practice.

Pitch identification - names and relationships

At some point names are going to be given to these notes and these names will be of several kinds. One name will describe the actual, fixed pitch. Another name will describe the pitch relationship and another, the degree of the scale it belongs to. For any trained musician it will be important to hear and understand all three of these naming systems.

There are a number of different pitch-naming systems used in the world today. I will focus only on the fixed Doh systems used in France (and common to the Swiss Romande, Italy and Spain although there is a moveable Doh movement—or relative solfa as it is more properly called—in those countries) and the system used throughout the United Kingdom, other Anglophone countries, Hungary and also in slightly different form in German-speaking countries and Scandinavia.

In those countries that traditionally use a fixed Doh solfège system, the syllable "Doh" corresponds to a note found as a white note immediately below a pair of black ones on the piano. Concert pitch is what in England is called A 440 and this is called Lah 440 in a fixed Doh system. There is nothing magical about calling it Lah instead of A – it is just a label for a certain pitch. Although it is one step in the sequence Doh, Re, Mi, Fa, Sol, La, Si Doh it tells you nothing particular about its relationship to other pitches or its expressive intention and chromatic alterations are not identified verbally so the equivalents of D, D sharp and D flat are all called Re.

In the countries using moveable Doh (solfa in English), the fixed pitches are named using the letters of the alphabet: A-B-C-D-E-F-G – or in German A-H-C-D-E-F-G. It is easy to sing a melody using these letters since they are monosyllabic when sung but it would be very difficult in, say, Italy where the letter B is called Ebbe, F Effé! The syllables Doh, Re, Mi etc. are reserved for expressing pitch relationship: Doh, for example, is the Tonic of a major scale and there is always a semi-tone between Mi-Fah and Ti-Doh. These Relative Solfa systems also have a complete set of chromatic syllables, often different ones for rising and falling, for example: Doh, Di, Re, Ri, Mi, Fah, Fi, Soh, Si, Lah, Li, Ti, Doh. A descending chromatic scale will then be sung as follows: Doh, Ti, Toh, Lah, Loh (or Law), Soh, Saw, Fah, Faw (if you want it), Mi, Maw, Re, Raw, Doh. Each of these semitones has a hand sign attached to it for use in aural training. This way of dealing with chromatic alteration helps a singer to feel the rising tone as it is supported by the use of a naturally higher

pitched vowel and the descending tone's depth is underlined by the use of a darker vowel. In this way, fine discrimination can be made, especially in a cappella singing (where equal temperament need not be required) in the difference between singing A A flat and singing A – G sharp. Many teachers like this system of semi-tones because it allows students to discriminate between a tone and its chromatic alteration (sharp or flat) in the way it is named (rather than singing the same syllable for three different pitches as is common in fixed Doh training) and to name a 12 note scale.

Most moveable Doh systems also include an in-built way of finding and recognizing the Tonic of the Relative minor scale since it is always Lah.

When singing modal music using a relative solfa system, the modes are given the seven, solfa names with the Ionian mode corresponding to a Doh scale. The Dorian mode is a mode of Re. However, it need not be sung with D always as the tonic. It is perfectly easy to sing a Dorian scale starting on G and preserving the semitones Mi-Fah and Ti-Doh. As a result, a Dorian scale from G will be sung Re (G), Mi(A), Fah(Bflat), Soh(C), Lah(D), Ti(E), Doh(F), Re(G).

Both fixed and moveable Doh systems provide for identifying the pitch as a degree of the scale by using numbers. These numbers are taken to suggest relationship in the tonic. Chord numbers follow this numerical system, chord 1 (or 1 for minor tonalities) being the tonic chord in major, minor or modal tonalities. However, the moveable Doh system contains one more trick.

Modulation

If the Tonic of a major scale is always Doh and I am in C major, C is Doh. If I want to modulate to G major, G will become the new Doh and its relative minor will start on F (Lah). At some point I will register that the note G has changed its identity – the key to understanding modulation: what was Soh and a Dominant in relation to the key-note is now Doh, the tonic or key-note itself. In order to effect this change, old Fah(F) will become Fi (F sharp) during the process of modulation. Once I have actually arrived in G major that F sharp (now naive to G major) will become Ti.

Making the process of modulation conscious in this way, not only inside one's head but in the way names are used, reinforces the sense of modulation in the experience of many musicians and music teachers. It is quite clear that the tonic, the "home" has shifted

Résumé

Cet article débat de la question litigieuse concernant les différents systèmes de solfège. Plus particulièrement, traite des 2 systèmes les plus répandus, le do fixe et le do relatif. (Plus généralement appelé do mobile).

La pratique du do fixe repose sur la hauteur absolue des sons, alors que le do mobile s'attache tout d'abord sur les relations entre les sons, puis par la suite sur les sons absolus.

Le système du do fixe est largement répandu dans les pays francophones et dans les cultures latines, telles que l'Italie et l'Espagne, où elle est l'unique manière de nommer les sons. Par contre

le système du do relatif est largement implanté en Grande-Bretagne et les pays anglophones, ainsi que dans les pays scandinaves. Et il y a aussi les pays comme la Hongrie, qui pratiquent la méthode selon Kodaly, où les sons fixes sont nommés par les lettres.

Puis l'article décrit brièvement le développement auditif (rythmique solfège) dans l'approche dalcroziennne, illustré par quelques exemples pratiques de l'usage du corps, du mouvement, de l'espace et du rythme, ainsi que par des exercices pour des enfants et des étudiants, en vue de développer l'habileté à identifier et construire des sons.

Selon l'auteur, bien que Jacques-Dalcroze lui-même ait utilisé le do fixe, il est possible de pratiquer l'un ou l'autre système, tous

location and that what used to be my near neighbour (for example, France, from an English point of view) is now my new home.

Supposing instead I decide to go from C major to C minor. Old Doh (C) will become new Lah and, always maintaining semitones between Mi-Fah and Ti-Doh, I will discover that I now have a special relationship to E flat major. The key-signatures sort themselves out very easily.

Atonal music

It is easy to sing atonal music using fixed Doh. In this system as Doh is always C the sense of fixed pitch memory is consciously cultivated so that even those who do not possess "perfect pitch" start to develop quite a solid pitch memory. Perfect, or absolute, pitch can be as much of a nuisance as it is a help since, as a pitch memory, it is sometimes closely attached to the instrument played in childhood and owners can easily sing or play out of tune relative to other players. Furthermore, if it is attached to treble instruments such as the flute or violin, the player may not necessarily discriminate bass tones well at all.

Moveable Doh pedagogies are less concerned with the development of absolute pitch as they are usually more concerned with pitch relationship and, if they are really well taught, with intonation, sound quality and the expressive implications of that relationship. However, a sense of fixed pitch can be developed by singing letter names as is increasingly popular. Atonal music is usually sung using Doh as C, like the fixed Doh system but with the altered chromatic names (Di for C sharp, for example).

Intonation

It is very important that some aural training take place without using any of these syllables. To sing in tune everyone must be able to hold a given pitch while changing the vowels sung on it. For example, holding an A (Lah) but singing a-e-i-o-u without altering pitch. Many people cannot do this, largely because they do not bear themselves nor correct the pitch relative to the natural pitch of the vowel. The vowel "i" in "ah/n" is a very high vowel as compared to the "ou" sound in "ah/n". Anyone can test this for themselves by whispering these vowels slowly. Singers who do not hold pitch

when they sing may be suffering from lack of breath support but they also may not be "lifting" or "thinking up" the "ew" sound especially if the pitch descends (as in singing a word such as "before" on A - G sharp where we might descend too far or on A-B where we might not go up far enough).

It is equally important that songs are sometimes sung using their text and as a performance or communication of a song. We are, or should be, concerned with making music. Exercises are a way of helping us to do that better, not ends in themselves.

Systems, integration and accessibility

Any system is only as good as its teachers. All teachers of musicianship need to ensure that all the essential elements are there: pitch recognition and discrimination throughout the pitch range, treble and bass; the ability to identify and create intervals, chords and melodies; playing with sound and musical improvisation; fixed pitch naming; the sensing and understanding of pitch relationships and their possible meanings; the sensing and understanding of harmonic motion; being able to sing in tune and match tone quality with another. Those using a fixed Doh system will need to be decide how they will deal with chromatic alteration and tonal relationship; those using a moveable Doh system will need to ensure that some sense of fixed pitch is developed and make decisions about what to do when music is intentionally, totally ambiguous or modulates very frequently and to remote keys. This is because the purpose of aural training is to be able to learn to make, communicate and understand music. Dalcroze's special contribution to the experience, expression and teaching of music is the use of natural and potential relationships between music and movement and the spatial dimension: his is not simply a music education but an education in and through music movement relationships. A Dalcroze aural training is characterised by its use of space, movement and rhythm to enhance pitch perception and develop inner hearing. It can be applied using any consistent and coherent system of naming notes that works for the context in which it is applied. In the UK, moveable Doh is likely to remain the system in use because for well over a hundred years choirs throughout the kingdom have been trained in it and in some cases sing purely from the solfa notation. Choral singing remains deeply embedded in the cultures of these islands despite the decline in

Figure 6. Hutchins, Larrouy-Maestri and Peretz (2014)

Singing ability is rooted in vocal-motor control of pitch

Sean Hutchins · Pauline Larrouy-Maestri · Isabelle Peretz

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Abstract The inability to vocally match a pitch can be caused by poor pitch perception or by poor vocal-motor control. Although previous studies have tried to examine the relationship between pitch perception and vocal production, they have failed to control for the timbre of the target to be matched. In the present study, we compare pitch-matching accuracy with an unfamiliar instrument (the slider) and with the voice, designed such that the slider plays back recordings of the participant's own voice. We also measured pitch accuracy in singing a familiar melody ("Happy Birthday") to assess the relationship between single-pitch-matching tasks and melodic singing. Our results showed that participants (all nonmusicians) were significantly better at matching recordings of their own voices with the slider than with their voice, indicating that vocal-motor control is an important limiting factor on singing ability. We also found significant correlations between the ability to sing a melody in tune and vocal pitch matching, but not pitch matching on the slider. Better melodic singers also tended to have higher quality voices (as measured by acoustic variables). These results provide important evidence about the role of vocal-motor control in poor singing ability and demonstrate that single-pitch-matching tasks can be useful in measuring general singing abilities.

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Introduction

Music is an important and universal aspect of culture, and one of the most prevalent forms of musical activity is singing. Nevertheless, many people do not sing well, despite having no problems hearing or understanding music. Poor singing ability can have several manifestations, including problems with timing and with timbre (the quality of a sound, independent of pitch, loudness, or timing). However, the most common manifestation of poor singing ability is poor pitch control (e.g., Dalla Bella, Giguère, & Peretz, 2007). In addition, music educators rank pitch intonation as the single most important factor in determining someone's singing talent (Watts, Barnes-Burroughs, Andrianopoulos, & Carr, 2003). Because of this, many studies of singing ability have focused on the ability to match one or more pitches (e.g., Estis, Coblenz, & Moore, 2009; Hutchins & Peretz, 2012; Pfordresher & Brown, 2007; Watts, Moore, & McCaghren, 2005). This ability is commonly measured acoustically as the distance in pitch between the sung note and the target note (the error).

In order to vocally match a target note, singers must perceive the pitch, determine the configuration of their vocal apparatus that will create a note of the same pitch, and enact that motor command. An error in any of these steps will lead to inaccurate vocal pitch matching (Berkowska & Dalla Bella, 2009; Pfordresher & Brown, 2007). Many studies searching for the cause of poor singing abilities have focused on perceptual abilities, generally by correlating vocal pitch-matching accuracy with a measure of pitch perception. Although some of these studies have found relationships between these two abilities (e.g., Estis et al., 2009; Estis, Dean-Clayton, Moore, & Rowell, 2011; Moore, Keaton, & Watts, 2007; Watts et al., 2005), several others have failed to do so (e.g., Bradshaw & McHenry, 2005; Dalla Bella et al., 2007; Moore, Estis,

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Gordon-Hickey, & Watts, 2008; Pfordresher & Brown, 2007). Ultimately, however, it is unlikely that problems with pitch perception can account for the majority of instances of poor pitch-matching abilities, given that errors in vocal pitch matching (when they occur) are often much larger than errors in measured pitch perception ability.

A recent study by Hutchins and Peretz (2012) used a novel method to investigate the relationship between the ability to perceive and vocally imitate pitches. This study used a new instrument called a slider as a nonvocal alternative to pitch matching. The slider is played by pressing on a horizontal touch-sensitive strip and creates a synthetic vocal tone based on the position at which it is pressed. Unlike a piano, this instrument is not divided into discrete steps but can create any pitch within its range, just like the voice can. Hutchins and Peretz asked musicians and nonmusicians to match synthesized vocal tones on the slider and with their own voices. Participants were considerably better at matching pitches with the slider than with their voices, despite their unfamiliarity with the new instrument. As a control for timbre, participants were also asked to match examples of their own voice singing, with the target examples taken from prior recordings. Participants were more accurate at matching their own voices than synthesized tones but were still less accurate than they were with the slider. Overall, the pattern of results indicated that poor vocal pitch-matching ability was not generally caused by poor perception ability, since poor singers were generally able to match pitches accurately on the slider. Rather, of the 31 nonmusicians tested, 20% were impaired on both singing tasks (matching synthesized vocal tones and matching their own voice), indicating a vocal-motor impairment, and a further 35% were impaired at matching synthesized vocal tones, but not at matching their own voice, indicating a sensorimotor problem involving translating between timbres (since they could vocally match only an identical timbre, but not a different timbre; see Hutchins & Peretz, 2012, for further details). All participants, however, were more accurate in using the slider than in either kind of singing.

An alternative explanation for the general superiority on the slider than on vocal self-matching is related to the specific timbres used in each task. Participants were able to make more accurate tuning judgments (deciding whether two notes were the same or one was mistuned) about the synthesized vocal timbre created by the slider than about natural vocal timbres (Hutchins & Peretz, 2012, Experiment 5). This general trend to be less discerning of tuning errors in the voice than in other instruments, termed the *vocal generosity effect*, was confirmed and extended in a later study (Hutchins, Roquet, & Peretz, 2012). Most listeners do not notice tuning errors in the voice until they reach 50 cents off (100 cents = 1 semitone), as compared with only 20–30 cents in an instrument (such as the slider). Thus, participants' lower errors on the slider task than on the self-matching task may only have been a function of a better ability to resolve tuning for the slider's timbre.

Another question that can be raised about the study of Hutchins and Peretz (2012), as well as many other studies of singing ability, is the relationship between the ability to sing single tones and whole melodies. Many studies of singing ability focus on pitch matching of single tones or small numbers of tones, with the assumption that this ability will scale up to the ability to accurately sing whole melodies (with a few exceptions; e.g., Dalla Bella et al., 2007). However, this assumption has not yet been validated experimentally. Pfordresher and Brown (2007) did show that error on single-pitch matching is correlated with pitch errors in two- or four-tone contexts. However, there are many reasons why single-pitch matching might not always predict melodic singing ability, such as the beneficial effect of establishing a tonal context or the cumulative effect of corrective errors (a negative lag 1 correlation). Given that the ability to sing melodies accurately is generally of much greater importance than matching individual pitches when evaluating overall singing ability, it is important to quantify this relationship.

Finally, one other issue concerns the relationship between singing ability and other measures of vocal quality. Although the mean pitch error is the primary factor in most evaluations of singing ability (Watts et al., 2003), other factors can play a role in how we evaluate singing ability. Our intuition is that poor pitch singers would also tend to have lower quality vocal timbres, but it is possible that these abilities are unrelated, which would mean that there exists a category of singing problems that remains unevaluated by pitch-error-based measurements. In addition, the vocal generosity effect (Hutchins et al., 2012) also demonstrates that timbre can have a significant effect on our tuning judgments (see also Larrouy-Macstri, Magis, & Morsomme, in press), making it important to evaluate these qualities separately. Higher quality vocal tones may assist in evaluating one's own vocal feedback.

To address these questions, we designed a new experiment to compare pitch-matching ability on the slider and voice with each other and with melodic singing ability, without the complications of a varying timbre. Nonmusicians (chosen here because they show a greater range of singing abilities and are more representative of the general population) first recorded single tones at different pitch heights to use as target stimuli. They imitated those recordings with their voice and on the slider. In contrast with the previous studies (Hutchins & Peretz, 2012), the slider sound was not synthesized but used the recordings of each participant's own voice. These recordings were altered using a digital signal processor specifically designed for real-time vocal manipulations. Thus, the vocal pitch-matching responses and the slider-based pitch-matching responses had the same timbre (although self-produced responses will sound somewhat different from slider-produced responses, due to the influence of bone conduction and other physical intermediaries). Following the pitch-matching tasks, participants were also asked to sing a complete version of a well-known song ("Happy

syllable of "happy") and the final note of the song were analyzed (the three target intervals were adjusted accordingly, yielding 0, 0, and +500 cents). This provides a measure of how accurately the singers returned to the tonally stable notes, with higher scores indicating that the singer had a greater tendency to allow these to drift over the course of the melody.

Results

Slider-voice comparisons

Participants were considered to be poor at a pitch-matching task if they had a mean absolute pitch error of greater than 50 cents within one response modality (for more on the use of this criterion, see Hutchins & Peretz, 2012; Hutchins et al., 2012). Five participants (23%) passed this threshold in the vocal pitch-matching task, but only 1 (5%) did so in the slider pitch-matching task (who was not one of the 5 who failed the vocal task). Comparisons were carried out between the results from slider and voice pitch-matching tasks for each of the three pitch measurements using three separate paired *t* tests. We also tested the correlations between slider and voice for each measurement.

On average, participants had lower absolute pitch errors and higher percentage of accurate answers in the slider condition (mean error = 13 cents, *SE* = 0.29 cents, 98% accuracy) than in the vocal condition (mean error = 38 cents, *SE* = 1.03 cents, 86% accuracy), $t(21) = 2.54$, $p = .02$, $d = 0.54$ (error measurement); $t(21) = 2.86$, $p = .009$, $d = 0.62$ (percent accuracy measurement). Participants were able to match a pitch more accurately on the slider than with the voice. There was no significant correlation between slider and voice pitch-matching abilities with either measurement.

The signed pitch error, however, showed a different pattern of results. Here, there was no difference in the tendency to produce flat or sharp errors between slider ($M = 2.01$ cents, *SE* = 0.24) and voice ($M = 0.41$ cents, *SE* = 0.92) conditions, $t(21) = 0.19$, n.s. One-sample *t* tests indicated that neither modality had a significant tendency to elicit sharp or flat errors, $t(21) = 1.10$, n.s. (slider); $t(21) = 0.05$, n.s. (voice). However, with the signed errors, there was a moderate but significant correlation between the slider and the voice modalities with the signed pitch error measurement, $r(20) = .45$, $p = .04$, indicating that participants who showed the tendency to be more sharp on the slider also tended to be more sharp in their sung responses. However, this was entirely driven by one outlier, and the correlation drops to $r(19) = .15$, n.s., when it is removed.

We also compared the average number of responses that participants chose to make using the slider and their voice during each trial. As in Hutchins and Peretz (2012), participants made more responses in the slider condition ($M = 10.73$, *SE* = 0.15) than in the singing condition ($M = 1.05$, *SE* = 0.01),

$t(21) = 8.20$, $p = .002$, $d = 1.74$. Despite being allowed to correct their responses freely, participants generally chose to respond only once in the singing condition, even though they were less accurate in this condition. It is unlikely that attempting to vocally match the pitch more often would improve their mean error, however, since previous work has shown that participants do not change their pitch-matching accuracy over multiple attempts at matching a single target tone, even over as many as 20 attempts (Hutchins & Peretz, 2012, Experiment 4). The trial-by-trial data in this experiment show the same pattern; our results showed that the average error on the slider did not differ between the first 10 trials ($M = 14.47$) and the 15th through 25th trials (the last 10 completed by each participant; $M = 13.97$), nor did average error differ between the first and last 10 attempts in the vocal-matching condition ($M = 36.80$ vs. $M = 35.98$). More attempts do not lead to greater vocal accuracy.

Vocal quality

To assess how the quality of the original target tones sung by the participants varied according to pitch height, we conducted three separate one-way repeated measures ANOVAs using the factor of target height (five levels), with the measurements of jitter, shimmer, and pitch stability as dependent variables (shown in Table 1; degrees of freedom are reported using Greenhouse-Geisser corrections). We found main effects of jitter, $F(2.67, 55.93) = 18.58$, $p < .001$, $\eta_p^2 = .47$, and shimmer, $F(2.44, 48.95) = 10.61$, $p < .001$, $\eta_p^2 = .37$, such that both tended to decrease (indicating better voice quality) with higher pitches. There was no main effect of target height of the tone on pitch stability. There was also a significant correlation between jitter and shimmer across the five target tones, $r(20) = .49$, $p = .02$, but no correlations between pitch stability and either of the other two measurements. Participants tended to have better voice quality when they sang higher pitches, but this did not affect pitch stability.

Target pitch height

Another relevant question is whether high versus low tones tend to induce errors in particular directions, both with the

Table 1 Means of each vocal quality measurement (shimmer, jitter, and pitch stability [*F_{SSD}*]), across the five target pitch heights

	Target Pitch Height				
	Low	Medium-Low	Medium	Medium-High	High
<i>F_{SSD}</i>	9.01	10.13	12.40	8.29	11.16
Jitter	0.72	0.56	0.46	0.37	0.33
Shimmer	4.44	3.93	3.16	2.59	2.24

slider and with the voice. To measure this, we conducted two one-way repeated measures ANOVAs separately for slider and voice response modalities, across the five levels of target height. The target height category (low, mid-low, medium, mid-high, and high) was used as the independent variable in this analysis, to allow comparison across participants with different vocal ranges (otherwise, this analysis would be dominated by the difference between males and females; see Fig. 1 for the range of actual targets produced). Signed pitch error was used as the dependent variable, to preserve error directionality (see Fig. 2). This measurement was different among targets in the voice condition, $F(1.50, 31.45) = 4.60$, $p = .03$, $\eta_p^2 = .18$. Participants were more likely to sing flat when matching high target notes and more likely to sing sharp when matching low target notes, tending to err toward the middle of their vocal range. However, there was no difference in the ability to match the different target tones in the slider condition, $F(2.46, 51.69) = 0.86$, n.s., which suggests that the vocal errors were due to vocal constraints, rather than perceptual constraints.

Melodic singing ability and its relationship to other tasks

Mean error was not significantly different between the melodic condition (mean interval error, $M = 45$ cents, $SE = 4.92$) and vocal pitch-matching condition (absolute pitch error, $M = 38$ cents, $SE = 1.03$). These two measurements were correlated, $r(20) = .48$, $p = .02$ (see Fig. 3). This correlation dropped slightly below the significance threshold when the four overall least accurate singers were removed, $r(16) = .44$, $p = .07$, although it retained the same approximate strength, indicating that the correlation is not entirely due to the difference between accurate and inaccurate singers. However, in this case, it is inappropriate to remove these cases, since we are interested in precisely these cases of poor singers. There was no significant correlation between melodic singing ability and any measurement of slider pitch-matching ability, nor was there a correlation between any measurements of single-

pitch-matching ability and tonal drift in melodic singing. Melodic singing ability seems to be moderately correlated with vocal pitch matching, but not with slider pitch matching.

To see whether there is a relationship between singing ability and vocal quality, we correlated our measurements of pitch-matching ability (on the slider and voice) and melodic singing ability (mean interval error and tonal drift) with the vocal quality measurements (jitter, shimmer, and pitch stability). We found a significant correlation between the mean interval error during "Happy Birthday" and the internal pitch stability (F_0SD) of the sung target tones, $r(20) = .43$, $p = .05$. Participants with more stable individual tones also produced more accurate melodic intervals, on average. There was also a significant correlation between the tonal drift (measuring the long-term stability of melodic singing) and the target tone jitter, $r(20) = .49$, $p = .02$, and a nonsignificant trend toward a correlation of tonal drift and target tone shimmer, $r(20) = .39$, $p = .07$. In general, participants with a higher voice quality tended to sing "Happy Birthday" more accurately. There were no significant correlations between any vocal quality measurements and slider or vocal pitch-matching abilities.

Discussion

This experiment had two main goals. First, we aimed to discover whether matching a pitch on the slider would be equivalent to matching a pitch with the voice when the timbres were highly similar. Second, we aimed to discover whether single-pitch-matching ability would predict melodic singing ability, in terms of both pitch error and vocal quality.

Slider-voice comparison

Despite the equivalent timbres in the slider and vocal pitch-matching conditions, nonmusicians were still significantly better at matching pitches on the slider than with their voice. Moreover, there was no correlation between participants'

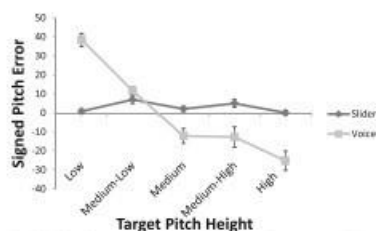


Fig. 2 Signed errors for voice and slider conditions across the five different target heights, with standard error bars

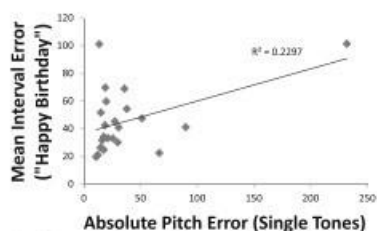


Fig. 3 Scatterplot of mean absolute error in the vocal pitch-matching condition and mean interval error in the melodic singing condition

average errors in each modality. If perceptual problems were a common cause of poor singing, we would expect to see pitch errors on the slider that were similar in size to those in the voice and correlations between these two measurements, due to a fundamental problem of poor pitch perception affecting both subsequent actions. **On the contrary, our results confirm that poor singers are able to match the same pitches when using a different motor effector (the finger, in this case).** Because there is only one timbre throughout the experiment, for targets and responses, the proximal cause of poor singing here is likely to be poor vocal-motor control (see Hutchins & Peretz, 2012). In addition, the rate of poor singers here (23%) was similar to that found to have a vocal-motor control problem in Hutchins and Peretz (2012) (20%).

Additional evidence for the role of vocal-motor control in pitch-matching tasks can be found in the effects of target pitch height. Although participants were asked to produce target tones in a comfortable range, they showed a significant tendency to sing flat when imitating higher-pitched targets and sharp when imitating lower-pitched targets. There was no similar tendency in responses on the slider, ruling out a perceptually based explanation for this finding. This pattern (which was not present in previous self-matching paradigms; Hutchins & Peretz, 2012) indicates a clear role of vocal-motor control in singing errors; participants had trouble consistently reaching tones that were toward the extremities of their range. The analysis of vocal quality of the self-produced target tones (shown in Table 1) also shows an effect of vocal-motor control on target quality; lower-pitch tones were consistently of lower vocal quality. However, this lower quality did not seem to affect the ability to accurately perceive the pitch of these tones, as evidenced by the consistent, accurate pitch-matching ability across all targets in the slider.

Scaling up to melodies

Another key aim of this study was to find evidence for the utility of pitch-matching tasks in evaluating general singing ability. Although it has been assumed that the ability to match individual pitches is a foundational skill in singing, it had not yet been verified that this specific ability is related to the ability to sing whole melodies in tune. Our results showed a significant correlation between the average amount of error in singing melodies and in vocally matching single tones. **Nonmusicians who were better at singing melodies in tune were also better at vocal pitch matching.** Furthermore, there was no correlation between pitch-matching ability on the slider and melodic singing ability, indicating that vocal single-pitch matching is measuring a singing-specific ability, rather than a general musical ability. This provides experimental evidence that measuring vocal pitch-matching ability for single tones is a useful tool for gauging overall singing ability. However, it should also be noted that this correlation was not

one to one; there is still a good deal of variance in melodic singing ability unaccounted for in single-pitch matching, some of which may concern tonality. Larrouy-Maestri, Lévêque, Schön, Giovanni, and Morsomme (2013) showed that, together, intervallic error and tonal drift could account for 81% of the variance in experts' judgments of singing ability; our results showing that single-pitch-matching error can predict intervallic error but not tonal drift lend quantitative confirmation to these expert judgments.

Our results also showed a significant correlation between melodic singing ability and vocal quality. People who were better at singing melodies in tune tended to have better vocal quality and sang individual tones more stably. Interestingly, no measurements of vocal quality had any significant correlations with vocal pitch-matching ability. Although this is only correlative evidence, this seems to indicate that the relationship between vocal quality and in-tune melodic singing is not mediated by vocal pitch-matching ability; there is an aspect of melodic singing that is influenced by vocal timbre separately from single-pitch matching. It is also important to note that, because the experimenter selected the tones to use as targets partially on the basis of vocal quality, these represent the upper ranges of quality for each singer.

One possible explanation for the relationship between vocal quality and the ability to sing in tune is that it is likely that those with better vocal quality are also more likely to sing more often; the extra practice may lead to better overall singing ability and better vocal quality. Those who practice singing melodies more often may not practice single-pitch imitation to the same extent, which could be a reason for the lack of correlation between vocal quality and single-pitch matching.

It should also be noted that the aspects of vocal quality measured here (pitch stability, jitter, and shimmer) represent only some possible measurements of vocal quality and timbre. Of these, both pitch stability and jitter, which are different measurements of short-term fluctuation in pitch, are strongly related to the mean pitch. Although these do not directly affect mean pitch in single-tone or melodic contexts, it is less surprising that there would be relationships between these variables (the same does not hold for shimmer, on the other hand, which is a measurement of short-term fluctuation in amplitude). These measurements were chosen because they represent a few standard variables used in assessing vocal quality, but other measurements (e.g., breathiness, spectral centroid, spectral envelope, etc.; Larrouy-Maestri, Magis, & Morsomme, 2014) may reveal a different pattern of effects. In addition, because we measured the vocal quality of only one vowel (/a/), there is the possibility that vocal quality of any given participant may be different across vowels. Exploring the relationship between other aspects of timbre and singing ability would seem to be a fruitful avenue for future exploration.

Conclusion

By using a touch-based measurement of peoples' sensitivity to pitch variations of their own voice, we were able to provide clear evidence that timbral factors are not responsible for the difference between pitch perception and production abilities. Rather, this novel method makes it clearer that vocal-motor problems are a primary cause for many types of singing difficulties. In addition, we have shown that the types of single-tone pitch-matching tasks used here and in many previous studies are a good proxy for melodic singing ability. Finally, differences in timbre and vocal quality can also be associated with the ability to sing melodies in tune.

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Figure 7. Kervin (2023)

The Key to Singing Off-Key: The Trained Singer and Pitch Perception Distortion

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Summary: Objectives. Pitch perception distortion (PPD) is a novel term describing a phenomenon in which an amplified, accompanied singer's perception of their sung pitch relative to band or accompaniment becomes ambiguous, leading to one of two conditions: a) the singer believes they are out of tune with the accompaniment, but are in tune as perceived by a listener, or b) the singer believes they are in tune with the accompaniment, but are not. This pilot study aims to investigate the existence and incidence of PPD among amplified, accompanied performers and identify associated variables.

Design/Methods. 115 singers were recruited to participate in an online survey, which collected information on musical training, performance environment, and PPD experience.

Results. Reported PPD incidence was 68%, with 92% of respondents indicating that PPD occurred rarely. The factors reported as most associated with PPD experiences included loud stage volume, poor song familiarity, singing outside one's habitual pitch range, and singing loudly. Contrary to previous studies and our hypotheses, no association was found between modality of auditory feedback (e.g., in-ears versus floor monitors) and incidence of PPD. Additionally, higher levels of training were found to be associated with higher incidence of PPD.

Conclusions. The reported incidence supports that PPD exists beyond chance and anecdotal experience. In light of the highly trained sample, the data suggest that pitch accuracy in accompanied, amplified performance may be more associated with aural environment—specifically loud stage volume—and a highly trained singer's tuning strategy in response to that environment rather than a singer's mastery of vocal intonation skills in isolation. Loud stage volume was implicated as a primary factor associated with PPD, which may be related to the stapedius reflex. Future investigations will target attempted elicitation of PPD in trained singers after establishing baseline auditory reflex thresholds and objective measurements of intonation accuracy.

Key Words: Singing—Intonation—Pitch Matching—Pitch Discrimination—Pitch Perception.

INTRODUCTION

Whether out at karaoke or watching American Idol, most of the general population has witnessed someone singing off-key. These blunders carry a heavy burden of stigma, especially for high-profile performers. This begs the question: if casual listeners can discern when a singer is out of tune,¹⁻³ why can't trained vocalists identify and correct off-key singing during performance?

Pitch perception distortion

Anecdotally, the author has observed incidences of singing out of tune among colleagues, students, and during the author's own performances, especially those in performance environments with limited auditory feedback. When self-perception of pitch is altered, it can lead to a condition

defined here as *pitch perception distortion (PPD)*, a novel term created to describe this phenomenon. Pitch perception distortion occurs when an amplified, accompanied singer's perception of their own pitch relative to that of the accompaniment becomes ambiguous, leading to one of two conditions: a) the singer believes they are in tune with the band or accompaniment, but, as perceived by a listener, is not, or b) the singer believes they are out of tune with the accompaniment, but is in fact in tune.

The primary aim of this project is to investigate the existence and incidence of this phenomenon among amplified, accompanied vocal performers beyond anecdotal observation. Secondary aims include identifying conditions and other variables that may be associated with pitch perception distortion.

Variables in pitch matching

Singing in tune requires multiple physiological and cognitive systems to support both pitch discrimination and pitch matching abilities. A number of variables, both inherent and external to the singer, play a role in the accurate execution of these skills in the context of a live amplified and accompanied performance. These include internal characteristics—such as level of training,⁴⁻⁶ cognitive load,¹⁰ and psychological state^{11,12}—as well as environmental characteristics, such as auditory feedback,¹³⁻¹⁶ melodic and harmonic context,^{17,18-20} timbral qualities of instrumental reference stimuli of the accompanying ensemble,²¹⁻²³ and venue or stage acoustics.²⁴⁻²⁶

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Training was of special interest in this project, as prior literature suggests that higher levels of training are positively correlated with pitch matching and discrimination abilities.^{3,4,5,6,27} From a motor learning perspective, it stands to reason that increased training (eg, in-studio training, ear-training and music theory training, performance experience, etc) would increase a singer's auditory-motor mapping and support pitch matching accuracy.^{7,10,28} It was hypothesized, therefore, that higher levels of training would be associated with lower reported incidence of PPD.

Auditory feedback has also been noted to have an effect on pitch matching accuracy, where higher levels of auditory feedback and increased timbral similarity of that feedback to a human voice were associated with increased intonation accuracy.^{14,21,30-35} Vocalists receive both internal and external auditory feedback during singing. For the purposes of the current study, internal auditory feedback is defined as a singer's self-perceived vocalizations via bone conduction (BC) hearing, and external auditory feedback via air conduction (AC) hearing includes the singer's unamplified voice as perceived by their ears, the singer's amplified voice via monitoring, and the target tuning reference stimuli from the accompaniment or band.^{4,20,36-40}

The anecdotal experiences that prompted this investigation often occurred in loud, complex acoustic environments. Prior literature posits that loud stage volume leads to masking conditions, which can alter timbral characteristics and levels of auditory feedback, thus affecting pitch matching accuracy.^{14,16,31,40,41} Therefore, it was hypothesized that larger venues and larger ensemble sizes—both of which contribute to the potential for a louder performance environment (ie, reverberation and opportunities for masking conditions)—would be associated with increased incidence of PPD.

Need for the study

This phenomenon has not been previously addressed in the context of amplified and accompanied performers. Previous work has investigated the effects of auditory feedback and training on both pitch perception and pitch matching tasks, but largely utilized isolated stimuli without musical context or accompaniment. Previous investigations have also centered largely on classical singers.²⁴ In contrast, this investigation targets singers of Contemporary Commercial Music (CCM) (as defined by Lovetri⁴²) in amplified and accompanied performance settings, which accounts for a significant portion of professional singing environments. This study may therefore be beneficial to inform pedagogical and performance practices for this population of singers.³⁴

METHODS

The study was developed during the COVID-19 pandemic, which affected both study design and the retrospective nature of singers' responses due to lack of active performing. An anonymous online Qualtrics⁴³ survey entitled "The Key to Singing Off-Key" was developed and distributed to

assess the incidence and nature of PPD. This project was approved by New York University's Institutional Review Board with waiver of informed consent.

Participants

Participants were adult vocalists (18 years of age or older) who typically sing with both amplification and accompaniment and perform in a live setting at least 1-2 times per month. Performers who sing primarily a cappella or without amplification were excluded, as well as those who do not perform regularly. As the survey was written in vernacular English and not translated, non-English-speaking participants were also excluded. Participants were sourced through targeted posting of the survey link on the author's social media profiles and email listservs. All survey responses were anonymous. No identifying information was collected, and all study personnel were blinded to participant IP addresses.

Survey design

Following questions establishing inclusionary and exclusionary criteria, participants answered questions about their musical training, including number of years of academic musical training and voice lessons. They also provided information about their typical performance environment, including size and type of venue, as well as the instrumentation with which they typically performed.

The primary question asked subjects if they had ever experienced pitch perception distortion (PPD) and defined the novel term for clarification. If participants answered no to the primary question, they were directed to the end of the survey. If participants answered yes, they were asked additional questions regarding the frequency and circumstances surrounding their performance experiences, such as stage volume, knowledge of the song, and pitch range.

A copy of the survey questions can be found in Appendix A.

RESULTS

The survey link was actively distributed for a period of 18 days, during which 195 total responses were gathered. Of the 195 responses, 80 participants were eliminated based upon the exclusionary criteria, leaving 115 total respondents ($n = 115$). Participants were required to answer all questions following the initial inclusionary/exclusionary criteria, and no data were found to be missing.

A statistical analysis was conducted using Microsoft Excel⁴⁴ and IBM SPSS, Version 27.0.⁴⁵ The results were analyzed using descriptive statistical measures, including frequency. Chi-square inferential statistical analyses and binary logistic regression were conducted to investigate the nature of potential associations between participant characteristics and reported incidence of PPD within the sample population. Given the exploratory nature of this pilot survey study, the significance level was set at $\alpha = 0.10$.⁴⁰

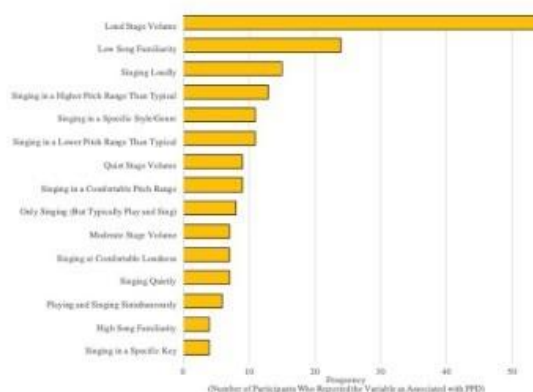


FIGURE 1. Performance variables associated with pitch perception distortion (PPD).

Overall PPD experience

Of the 115 responses that met the inclusionary criteria, 78 participants, or approximately 68% of respondents, reported experiencing pitch perception distortion. This response from the sample population supports the existence of PPD as a phenomenon beyond chance and beyond anecdotal experience.

Of the 78 participants who reported experiencing PPD, 92% indicated that PPD occurred "rarely" or "sometimes." In terms of type of PPD experience, 18% reported thinking they were *out of tune* with the band while actually being in tune, 28% reported thinking they were *in tune* while actually being out of tune, and over half of respondents (54%) reported experiencing both variants. 71% of those that experienced thinking they were in tune with the band or accompaniment but were actually out of tune reported that they were "in tune with themselves." In other words, the intervallic differences between their notes were perceived to be perceptually correct in isolation, but were not in tune with the band or accompaniment.

Conditions associated with PPD

Participants who reported experiences of PPD were asked to select all conditions from a list that were associated with their experiences. The most salient variables reported were loud stage volume (69%, which 54/78 participants reported), low familiarity with the song (31%, 24/78 participants), and singing loudly (19%, 15/78 participants). These were followed by singing in a higher pitch range than typically sung (17%, 13/78 participants), singing in a lower pitch range than typically sung (14%, 11/78 participants), and singing in a specific genre (14%, 11/78 participants). If participants

selected singing in a specific genre, they were then asked to choose the genre most associated with their PPD experiences. These results had small sample sizes with high variability and lack of recall by participants, which led to no conclusive patterns observed regarding genre and PPD upon analysis.

The frequency of performance variables associated with PPD as reported by respondents can be found in Figure 1.

Level of training

Two parameters were chosen to define participants' level of training: musical training (defined as level of academic musical study) and vocal training (defined as length of private vocal study). The latter was thought to indicate a participant's motor-centric learning experience specific to vocal production in singing, while academic music training may point towards one's level of aural discrimination training. Despite this distinction for the purposes of analysis, these training parameters overlap and include elements of both aural and motor training, as curricula and pedagogy techniques inevitably vary.

The participants were placed into three groups based on level of musical training: those with no collegiate training, those with undergraduate collegiate training, and those with graduate collegiate training. Of these groups, 78% of those with no collegiate training, 61% with undergraduate training, and 78% of those with graduate training reported experiencing PPD.

The participants were also divided into three groups according to length of vocal training: 0-3 years, 4-6 years, and 7+ years. Of these three groups, 75% of singers with 0-3 years of vocal training, 59% of those with 4-6 years of

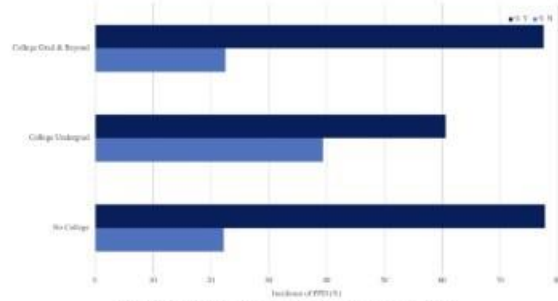


FIGURE 2. Musical training level and incidence of PPD.

vocal training, and 68% of those with 7+ years of vocal training reported experiencing PPD. A visual representation of these data can be found in Figures 2 and 3.

A chi-square analysis did not reveal a statistically significant relationship between level of collegiate musical training nor length of vocal training and incidence of PPD ($\chi^2 = 3.70$, 2, $p > 0.05$; $\chi^2 = 1.66$, 1, $p > 0.05$), as shown in Table 1. However, when musical training was reduced to two binary groups who underwent collegiate musical training (undergraduate versus graduate, $n = 106$), the association between these variables and experiences of PPD were significant at $\alpha = 0.10$ ($\chi^2 = 3.21$, 1, $p = 0.073$).

A binary logistic regression was performed to further assess the nature of the association of these variables. Results showed that more advanced musical training was associated with reported increased incidence of PPD, significant at $\alpha = 0.10$ ($B = 0.806$, $SE = 0.455$, $Wald = 3.141$, $P = 0.076$). Thus, contrary to the author's hypothesis and findings of previous investigations, these data suggest that more advanced (graduate) collegiate training is associated with increased reported incidence of PPD.

Auditory feedback

Participants who reported experiencing PPD were asked to define whether it occurred most often when a) using a monitor system for auditory feedback, b) not using a monitor system, or c) in both situations. 29% reported most often experiencing PPD when using a monitor system, 37% when not using a monitor system, and 23% reported that it occurred in both situations equally (participants who were unable to recall were omitted from the sample, $n = 68$).

The potential relationship between experiences of PPD and auditory feedback was further investigated by asking those participants who endorsed experiencing PPD while using a monitoring system to define the feedback modality that was most associated with their experiences. 32% reported occurrence most often with the use of floor monitors (e.g., "wedges"), 19% with main speakers placed behind them, 17% with in-ear monitors, and 10% with earplugs (17% were unable to recall). While the reported incidence of PPD was somewhat higher in conditions without a monitor, the relatively small difference among groups and the small sample sizes were insufficient to conclude that the presence,

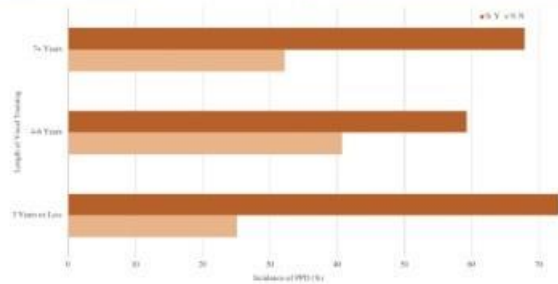


FIGURE 3. Vocal training level and incidence of PPD.

TABLE 1.
Training Level and Incidence of PPD

Training level		PPD incidence			Chi-Square Tests		
		No	Yes	Total	χ^2	df	P
Musical training (3 groups, n = 115)	No college	2	7	9	3.700	2	0.157
	Undergrad	26	40	66			
	Grad	9	31	40			
Musical training (2 groups, n = 106)	Undergrad	26	40	66	3.214	1	0.073*
	Grad	9	31	40			
Vocal training (3 groups, n = 115)	0-3 years	8	24	32	1.663	2	0.435
	4-6 years	11	16	27			
	7+ years	18	38	56			
Vocal training (2 groups, n = 115)	0-3 years	8	24	32	1.046	1	0.307
	4+ years	29	54	83			

* significant at $\alpha = 0.10$

absence, or modality of auditory feedback had an overt effect on PPD experiences among the sampled population.

Of additional interest were two participants who provided comments in the "Other" category. One stated that PPD occurs "only in the studio with headphones," and a second respondent stated PPD is "primarily related to high volume, not the volume source." The latter comment supports this study's findings that high stage volume was reported as the most salient factor associated with PPD experiences.

Other factors

No statistically significant associations were found when analyzing the relationship between venue size, ensemble size, or performance genre and incidence of PPD.

DISCUSSION

The primary finding of this study is that PPD exists as a phenomenon beyond chance and anecdotal experience according to the reported incidence among the sample population. In fact, the true incidence may have been underreported due to participants' recollection errors, reluctance to disclose, or denial due to stigma associated with these experiences, despite the anonymity of the survey.

Increased training and increased PPD

Contrary to previous literature and the hypotheses of this study, higher levels of training were found to be associated with higher incidence of PPD. This association was made more interesting by the overall highly trained population in the sample.

69% of participants were characterized as being highly trained; that is, they had both collegiate musical training and at least 4 years of vocal training. The association between increased training and increased PPD incidence may be due to the higher likelihood of trained singers to perform in more complex acoustic environments, to have more performance experiences (and thus more opportunity to

experience PPD), and an enhanced ability to identify instances where they are singing out of tune. However, another primary finding of the study was the low frequency of PPD experiences within individuals. 92% of respondents indicated that PPD only occurred "rarely," which suggests association with a variable other than number of performance opportunities.

High stage volume as a primary factor

Although sample sizes were insufficient to assess the effects of auditory feedback modality on PPD, high stage volume was reported as the most salient factor, and was even notated, unprompted, as a primary concern by one participant. This points towards the aural environment and especially stage volume as a primary component of pitch perception distortion experiences.

High stage volume can affect internal and external auditory feedback, timbral characteristics of referential stimuli, and vocal production patterns.^{3,4,31,41} While auditory feedback has been previously shown to have positive effects on pitch matching, too much auditory feedback secondary to high stage volume may occur when monitors are competing with other sound sources,^{1,3,24} leading to masking conditions where the ratio of air conduction (AC) to bone conduction (BC) hearing is altered.^{37,40}

These conditions may be especially prevalent at loudness levels of approximately 70–115 dB SPL and above, the point at which the stapedius reflex is triggered.^{40,47} This protective aural reflex contracts the muscles of the middle ear when presented with high-intensity stimuli in order to decrease vibrational energy traveling to the inner ear and thus attenuate intensity.⁴³ Like masking conditions, this intensity attenuation may alter the ratio of AC to BC hearing, where a singer relies more on internal auditory feedback (BC hearing) in the context of attenuated external auditory feedback (AC hearing).⁴⁰

Compared to AC hearing, BC hearing has low pass filtering, which is one of the reasons that one's voice sounds

different when played back on a recording versus as heard by oneself.⁴⁰ Timbre has been demonstrated in previous investigations to have an effect on pitch perception.^{1,21,22} If a singer is relying more on internal auditory feedback through BC hearing, the resulting timbral changes could affect pitch perception and potentially lead to PPD.^{40,41,49} The stapedius reflex itself also has a frequency component, where it “decrease[s] sound transmission to the cochlea, more for low frequencies than for high frequencies.”⁴¹ This change in timbre may also contribute to pitch perception distortion experiences.

Furthermore, vocalizations as heard back through monitoring systems (via AC hearing) may be timbrally different from internal auditory feedback (BC hearing), leading to further pitch perception distortion. The stapedius reflex can be triggered by both environmental sounds and by one's own vocalizations,^{40,48} which is consistent with this investigation's finding that both “loud stage volume” and “singing loudly” were reported to be associated with PPD by the participants.

Intervallic vs referential tuning

Tuning strategies for accompanied singers are not clearly defined in the literature, but are essential to the discussion of PPD experiences. Discriminatory ability of both intervallic and referential tuning is an underlying assumption of PPD among a highly trained population. Intervallic tuning is defined here by the author as the production of consistent intervallic differences between notes, whereas referential tuning is defined as matching one's sung pitch to a reference stimulus.^{29,53} Both intervallic and referential tuning are critical to intonation accuracy in an accompanied live performance setting and roughly correlate with internal auditory/kinesthetic feedback and external auditory feedback, respectively. Both tuning strategies are subject to effects from the aural environment during performance.

Tuning strategies in a loud environment

In terms of referential tuning, the bass or lower tones typically establish a harmonic tonality.⁵³ A trained singer with extensive musical training relies on a sort of “neural priming” in a harmonic context, somewhat like inferring the interior letters of a word during reading.^{17,20,54–56} These subconscious trained responses^{6,57,58} that are activated by a harmonic context can be affected in a loud environment where timbral changes secondary to intensity attenuation from the stapedius reflex may be present, which could alter the singer's perception and thus their vocal output. This may be especially true in instances when the singer has poor knowledge of the song,⁵² which was reported as a salient factor associated with PPD experiences, where their cognitive expectations would be less habituated.

Monitor levels of the singer's own voice versus other instruments may also influence tuning strategies. If the singer's own voice in the monitor is loud to the point of masking reference stimuli from the accompaniment, the singer may

be using a more intervallic tuning strategy, where they are tuning to their own voice as heard in the monitor versus tuning to the reference stimuli from the band.

The intersection of training and auditory feedback in the performance environment

Training has been shown to increase a singer's reliance on internal modes of feedback through “kinesthesia,” or awareness of bodily sensations.⁷ This internal reliance precludes an unwanted increase in vocal effort secondary to the Lombard effect⁵⁹ and reduces the singer's susceptibility to changes in referential stimuli or external auditory feedback.^{3,1,4,61,62} However, kinesthetic strategies used by trained singers may be a confounding factor in investigating PPD. Increased reliance on kinesthetic feedback in conjunction with neural responses related to tonal “priming” may be responsible for the simultaneous maintenance of intervallic tuning and breakdown of referential tuning.^{6,9,2,63} This is supported by the current investigation's finding that the majority of singers reported being “in tune with themselves” when they were out of tune with the band during PPD experiences.

Making conditions and loud aural environments that cause a singer to compete to be heard can certainly increase vocal effort, which can affect tuning. However, the finding that singers reported maintaining intervallic tuning points towards PPD experiences as being separate from instances of out-of-tune singing resulting solely from vocal strain in loud environments.

The data from the current project support the idea that, while increased training positively impacts general pitch discrimination abilities, discriminatory skills alone are not enough to ensure accuracy in pitch matching tasks.^{7,4,63} Trained mapping of kinesthetic feedback to support aural discrimination skills is a fundamental tenet of vocal training. However, the potential for intervallic tuning strategies to fall short in a complex and variable aural environment may point towards a need for adjustment in pedagogy. These adjustments may include training singers' responses to variable aural environments where kinesthetic feedback alone is insufficient to avoid off-key singing.^{26,67}

Additionally, with regards to training and the aural environment, amplification is rarely used in the context of individual study with a voice teacher or in settings such as music theory, ear training, or sight singing classrooms commonly part of aural collegiate training. CCM singers frequently receive training in the use of microphones and amplification “on the job.” Furthermore, performance venues tend to have variable amplification equipment types and configurations. This variable training and experience with amplification represents both a potential contributing factor in cases of PPD as well as a gap in training approaches for CCM performers.

Singing on key is complex

The findings of the current investigation highlight the complex and multifactorial nature of perceptual and motor

processes involved in pitch matching in a live performance environment, where both aural and motor skills are linked to contextual information as well as a singer's trained response to that context. Even with preliminary results, there is much to be inferred regarding pedagogical approaches. These include training a singer's responses to various environmental contexts to and addressing both referential and intervallic intonation strategies during development of auditory and motor skills.

LIMITATIONS

The majority of respondents were highly trained and identified as female. Due to self-selection of participants, it is unknown whether this imbalance was due to a greater willingness on the part of these individuals to take the survey, an overall higher percentage within the target population, or chance. Additionally, those who have experienced PPD were more likely to be drawn to and complete the survey. The survey did not include singers who primarily perform in unamplified settings (e.g., choral, a capella, classical) which may be environments where PPD is also experienced.^{17,18,19} All participants reported hearing within normal limits, except for one, who reported "some hearing loss due to illness and loud live performances," which could have affected results.

Based on the inclusionary criteria, it was assumed that participants had the capability to perceive accurate intonation, sing in tune, and to recall these experiences. This first point was deemed a reasonable assumption based on previous literature supporting the ability of non-singers and singers alike to discern intonation accuracy. Given the primacy of pitch matching skills in vocal performance and the stigma of PPD experiences, participants may have been more likely to remember these events and circumstances surrounding them. Conversely, singers may have been less likely to report experiences of PPD due to that same stigma, despite the anonymity of the survey. Recollection errors may also have been increased within the survey distribution period of May 2020, during the first height of the COVID-19 pandemic, when singers were not performing as often. Indeed, the results of the current project only include instances of PPD where the participants were aware of singing out of tune; the actual incidence may be under-reported. This lack of response accountability highlights the need for further research in this area with more experimental control.

Participants were asked about venue and ensemble sizes that characterized their typical performance environments. However, the majority of participants reported varied performance settings, resulting in no conclusion regarding the role of the venue or accompanying ensemble in PPD experiences. Future experiments will aim to control for ensemble size and instrumentation of accompaniment as well as room acoustics.

At the time of survey distribution, the phenomenon was called *pitch perception dysphoria* rather than *pitch perception distortion*. Following the conclusion of survey response collection, the name was later changed in order to better represent the pitch perception phenomenon and to avoid association with connotations of psychological distress, as in gender dysphoria. The original terminology may have affected participants' responses.

The design of the survey resulted in small sample sizes once participants progressed past the central question regarding whether or not they had experienced PPD, which led to decreased statistical strength when analyzing associated factors. However, the author felt these design points were necessary in order to make the survey accessible and concise in order to deter attrition during completion.

FUTURE DIRECTIONS

Future investigation will target attempted elicitation of a PPD response in trained singers in a controlled auditory environment as well as objective measurement of intonation accuracy. The controlled experimental environment should include considerations of maintaining consistency of room acoustics, monitoring equipment, and makeup of accompanying ensemble. Discriminatory ability of both intervallic and referential tuning is an underlying assumption of PPD among the population in this study, and a limitation. For future studies, baseline tuning discrimination will be established for individual participants. Additionally, as the stapedius reflex is suspected to play a role in PPD experiences, it may be utilized in future studies, where an auditory reflex threshold for each participant is established and used as a baseline to attempt to induce PPD conditions. Future projects may also wish to include gender-matched populations and compare trained vs untrained individuals in order to better ascertain the experiences of PPD across different populations.

CONCLUSION

According to the reported incidence among the sampled population in this pilot study, pitch perception distortion (PPD) exists beyond chance and anecdotal experience. In light of the high incidence of PPD among the highly-trained sample, the data suggest that pitch accuracy in performance may be more associated with aural environment—specifically loud stage volume—and a trained singer's shifted tuning strategy in response to that environment as opposed to a singer's mastery of vocal intonation skills in isolation. The contextual complexity that affects a trained singer's perceptual discrimination and motor execution during live performance is a matter for continued study to develop performance practices and pedagogical strategies to counteract these effects and avoid off-key singing.

Figure 8. Kilpatrick (2020)

Movement, Gesture, and Singing: A Review of Literature

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Implications

- Research has shown that the usage of movement by an ensemble can contribute positively to music outcomes and to rehearsal and performance experiences. Teachers may want to try incorporating intentional movement activities into their rehearsals.
- Research has exposed intersections between movement, music, and emotion. Music teachers may find that movement training will improve their use of movement as an educational and conducting tool.
- Research has found that movement activities in rehearsal increase ensemble engagement and understanding. These activities can create lasting links between concepts; therefore, teachers may find movement and gesture exercises to be effective in their own rehearsals.

Abstract

The purpose of this review of literature was to explore intersections between movement and gesture, and to examine their effects on singing. Music educators have long championed the integration of movement into music instruction. The effects of movement have been studied and correlations found between an individual singer's intonation, internal pulse, and tone quality. The incorporation of movement activities into choral rehearsals has shown a significant level of perceived benefits by singers. The conducting gesture as a form of aesthetic movement has also been examined. One factor consistently reported is a relationship between the intentional use of movement in rehearsal and increased engagement. Additionally, movement has also been found to share a meaningful link with music and emotion. Movement and music both illustrate abstract emotional concepts and can aid in the formation of concrete relationships between them. Recommendations for music educators and suggestions for future research are provided.

Keywords

chorus, conducting, gesture, movement, singing, voice

Music and movement have been said to be inextricably linked (Abril, 2011). This relationship has been recognized by music educators who have championed the use of movement in their educational philosophies (Abril, 2011; Choksy, 1981; Mead, 1986). **Movement has been associated with music elements, such as beat entrainment and other rhythmic elements (Conway et al., 2014), pitch and intonation (Brunkan, 2016; Liao & Davidson, 2007); and cognitive elements, such as executive function, sensorimotor entrainment, memory (Maróti et al., 2019); as well as aesthetic elements, such as music expression and emotional understanding (Wis, 1993).** Many phenomenological beliefs have existed among music educators, conductors, and voice teachers about the use of movement to elicit certain technical or expressive elements from their students (Jost, 2011). Specific movements, or gestures, have long been employed to aid musicians in the rehearsal process or to guide musicians

to a better performance under the gestural direction of a conductor.

The purpose of this review of literature was to explore intersections between movement, gesture, and singing with a goal of better understanding the effects of movement and gesture on singing. For the purposes of this literature review, *movement* has been defined as physical processes that occur in the creation of or the response to a music stimulus (Abril, 2011), and *gesture* has been defined as intentional physical movement to express a desired music outcome to others or to illustrate a concept

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of technique, expression, or performance in rehearsal (Brunkan, 2015; Novack et al., 2016).

Method

I examined the intersections between movement, gesture, individual singing, and choral singing for this review of literature. Emphasis was placed on studies that attempted to demonstrate relationships between the implementation of movement or gesture and elements of vocal performance. Conducting, as a gestural art and a demonstration of aesthetic movement, was also considered through the experience of both conductor and singer. Planned movement to accompany music (i.e., choreography) and spontaneous movement inspired by music were not considered in this review of literature. Although both could affect vocal production, they are not commonly thought of as ways to improve vocal performance. In addition, conducting pedagogy and conductor training research were not considered.

I used targeted database searches for studies to include in this review using search terms related to movement (e.g., "movement," "gesture," "conducting," and "Laban") and singing (e.g., "singing," "vocal," "voice," "choral," and "chorus") with a goal of finding information that would aid practicing music teachers in developing tools for instruction. Studies identified in these database searches were included in this review, including journal articles, doctoral dissertations, and master's theses; additional sources were also included that were found in the reference lists of previously identified studies.

Relationships Between Music and Movement

Movement and Music Education

Music has been said to elicit physical responses in people (Hylton, 1987). Understanding movement, whether for its own sake or for representative purposes, can lead to a more complete understanding of how human beings interpret physical action (Novack et al., 2016). The building of motor skills has been found to be an important element in the normal development of humans (McLeod, 2018), and bodily based learning can be incorporated into education (Wis, 1993). Just as music skills tend to develop sequentially, so do motor skills. Education in movement can not only give children a movement vocabulary but also tools to create movement from their own imaginations (Choksy, 1981).

Émile Jaques-Dalcroze (1865–1950) was a leading figure in music education and a proponent of the strong links between music and movement (Abril, 2011). A Swiss music educator, Dalcroze began advocating for

reform in music education as early as 1905. Frustrated by his students' inability to understand the way music operated in space, Dalcroze observed students responding to music with spontaneous movement. These movements became the foundation for the Dalcroze method (Mead, 1986). He invented music exercises that linked music and movement and encouraged his students to have awareness of their whole body while engaging in music activities (Anderson, 2011). The Dalcroze method has four basic principles: (a) perceiving and responding to music; (b) developing an inner sense of music (e.g., inner aural sense and inner muscular sense); (c) sharpening communication between the ear, eye, body, and mind; and (d) developing a repertoire of aural and kinesthetic images that are associated with traditional music notation (Mead, 1986).

Dalcroze believed that the responsibility of music education was to integrate the use of the whole body in perception and performance of music. This belief contrasted with what he observed as music *arrhythmia*, or the lack of music expression. The fusion of body awareness and music would be the opposite—*euhythmia* (Daley, 2013). Dalcroze also believed that rhythm is movement and that by discovering movements analogous to music events, music would become internalized (Hylton, 1987). Seitz (2005) noted that "the orchestration of the body involves the concatenation of bodily gestures, the juxtaposition and opposition of bodily movements in relation to emotional attitudes, as well as the use of immobility (i.e., rest) and silence" (p. 423). Dalcroze eurythmics has been said to involve the development of the inner muscular sense as a sixth sense (Mead, 1986). Choral conductors with Dalcroze training were interviewed about the intersections of the Dalcroze method and choral conducting by Daley (2013). The Dalcroze method applied to the choral context in developing skills (e.g., vocal, aural, kinesthetic, ensemble, and literacy), in preparing the body to perform as both a conductor and singer, and to transfer these concepts to an increased connection between singing/conducting and the benefits to the whole person, including mental acuity, self-actualization, self-awareness, and self-confidence.

Other influential figures in music education have also placed an emphasis on movement. Zoltán Kodály's (1882–1967) method of music education emphasized movement using games, dances, and improvisation (Choksy, 1981). John Curwen (1816–1880) and Sarah Glover (1785–1867) created hand signs paired with the tonic sol-fa system (Colles, 2008). These hand signs were given further meaning when pitch was related to a vertical spatial plane by Kodály (Hylton, 1987). The German composer and music educator, Carl Orff (1895–1982) also advocated the value of movement in his *Orff-Schulwerk* approach. He believed that music and movement were

closely linked, not only in the learning process, but also in children's natural responses to the world around them (Abril, 2011).

Understanding and Defining Movement

Rudolf Laban (1879–1958) was a dancer, choreographer, artist, and theorist. He has been cited as the father of modern dance (Preston-Dunlop, n.d.). He defined four core elements of movement: Flow, Weight, Space, and Time. Laban also created Eight Effort Elements to demonstrate his theories (Billingham, 2001). These elements were used to create the first system for documenting movement, which was called Laban Movement Analysis (LMA) or Labanotation (Conway et al., 2014). LMA has been one of the primary methods of recording dance movements (Preston-Dunlop, n.d.). LMA and Laban's approach have been used in several studies of conducting. Gambetta (2005) applied training in Laban techniques as a treatment for four conductors. Their posttreatment performances were analyzed by both LMA experts and expert conductors. Both sets of experts agreed that the LMA training contributed positively to the conductors' effectiveness. In another study, undergraduate conductors received training in Laban techniques and LMA was found to have merit as a training tool at that level as well (Yontz, 2001). In his research of intersections between dance pedagogy and conducting pedagogy, Schlomer (2012) found that many conducting methods and texts misinterpreted Laban's work and were antithetical to the principles of dance pedagogy.

Laban's interest in efficient movement was shared with Moshé Feldenkrais (1904–1984), an Israeli physicist and martial artist. Feldenkrais believed in teaching people to find their personal best way of being. Exploring the body's most efficient movement and emphasizing the needs of the individual rather than adhering to a strict form are music applications for the Feldenkrais method. The process of singing or playing an instrument has been said to be an organic movement experience where layers of knowledge are constantly being applied (Lee, 2018). Paparo (2016) wrote that the Feldenkrais method was used to "elicit a greater understanding of embodiment in relation to singing" (p. 488). He found that engaging the entire body in the singing process and being aware of the body gave the students a greater perception of connection to the music and their own singing (Paparo, 2016).

Effects of Movement

Movement's unique link to music has been explored in research. In a study by Maróti et al. (2019), the Kodály method was used to determine if sensorimotor entrainment was encouraged by movement instruction. Two

types of movement instruction were used as treatments, one using predefined movements and the other using free movement. After 8 months of instruction, the results indicated that predefined movement and free movement correlated to different aspects of cognitive function and music discrimination. **Entrainment-based methods showed significant improvement when compared with singing-based methods in the areas of pitch discrimination,** working memory, phonological processing, and verbal skills, while singing-based methods improved executive function skills more than sensorimotor entrainment (Maróti et al., 2019). Movement has also been shown to have advantageous effects on steady beat training (Conway et al., 2014). Steady beat movement training has also been contrasted with fluid movement training, the latter having positive effects on the perceived vocal tone quality of children's singing (Newell, 2013).

Music and movement can be combined to make abstract concepts concrete for singers. Irrgang and Eggermann (2016) postulated that movement inspired by music could be used to measure music emotion. The movement inspired by music was found to relate to the emotion evoked by the music. Using a computer program that generated matched examples of music and movement, other researchers found that emotion, music, and movement were related to one another (Sievers et al., 2013). Unique features were evident in each emotion's expression in both movement and music. The research used participants in the United States and an isolated village in Cambodia and found that there was a common structure and understanding of these concepts across cultures (Sievers et al., 2013). Wis (1993) found that movement activities in the choral rehearsal were effective in communicating expressive intent and may better capture the aspects of music that are difficult to express with words functioning as a physical metaphor. Together, these results suggest that the connections between movement and music are universal and this connection provides opportunity for the energy of naturally occurring body movements to be transferred to singing activities. Movement as a physical metaphor can provide a way for singers to create specific connections to concepts otherwise ineffable.

Movement in the Choral Rehearsal

Movement can be used as a rehearsal tool to illustrate music and expressive concepts, to demonstrate technique ideas in vocal warm-up, and to enhance performance. **Clapping and moving the body to a beat can illustrate rhythmic concepts.** Students may use other physical movements to illustrate phrases or motives. Movement has been found to naturally lend itself to working with complicated rhythmic patterns (Hylton, 1987). Many

implications on the practice of conducting. Mathers (2009) explained that the declamatory mode, corrective mode, and narrative mode are three types of nonverbal communication. The conductor uses the corrective mode (i.e., the beat pattern) to solve problems. It is the corrective mode that is taught first to beginning conductors and provides the most basic music information. The declamatory mode and the narrative mode of nonverbal communication serve more expressive purposes, with the declamatory mode emphasizing illustrators and affect displays and the narrative mode being accessed by regulators and affect displays. Many conductors surveyed expressed discomfort with using gestures in the declamatory and narrative modes (Mathers, 2009). Van Weelden (2002) urged conductors to be aware of nonverbal behaviors while in front of an ensemble. Ensemble participants may have biases against certain types of behaviors and nonverbal presentation by the conductor can influence the ensemble's response.

Gestures can also have unintended consequences. Manternach (2012), for example, examined the effect of conducting gesture on extraneous head and shoulder movement in singers. He found that the singers mirrored the head and shoulder movement of the conductor. A downward moving gesture was found to increase undesirable shoulder movement. Other research has shown that gestures may not be the most effective tool for communicating in the rehearsal realm. Nápoles (2014) found that participants responded best to dynamics that were explained with verbal instructions, rather than shown with gestures. Awareness of these factors limiting the effectiveness of gesture is essential for practitioners.

The expressive magnitude of conducting gestures can also positively influence the perception of an ensemble's performance. Research has shown that there is a significant difference in the ratings of performances conducted with expressive gestures as opposed to strict gestures. This was true when the participants heard only audio, saw the conductor from the back, or saw the conductor from the front (Nápoles, 2013). Another study found that listeners associated gesture with music content, indicating that visual components influenced listener perception of quality (Kumar & Morrison, 2016). Research has also shown that conductors with larger affect and gesture had a positive effect on the ratings their ensemble received (Morrison et al., 2014).

Cataloging Gestures and Their Meanings

Continuing technological advancements have aided researchers in examining the actual physics of the conducting gesture. Using newly created computer programs, three-dimensional renderings of conductors have been created (Luck & Nte, 2008). These renderings allow for greater control over what aspects of the gesture are shown

to the participants. Luck and Nte found that the physical mechanics of the gesture had little effect on how they were perceived by ensemble singers. Motion capture has been used to help further quantify the specific mechanics of gesture. In one study by Bishop and Goebel (2018), the researchers used this technology to analyze the head nod gesture used to cue other instrumentalists in an unconduted ensemble. The physics of the clarity of the beat presentation were examined. Both smoothness and a larger magnitude of gesture were found to be more effective, as well as the experience of the musician doing the cuing (Bishop & Goebel, 2018).

Billingham (2011) defined conducting gestures by their stylistic function. The gestures were created in consultation with an expert in Laban Movement Theory and were based on Laban's Eight Effort Elements in Combination: Float, Wring, Glide, Press, Flick, Dab, Slash, and Punch. A collegiate-level choir gave feedback about the eight defined gestures and further refining was done. When the gestures were evaluated, six of the newly created gestures were deemed to be successful: those based on Float, Punch, Glide, Dab, Flick, and Press.

Gesture in the Choral Rehearsal

Expanding on the work of Hibbard (1994) and Wis (1993), Chagnon (2001) further developed and defined the catalogue of movements and their purpose, transforming them into intentional gestures. He found that there were three general ways in which gestures were used by conductors in choral rehearsals. The first was integrating gestures into rehearsal and making transfers between those gestures and music expression concepts. The conductor demonstrated the selected gesture, and the ensemble singers repeated the gesture. These gestures were then incorporated into the conducting gesture to elicit a response in performance. The second method integrated conductor-modelled/singer-reproduced gestures almost purely as a tool of vocal technique. Gestures were used primarily to relate to posture, vowel formation, and projection. The third approach emphasized the singers as expressive partners in music making. Singers used movements, inspired by the Dalcroze method, to relate to the music's text and structure in an improvisational manner. The ways in which gesture can be used are limited only by the imagination of the singer.

Outcomes of Specific Gestures

Employing specifically designed gestures in rehearsal and warm-up can have significant positive effects for singers. A wide variety of gestures can be used in the choral classroom. These gestures can be used to facilitate expression, articulation, and a host of other music concerns. Singers

have been found to be more on-task when using movement activities (Hibbard, 1994; Peterson, 2000). Gesture activity participation and magnitude could also be used as a form of assessment.

Brunkan (2015) sought to examine the effects of three specific gestures on singers' perceptions of their own performance and attention and experts' opinions of the pleasantness of the vocal quality using a CRDI. The selected gestures were (a) a low, circular arm gesture; (b) a pointing gesture; and (c) an arched hand gesture. The acoustic elements of amplitude, formant frequency, and fundamental frequency (F_0) were also measured for both conditions. Results indicated that there were significant changes to the acoustical properties of the individual participant's vocal production, including positive effects on intonation with all three gesture treatments. The low circles and arched hand gesture resulted in lowered formant frequency in most participants. The low circles and pointing gesture resulted in increased amplitude, while the arched hand resulted in lowered amplitude (Brunkan, 2015). In a study using motion capture, Brunkan (2016) found that the low, circular arm gesture improved pitch accuracy, as well as singer perception of tone and production. In another study examining circular gesture, Coffman (2018) examined choirs that performed with circular hand gestures at a high and low position and reported differences in individual and overall choral sound with the gestures. An expert panel did not perceive the performances with hand gesture to be of higher quality than those without hand gestures (Coffman, 2018).

In a series of three studies based in Taiwan using primary school children, researchers examined the effects of gesture in a variety of formats. In the first study, Liao and Davidson (2007) explored the links between gesture and singing using Dalcroze mirror and follow games. Functions of gesture were revealed to be focus, guidance, support, good intonation, and sensation. In the second study, 5- and 6-year-old children were taught gestures to accompany tonal patterns to determine whether their pitch accuracy would improve (Liao, 2008). Liao found there was an immediate improvement in pitch accuracy, suggesting that gestures provide a kinesthetic sense of motion that can aid in accurate singing.

Intersections of Movement and Gesture

Liao and Davidson (2015) used gesture and movement training in combination to examine their effect on children's singing intonation in the third study. Specific gestures, created in consultation with Dalcroze masters, were created for five vocalizes. The movement training was also inspired by Dalcroze. The gestures alone had a significant effect, but the combination of movement and gesture was more powerful and had a significant effect on

intonation, particularly in more complicated exercises (Liao & Davidson, 2015).

Discussion

Summary

It is clear from previous research that there is an indelible relationship between movement and its impact on singing, whether it is movement meant to inspire music expression and precise performance or movement meant to aid singers in understanding abstract concepts of vocal technique or emotional expression. Movement in the rehearsal process has been found to create lasting social connections in the ensemble and cognitive links in the individuals in the ensemble. These connections are a significant factor in rehearsal engagement for many ensemble musicians. Music and movement have been found to be mirrors for representing emotional concepts that are outside the realm of speech. Durrant (2009) explained, "Music and physical gestures are two very different symbolic modes, each used for artistic expression. How one is translated into the other is a complex action, processed cognitively and emotionally" (p. 329).

Applications

The links between movement/gesture and positive perceptual outcomes for singers and conductors in rehearsal and performance are just beginning to be explored. The current research available has indicated that the use of gestures and movement in choral rehearsals tend to increase singer engagement. Singers have been found to perceive that gestures assist them in achieving not only improved vocal quality (Benson, 2011; Brunkan, 2015, 2016; Mann, 2014) but also in linking together music and emotional expression (Wis, 1993).

For the in-service music educator, incorporating movement into rehearsals could have positive effects. Observable outcomes of the use of movement and gesture in rehearsal might include the following: increased student engagement, improvements in pitch, intonation, and rhythmic entrainment; improvements in cognitive skills and executive function skills; increased expressive commitment and attentiveness in performance; and awareness of and attentiveness to the conductor's gestural performance as a means of communicating expressive and music content. For example, the use of a specific gesture tied to a vocal technique concept in warm-up, can then be related to a challenging technique area in repertoire, and then incorporated into the conducting gesture in performance. Creating these links establishes a way for the ensemble member to transfer the concept effectively through a variety of contexts.

Figure 9. Kis Zuvela (2018)

Introduction

Although ubiquitous in music pedagogy worldwide, the repercussions of various systems of mnemonic syllables are rarely the subject of systematic empirical research in professional music education. The same could be stated about the research of mnemonic syllabaries in general. Even when these topics are addressed to, only a handful of surveys involve musicians or students of music (e.g. Rogers 2007; Mikumo 1992 compared two groups of students with different training levels), while others dealt with non-musicians (e.g. Cassidy 1993). Let us briefly discuss selected results of the former research category that could contribute to our topic.

An early comprehensive study (Silvey 1937) has shown that, according to the users' opinions, solmization has no higher priority in their music education. Solmization has been rated as only fourth, fifth or sixth factor that may contribute to music reading. Silvey argues that the emphasis put onto solmization in general education cannot be justified by its results. However, these results have not been verified by an external criterion and can thus not be taken into account as definite.

The premise that verbal strategies could enhance melody processing was tested by Mikumo (1992), who suggested that highly trained subjects could use verbal encoding strategies (such as labelling tones by their names³) to enhance pitch discrimination in 'high-tonality structures' (tonal contexts). Verbal strategies, however, turned out to be less useful in 'low-tonality structures' (atonal contexts). Expectingly, less well trained subjects were unable to use verbal (or any other) encoding strategies in melody processing.

In a series of sightsinging exercises Cassidy (1993) proved that subjects using solfège scored significantly better than those using musical alphabet or a neutral syllable, which again confirms the importance of solfège syllables as carriers of meaning in conceptualizing music.

Rogers (2007) conducted a survey with university students enrolled in a high-levelled course in music theory. The examinees, which did not possess absolute pitch, scored significantly better when they employed verbal encoding in comparing two pitch series. Rogers considers solfège syllables to be a part of the musical vocabulary together with other musical terms (2007, 149). She also emphasizes that vocabulary training should include careful observation of the cognitive function of syllabic systems as "a means for recalling and recognizing music beyond the extremely brief limits of sensory memory" (*ibid.*).

Beside the mentioned examples, the existing research on the role of syllabary in music perception and cognition is still considerably rare. None of the studies offers satisfying answers on the question of syllabary in professional musical contexts. Most studies use

³ The tone names Mikumo used were solmization syllables. In this study the syllables were used during a spoken interference, i.e. they did not *a priori* bear either relative or absolute meanings.

short, context-deprived sequences of equal-length tones played on the piano or an electronic instrument that included neither excerpts from musical literature nor comparisons with external criteria (e.g. Mikumo 1992, Cassidy 1993 or Rogers 2007). Furthermore, the number of examinees is often low (for instance, Mikumo 1992 used two groups with $n=26$, and Rogers 2007 had a group with $n=15$ and another one with $n=19$)⁴. Luckily, even if the existing research on the topic lacks correlation with real professional situations and leaves many questions unanswered, there is still a certain corpus of findings and results music pedagogy could rely upon. However, it seems that pedagogy somehow missed the opportunity to seize the full potential of the results of experimental research so far. The issue of choosing a suitable solfège syllabary too often remains a matter of pedagogical tradition and is seldom examined experimentally, although even expert subjects such as Huron (2006) confirm the importance of mnemonic syllables in conceiving and understanding pitch relationships.

Huron also devised a theory of conscious interval recognition as a reconstruction from a scale degree representation which includes verbal labels (i.e. relative solmization syllables) as carriers of meaning (2006, 117–120). It is not surprising, though, that some authorities even define solmization as "the use of syllables in association with pitches as a mnemonic device for indicating melodic intervals" (Hughes and Gerson-Kiwi 2001).

A recent study (Kiš Žuvela 2017) has shown that mnemonic pitch syllables, especially solmization, can play a major role in quotidian professional activities of music students within high education. Almost three fourths of the examined students reported that they spontaneously pronounce solfège syllables while listening to, playing, singing or reading tonal music. Moreover, this research has shown high correlation of this phenomenon with external criteria: the frequency of the spontaneous appearance of pitch syllables during musical activities was positively related to the students' last exam grade in their Ear Training courses.

This paper is an attempt to establish a new approach to the research of the impact that solfège systems used in the ear training of professional musicians have on their understanding of music. It aims to give a critical insight in the state of art, to examine the consequences of using a particular solfège syllabary used in ear training of professional musicians on their ability to comprehend music played in real time, in a genuine context (original recordings of symphonic music). Finally, the author hopes that this study could open new avenues of research, as well as prepare ground for new, research-based educational strategies.

Solfège syllables: terminology, definition and information value

Although often considered to be a device originating in Western music tradition, solfège syllables (or solmization in a wider sense) have been used worldwide since the ancient times as labels denoting tones "as single entities which form the basic material of music" (Hughes and Gerson-Kiwi 2001). In a narrower sense, most contemporary authors

⁴ A rare exception in this respect is Silvey 1937, with a sample of 1804 subjects.

recognize the Guidonian system of mnemonic syllables to be the origin of solmization as we know it today (e.g. Hughes and Gerson-Kiwi 2001). Guidonian system of syllables, just like the earliest staff notations, did not determine absolute pitch values, but rather intervallic relations within the system of hexachords. The Guidonian syllables were only brought into connection with absolute pitch values centuries later, probably in 12th century (*ibid.*), when the former started to be used as a substitute for notation. Parallel development of systems of solfège syllables that included relative and absolute solmization variants could be assumed to have appeared back then, introducing ambiguity into the didactic syllabary. Martin (1978, 21) claims that movable Guidonian system has replaced with a fixed-*do* system first in Italy, in the 17th century.

Solfège syllables: musical alphabet and solmization

Since there is no general consent on the scope and meaning of the terms 'solfège syllables' and 'solmization', the author will propose her own set of terms and their respective definitions for the purpose of the present study.

Solfège syllables are any mnemonic syllables denoting pitch, either in absolute terms or in terms of degrees of a musical scale. Contemporary systems of solfège syllables include the musical alphabet and different systems of solmization. The musical alphabet is a syllabic system based upon the names of the letters of the Latin alphabet which are used as the labels for fixed, absolute pitches. The basic alphabetical set consists of the following labels: *A*⁵, *B*, *C*, *D*, *E*, *F* and *G*. It can be expanded with further labels denoting pitch alterations such as *sharp* (for an ascending alteration in reference to the basic pitch) or *flat* (for a descending alteration).

On the other hand, the term *solmization* in this paper encompasses all syllabaries indicating scale degrees that are based upon Guidonian mnemonic syllables (*ut*, *re*, *mi*, *fa*, *sol*, *la* and *si*), together with their regional variants. This study will address several variants of solmization based upon Guidonian syllables which are in use within the system of professional music education in Croatia. Taking into account enormous terminological variety in the field literature and local languages worldwide, the author proposes her own explanation of basic terms related to systems of solmization which will be examined in this paper.

As mentioned in the footnote 1, solmization can either be:

- 1) a relative or 'movable-*do*' system, where the syllable *do* always denotes the tonic of a major key,⁶ or
- 2) an absolute or 'fixed-*do*' system (also known as fixed solmization), where the syllable *do* always denotes the pitch *C* (as well as its altered versions like *C sharp*, *C flat* etc.).

⁵ The syllable *A* denotes the main reference tone in Western music tradition, the so-called *concert pitch*, whose contemporary frequency standard is generally considered to be 440 Hz.

⁶ Some authors refer to relative systems of solmization as to 'functional', claiming that the position of the labelled tone within the scale provides it with a specific function. As the function cannot be generalized and considered to be inherent in the tone position, but is strongly influenced by tonal context, style and other circumstances, the author will sustain from using this terminological solution.

Relative systems can further be divided into two major categories: *tonic do* systems, where the syllable *do* denotes the tonic in both major and minor keys,⁷ and *tonic do-la* systems, where the tonic is solmized *do* in major and *la* in minor keys.

The information value of solfège syllables

Different syllabaries contain different semantic contents. A solfège syllable which responds to all questions about the pitch in absolute terms, as well as in relative, contextual terms does not exist, because the total number of such syllables in the 12-tone equal temperament would be at least 144 (disregarding enharmonic variants!), and it is quite unlikely that such a system could be of any use in teaching music. A music pedagogue is thus usually forced to choose a single syllabary which would be his permanent teaching tool while being aware of its inconsistency, or, even worse, a syllabary is a matter of tradition or the school policy, and the teacher is unable to adjust his teaching tools to the repertoire they want to approach. In order to shed light on special features of each syllable system discussed in this study, Table 1 brings a short overview of the information values they are capable of communicating.

Table 1: *The information value of solfège syllables*

syllable system information value	movable-do solmization		absolute (fixed-do) solmization	musical alphabet
	tonic do	tonic do-la		
absolute pitch value	no	no	questionable / partially (giving the notational position within the staff, rather than the absolute pitch value, regardless of accidentals) ⁷	yes
relative pitch value (scale degree: relative position of a tone within a context – key, mode...)	yes	yes	no	no
alteration / accidentals (lowered or heightened scale degree)	yes	yes	no	yes
in case of modulation, the tonic:	shifts & keeps the same syllable	shifts & keeps the same syllable	changes the syllable	changes the syllable
modulation visible	yes (shifting all syllables)	yes (shifting all syllables)	no	yes (indirectly, altered syllables)

⁷ In Croatia and Bosnia and Herzegovina this approach to solmization is colloquially addressed to as *functional solmization* (a part of the approach called *Funkcionalna muzička pedagogija* [Functional Music Pedagogy]; for more details see Kazić 2013, 110–119). Please also cf. footnote 6.

Each system of syllables *offers some* semantic pitch information and *lacks other*; not a single one contains *all* relevant meanings. Every possibility of multiple encoding of pitch information, as well as its underdetermination due to the incapability of a syllable system to encode certain information (such as the insensitivity to accidentals in the case of absolute solmization), may contribute to the ambiguity of a musical passage, which can in addition cause difficulties in the cognitive process. While relative solmization systems offer most information on scale degrees and tonal centre changes, it lacks the information on the absolute pitch values. The musical alphabet shows absolute pitch values, but contains tonal information only encoded in (altered) syllables. The absolute solmization offers no information on either alterations (accidentals) or tonal changes due to its fixation to the “empty” staff, i.e. it offers only the information on the staff position of a note denoting a particular tone. This is the reason why advocates of the absolute solmization claim that this system enables easier transition towards singing with neutral (or any other) syllables. However, its contribution in acquiring the fine intervallic structures and tonal relationships is doubtful outside the realm of the diatonic C major.

A conscious teacher should be aware of the informational capacity of the chosen syllabary while preparing their teaching strategies. Many authors debated about the advantages and disadvantages of particular syllabic systems, but most of them did not rely upon any empirical data except their own subjective teaching impressions. Moreover, they usually advocated only one approach, without trying to compensate its disadvantages by using different strategies for different musical contexts.

Systems of solmization: advantages and disadvantages

The advantages and disadvantages of both solmization systems are by no means a recent or contemporary issue. Early examples of dispute could be traced back to the 19th century.⁸ An anonymous author (most probably the editor of the volume), writing in the *Musical Times and Singing Class Circular* back in 1848, shared a doubt and an opinion that may still be considered up-to-date (p. 3):

“We have had several letters from friends in reference to what they consider the proper way of adapting the well-known syllables, do, re, mi, fa, so to vocal exercises. The opinions are about equal as to whether Do should remain as the permanent representative of C, or whether it should be considered as representing the key-note of the major scale irrespective of pitch. To the latter opinion we decidedly adhere ourselves, because we have generally found the firmest sight readers to be those who have studied upon this method, which is prevalent in Lancashire and the west country of Yorkshire, and in these counties good chorus singers especially abound. On the contrary, we have seldom found the adherents to the fixed system are to be trusted out of the key of C.”

Most authors who advocate the use of relative solmization emphasize its significant role in early stages of training. Studies such as Reifinger 2012 proved that even if used during a

⁸ An inspiring overview of lively discussions on different systems of solmization and pitch notation systems in 19th century America is offered in Eisenstadt Blum, B. (1971). Solmization and Pitch Notation in Nineteenth-Century American School Music Textbooks, *Journal of Research in Music Education* 19(4), 443–452. Most topics are still relevant today.

limited period of time (only 16 teaching sessions), solmization may significantly improve the accuracy of pitch-related musical activities. Furthermore, movable solmization systems are valuable help in transposition, either in terms of shifts in tonal space (e.g. in modulation or in scores with transposing parts), or in cases of frequent clef changes. McPherson and Gabrielson (2002, 110) recommend the use of solfège to reinforce the transition from mere memorization (e.g. singing to a neutral syllable with no inherent meaning) to comprehension (singing using sol-fa syllables or using similar devices which carried semantic content) as a useful prenotation phase activity. However, some studies suggest that using solmization in advanced stages of music education could inhibit the development of comprehensive listening abilities (e.g. Silvey 1937) and instead suggest switching onto a more suitable syllable system when leaving tonality (c.f. More 1985, 17–18).

The musical alphabet (also known as the 'letter names' system) is a set of syllables indicating absolute pitch, in spite of its main disadvantages, the dependence on the standard Western notation and insensitivity to the internal tonal relations. The alphabet is irreplaceable in non-tonal contexts, since any application of a relative, tonality adjusted system would inhibit the user in acquiring non-tonal, pure intervallic relationships. Some teachers avoid the usage of musical alphabet in ear training courses since some combinations can be difficult to pronounce. However, in its German variant,⁹ which was used by many authoritative teachers such as Kodály, the musical alphabet can be cordially recommended to be used in a parallel manner together with a relative syllabic system in order to capture more relevant meanings of musical materials from the very beginning. In a later phase of musical education solmization is often being abandoned in favour of either alphabet or neutral syllables when switching to a non-tonal material. Even then solmization should not be completely excluded from training: it should be repeatedly addressed to whenever it corresponds with the internal nature of the musical material.

Absolute solmization, as used in music pedagogy, is the least determined syllabic system. With a high level of ambiguity, absolute solmization can barely be used for any purpose except as a "shortened" substitution for the alphabetic names (and, when so, there is no reason for not using the alphabet, which is completely determined, itself). The semantic underdetermination of the 'absolute' solmization syllables, as well as its inconsistency (homonymy originating in labelling different tones such as *F*, *F#* and *Fb* with the same name, *fa*) may discourage possessors of absolute pitch ability, while those with relative hearing will be likely to use the 'absolute' alphabet in a relative manner anyway (if they do not consult the reference tone). In that case a syllable tends to lose any meaning because it cannot operate as a referent to recall a suitable meaning in all contexts.

The following experiment will shed more light on the relation between the hearing system, syllabary used and the cognitive results in music dictation.

⁹ Unlike the one used in English speaking countries (where heightened and lowered tone names are created by adding the word *sharp* and *flat*), German variant of the musical alphabet (where the altered tone names are created by adding suffixes *-is* for an ascending alteration and *-es* for a descending one) consists almost exclusively of monosyllabic tone names (except the ones bearing double accidentals, which are rare) and is definitely not too difficult to pronounce.

The external criterion, the last achieved *Ear Training grades*, turned out to be the strongest predictor of notation accuracy. The model consisting of the predictors 'the possession of absolute pitch' and 'the syllabary used during the test' showed low probability value, $p=0.358$. The combination of 'the syllabary used...' and the 'Ear Training grades' showed a high probability value, $p=0.0015$. By inclusion of the predictor 'duration of musical training' together with 'the syllabary used...' and 'the Ear Training grades' the estimated probability value was $p=0.09073$. To conclude, the accuracy of notation can best be predicted by examining 'the syllabary used during the notation test' and the 'Ear Training grades' as an external criterion.

Hearing ambivalence

As mentioned in paragraph 3, the participants were asked to notate two examples from the common practice period using solfège syllables by their own choice. If applicable, they were recommended to use the system of syllables that appeared in their mind involuntarily while listening to music.¹²

Modulation or tonicization?

In case of example A the participants were asked to notate an excerpt of the leading melody taken from the 1st theme of the 2nd movement of Tchaikovsky's Symphony No 5 in E minor, Op. 54, bars 9–16. Picture 1 displays possible correct notations of the melody using four sets of syllables most common in the Croatian professional music education: the musical alphabet, the absolute solmization and two sorts of relative solmization, tonic *do-la* and tonic *do*.

The image shows two staves of musical notation in E minor, Op. 54, bars 9–16. Below each staff are four sets of syllable encodings: 'alphabet', 'abs.solm.', 'tonic do-la', and 'tonic do'. The syllables are written in a grid format, corresponding to the notes on the staff.

Staff 1 (Bar 9):

alphabet	abs.solm.	tonic do-la	tonic do
d	re	do	do
e	mi	re	re
f	fa	la	la
g	sol	do	do
a	la	re	re
b	si	la	la
c	do	do	do
d	re	re	re
e	mi	re	re
f	fa	la	la
g	sol	do	do
a	la	re	re
b	si	la	la
c	do	do	do

Staff 2 (Bar 10):

alphabet	abs.solm.	tonic do-la	tonic do
d	re	do	do
e	mi	re	re
f	fa	la	la
g	sol	do	do
a	la	re	re
b	si	la	la
c	do	do	do
d	re	re	re
e	mi	re	re
f	fa	la	la
g	sol	do	do
a	la	re	re
b	si	la	la
c	do	do	do

Picture 1: Possible correct encodings of an excerpt of the 1st theme of the 2nd movement of Tchaikovsky's Symphony No 5 in E minor, Op. 54, bars 8–16¹³

¹² The results of the test of involuntary appearance of mnemonic syllables during musical activities were discussed in Kiš Žuvela 2017.

¹³ Pictures 1 and 2: The author uses German musical alphabet note names since it is commonly used in Croatia, where the survey was performed.

The theme is also a period with an antecedent in D major. The consequent (bar 51) surprisingly begins with a strong modal contrast, with an *F* in the tonic chord, instead of the previous *F#*. Other scale degrees remain unchanged (i.e. the same as they were in the diatonic D major antecedent) until the appearance of the subdominant chord in bar 57 (the introduction of *B flat* instead of a *B*). Various mode changes follow till the end of this section. The modal change can be interpreted as either a modulation to the key of D minor (which is obvious when one employs the tonic *do-la* syllabary, because the name of the tonic, *D*, changes from a *do* to a *la*, together with the rest of the syllables), or a mode mutation (which would be more typical for a tonic *do* approach, because the tonic would keep the same syllable, *do*, and the changes would be evident as alterations of scale degrees). Again, both musical alphabet and absolute solmization lack information on this ambiguity, and the absolute solmization does not even record the modal change between the bars 43–48 and 51–56 (which are otherwise the same in terms of scale degrees, but differ in accidentals).

This example, which is even more complex than the first one (because the tonal centre remained the same, only one tone changed, and in spite of that the change was far more radical), left a majority of examinees astonished. A hundred of them did not provide an answer, and further 32 responded too incorrectly to be taken into account. The structure of the correct answers follows in Table 9.

Table 9: The structure of positive answers to the tonal change in bar 51

tonal content from bar 51 onwards	<i>n</i>	%	syllabaries used
modulation	39	61.90	relative solmization: tonic <i>do-la</i> (<i>n</i> =37); tonic <i>do</i> (<i>n</i> =2)
mode mutation	14	22.22	relative solmization: tonic <i>do-la</i> (<i>n</i> =5); tonic <i>do</i> (<i>n</i> =9)
absolute syllable values	8	12.70	alphabet (<i>n</i> =7), absolute solmization (<i>n</i> =1)
modulation and mode mutation ¹⁵	2	3.17	relative solmization: tonic <i>do-la</i> (<i>n</i> =2)

In this example the syllabary experienced in previous education substantially influenced the cognitive processes of the examinees. Expectingly, those who were trained using tonic *do-la* syllabary mostly (37:42 = 88.09%) changed the tonic syllable from *do* to *la*, although its pitch remained unchanged, and shifted the syllabary by an ascending third. On the contrary, the majority (9:11 = 81.82%) of those trained in tonic *do* system recorded the change as mutation by altering the syllable *ma* into *nja* without shifting the tonic syllable. However, there were exceptions in both groups, and two participants recorded both modulation and mutation using the tonic *do* syllabary.

¹⁵ These participants provided two different correct answers.

The structure of the notation test: 'absolute' aspects of hearing and solmization

The results of the notation tests brought to attention some interesting features that shed light on the nature of melody comprehension in a tonal context.

First, the subjects that displayed possession of absolute pitch used various syllabaries to notate the given melodies, as shown in Table 10. All of them achieved fairly high scores, but interestingly enough, those using relative solmization syllables notated the given melodies with an accuracy of 100%.

Table 10: *The structure of answers provided by the possessors of absolute pitch*

system of syllables used	<i>n</i>	%	average score (notation accuracy) %
musical alphabet	6	50	95.8
relative solmization	4	33.3	100
absolute solmization	2	16.7	93.75

The statistics revealed further interesting facts about the limitations of systems of absolute solmization discussed in the paragraphs 2.2 and 2.3. Most students trained with absolute solmization used their syllabary in a relative manner: although both excerpts begun in D major, they notated them as if they were in the C major key. Only the subjects possessing absolute pitch used the absolute solmization syllables accurately in terms of the absolute pitch values.

Table 11: *The use of the absolute solmization syllables during listening tasks*

the use of the 'absolute' solmization syllables	<i>n</i>	%
absolute (fixed <i>do</i>)	4	10.81
relative (movable <i>do</i>)	33	89.19

Such an outcome discredits a fallacy pretty common among music pedagogues, i.e. the surmise that the use of fixed-*do* systems of syllables in music education encourages the acquisition of perfect pitch. Table 11 shows that vast majority of highly skilled students of music trained in absolute solmization failed to develop absolute pitch ability, and even for those who really used the syllables as expected from an absolute pitch possessor, one cannot claim that the use of a certain syllabic system played a decisive role in developing absolute pitch ability.¹⁶

¹⁶ Deutsch (2013) leaves the question of the role of the pedagogical approach in ear training unanswered, offering some pros and cons extracted from the existing research on the topic. Other factors that might encourage the acquisition of absolute pitch are an early age of onset of musical training, the toneness of the mother tongue, relationships between language and music, some neuroanatomical features, as well as genetics. Whatever the case might be, not a single factor has been explored in terms of more 'musical' material (such as the recordings of symphonic music, which are the object of this study); most researchers avoid resemblance of their material to the one present in real musical activities, insisting on 'ecologically valid conditions'. The question of the relevance of such ecological research for musical practice thus remains open, reviving the old rivalry between the so-called psychology of tone and the so-called psychology of music.

The accuracy and nature of the answers corresponded closely with the nature of the applied solfège system and the internal logic of the musical material heard in the excerpts. On the one hand, relative hearers could not develop absolute pitch and have thus employed their 'absolute' solmization in a relative manner. On the other hand, even absolute pitch possessors showed better results if their training included relative solfège systems in tonal contexts. It is thus appropriate to call into question common attitudes towards methods of relative intonation such as Hallam's who claims that "teaching practices which encourage relative pitch with a tonic that changes but retains the same name – for example, Solfa – are likely to discourage the acquisition of perfect pitch." (2006, 42–43) Deutsch challenges such attitude by listing controversial results of studies in different countries, concluding that "the argument in favour of fixed-*do* training based on prevalence of AP in a few selected countries [where fixed-*do* training is quite common] is a problematic one" (2013, 149). **The present research also refutes the preference for fixed-*do* methods of ear training.** The participants with relative pitch displayed significantly poor results in music dictation tasks if trained by methods based upon absolute solmization syllables. A majority of them, while declaring to be using absolute solmization, actually used the syllables in a relative manner (referring to the tonic as to *do* and changing the position of the *do* while notating modulating melodies), unconsciously. In addition, even if the melody was notated correctly using absolute solmization syllables (which was most frequent with subjects who possessed absolute pitch), the evaluator was not able to discriminate whether they noticed alterations within a passage they perceived as non-modulating (because they used the same syllable, e.g. *sol* for both *G* and *G#*).

It is worth mentioning that Hallam (2006, 43) continues her discussion with a doubtful thought "whether it is desirable to promote the acquisition of absolute pitch" as an education goal at all. The author of the present study stands by the opinion that it should not be treated as priority in music education. The low percentage of students possessing absolute pitch in this sample (which is composed exclusively of future music professionals) also indicates that this extraordinary ability should not be regarded as a prerequisite for any professional (or amateur) music activity. The share of the possessors of absolute pitch among the participants of the present study, who are mostly going to become professional musicians, amounts at 6.12% ($n=12 / 196$). If one choses to include the participants with only partial (or border) absolute pitch ability, the total share would not be higher than 19.39 % ($n=38 / 196$). Harris (1918, 190) mentions a study from 1889 which included 340 students of the Royal Academy of Music in London; "only 50 – one in seven – had anything but a remote idea of absolute pitch. Obviously", Harris concluded, "therefore, the vast mass of people can sing only by some form of relative pitch – the Movable Doh, or Intervals" (*ibid.*). The share of these students who, "being embryo professionals, represented far more than the average capacity for music", was about 14.7% ($n=50 / 340$). The phenomenon seems to be (at least according to these two examples), global and has not undergone substantial changes in the last 130 years. Both shares, low in percentage, speak in favour of the attitude that, to paraphrase Hallam, it should not be desirable to promote absolute pitch acquisition as an educational goal, even within professional music education. There is at least no evident reason for such practice.

Conclusions

The present study revealed several levels and aspects of ambiguity hidden in different solfège syllabaries commonly used in the Croatian music pedagogy and worldwide. Generally, the results of this investigation speak in favour of relative approaches to intonation when dealing with tonal repertoire. Subjects who were exposed to relative solmization systems in their previous music education displayed superiority in pitch discrimination in tonal contexts regardless of their hearing system (absolute or relative pitch). Their understanding of tonal processes such as modulation and mode mutation relies heavily on the nature of the solfège system they were exposed to in their earlier music education.

However, this is an isolated example of a survey in this field in terms of method, instrument and aims; it is confined to simple tonal contexts and does not answer any questions about the nature of music perception and cognition in the posttonal age. An experimental study with more complex tonal and non-tonal repertoires could be a possible avenue for further research.

In spite of the numerous advantages of relative solmization, especially in early stages of ear training, one should keep in mind that the intensive use of relative pitch syllables might discourage users in their approach to non-tonal repertoires, where relative solmization obviously loses any substantial meaning. On the other hand, one should not forget that both historical and contemporary tonal repertoire still exists and gets performed regularly. Relative approaches to solmization thus still deserve their honourable place within professional musical education.

However, even tonal music cannot be encoded equivocally; users of different solmization systems will respond differently to the same sample, as was the case with tonal change in Beethoven (4.2.2), which could be encoded with either minor or major changes of syllabary. This study has shown that dealing with ambiguous material demands a combination of multiple approaches order to reveal its full semantic potential, which should have repercussions not only for perception and cognition of music, but also for its interpretation.

Greater awareness of the consequences of choosing a solfège system in music education could contribute significantly to students' understanding of both tonal and non-tonal repertoires. Only an attempt of a systematic ear-training program which would include several different approaches to solfège syllabaries in separate, combined and control groups of students could provide reliable answers to the question of repercussions of the use of different syllabaries. A flexible combination of approaches in accordance with the implicit logic of concrete musical material could prevent difficulties originating in the limitations of individual solfège systems and raise the level of comprehension of pitch relationships in general.

Figure 10. Kutlimuratovich (2024)



The Kodaly method is based on several key principles that guide its approach to music education. These principles are rooted in the belief that music is a fundamental part of human expression and should be accessible to all individuals. Here are some of the key principles of the Kodaly method:

1. Singing as the foundation: Central to the Kodaly method is the idea that singing is the most natural and effective way for individuals to develop their musical abilities. Singing helps students internalize musical concepts, develop aural skills, and connect emotionally with the music they are learning [1].

2. Sequential and systematic instruction: The Kodaly method follows a carefully planned sequence of musical concepts that gradually build upon each other. Students start with simple songs and activities and progress to more complex musical elements as they develop their skills.

3. Folk music and cultural heritage: Kodaly believed that folk music is an essential part of a nation's cultural heritage and should be at the core of music education. By incorporating folk songs from various cultures into the curriculum, students can learn about different musical traditions and connect with their own cultural roots.

4. Active music making: The Kodaly method emphasizes active music making through singing, movement, and playing instruments. Students are encouraged to engage physically and emotionally with the music they are learning, fostering a deeper understanding and appreciation of musical expression.

5. Aural training: Developing a strong sense of pitch and rhythm is essential in the Kodaly method. Students engage in activities that train their ears to recognize

and reproduce musical patterns, helping them become more confident and accurate musicians.

6. Music literacy: The Kodaly method places a strong emphasis on music literacy, teaching students how to read and write music notation. By developing these skills, students can communicate musically with others and access a wide range of musical repertoire.

7. Integration of music and other subjects: The Kodaly method recognizes the interconnectedness of music with other academic disciplines. Teachers can incorporate music into lessons on language, math, history, and other subjects, providing students with a holistic learning experience [6].

By adhering to these key principles, the Kodaly method aims to provide students with a comprehensive music education that nurtures their musical abilities, fosters creativity, and instills a lifelong love of music.

The Kodaly method offers several benefits for music education, both for students and teachers. Here are some key advantages of using the Kodaly method in music education:

1. Development of Musical Skills: The Kodaly method focuses on developing fundamental musical skills such as pitch recognition, rhythm, and aural training through singing and movement activities. Students learn to internalize musical concepts and develop a strong musical foundation that can be applied to various musical activities.

2. Sequential and Systematic Instruction: The Kodaly method provides a structured and sequential approach to music education, with a clear progression of skills and concepts. Students build upon their musical



knowledge gradually, moving from simple to more complex musical tasks in a logical sequence.

3. Active Engagement with Music: The Kodaly method emphasizes active participation in music-making, with a focus on singing, playing instruments, and movement activities. Students engage with music in a hands-on and interactive way, which helps to foster a deeper understanding and appreciation of music.

4. Use of Folk Music: The integration of folk music in the Kodaly method exposes students to a diverse range of musical styles and cultures. Folk songs are accessible, engaging, and provide a rich repertoire for students to explore. They also help to connect students to their cultural heritage and promote an appreciation for different musical traditions [2].

5. Development of Musical Literacy: The Kodaly method places a strong emphasis on music literacy, including reading and writing music notation. Students learn to read and write music through solfege syllables, hand signs, and other visual aids, which helps to develop their music reading skills and understanding of music theory.

6. Choral Singing: The Kodaly method promotes choral singing as a central component of music education. Singing in a choir helps students develop vocal technique, ensemble skills, and a sense of community through music-making. Choral singing also provides opportunities for students to perform and share their musical talents with others.

7. Creativity and Expression: The Kodaly method encourages students to express themselves creatively through music. Students have opportunities to improvise, compose, and arrange music, allowing them

to explore their own musical ideas and develop their artistic voice.

The Kodaly method offers a holistic approach to music education that nurtures musical skills, creativity, and a lifelong love of music. By engaging students in active music-making, providing a structured curriculum, and integrating folk music and choral singing, the Kodaly method helps students develop a deep understanding and appreciation of music that can enrich their lives both inside and outside the classroom.

Implementing the Kodaly method in the classroom involves a combination of teaching strategies, activities, and resources to create a rich and engaging music education experience for students. Here are some key steps to effectively implement the Kodaly method in the classroom:

1. Curriculum Planning: Develop a curriculum that is based on the principles of the Kodaly method, including sequential skill development, active music-making, and integration of folk music. Plan lessons that progress from simple to complex musical concepts, with a focus on singing, movement, and instrumental activities.

2. Singing: Singing is at the core of the Kodaly method, so incorporate plenty of singing activities into your lessons. Teach songs using solfege syllables, hand signs, and other vocal techniques to help students develop their pitch recognition and vocal skills.

3. Movement Activities: Use movement activities such as body percussion, dancing, and rhythmic games to reinforce rhythmic concepts and engage students in a kinesthetic way. Movement can help students internalize musical rhythms and develop a sense of pulse and beat.



4. Instrumental Activities: Introduce students to a variety of instruments, such as Orff instruments or classroom percussion, to explore different timbres and textures in music. Encourage students to play instruments along with songs or create accompaniments to enhance their musical experience.

5. Folk Music: Integrate folk songs from different cultures and traditions into your curriculum to expose students to a diverse repertoire of music. Use folk songs as a way to connect students to their cultural heritage and explore different musical styles [5].

By following these steps and incorporating the principles of the Kodaly method into your classroom instruction, you can create a dynamic and engaging music education experience that fosters musical skills, creativity, and a love of music in your students.

While the Kodaly method has proven to be highly effective in music education, there are also challenges and limitations associated with its implementation. Some of the key challenges and limitations of the Kodaly method include:

1. Time and Resources: Implementing the Kodaly method requires dedicated time and resources for training teachers, developing curriculum materials, and integrating the method into existing music education programs. Schools may face challenges in allocating sufficient time and resources to fully implement the Kodaly method.

2. Teacher Training: Effective Implementation of the Kodaly method relies on well-trained teachers who have a deep understanding of the method's principles and techniques. Providing comprehensive training for teachers can be challenging, especially in regions where access to Kodaly training programs is limited.

3. Adaptability: The Kodaly method was originally developed in a specific cultural and musical context, and some aspects of the method may need to be adapted to suit different cultural and educational settings. Educators may face challenges in adapting the Kodaly method to meet the needs and preferences of diverse student populations.

4. Assessment: Assessing student progress and achievement within the framework of the Kodaly method can be challenging, as traditional assessment methods may not always align with the method's emphasis on holistic musical development. Educators may need to develop innovative assessment strategies to effectively evaluate student learning.

Despite these challenges and limitations, many educators have successfully implemented the Kodaly method in their music education programs and have seen positive outcomes for their students. By addressing these challenges proactively and creatively, schools can leverage the benefits of the Kodaly method to provide high-quality music education experiences for students.

Conclusion. In conclusion, while the Kodaly method offers numerous benefits for music education, such as developing a strong musical foundation, fostering a love for music, and promoting active music-making, there are also challenges and limitations that educators may face when implementing this approach. By acknowledging and addressing these challenges, such as the need for time and resources, teacher training, adaptability, assessment strategies, sustainability, focus on instrumental skills, and potential resistance to change, schools can work towards effectively integrating the Kodaly method into their music education programs. With careful planning,



The Effect of Kodaly method on the musical knowledge and skills of preservice teachers

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Abstract. The aim of this study in which quasi-experimental design was used to investigate the effect of Kodaly method on the musical knowledge and skills of preservice classroom teachers. It was carried out with 97 classroom teacher candidates including 54 in the experimental group and 43 in the control group. "The Musical Hearing Test" (Gürgen, 2007) and "The Basic Music Knowledge Test" developed by the first author was used. Music lesson plans which were prepared based on Kodaly method were used for eight weeks. As a result of the study, statistically significant difference was found in favor of the experimental group for the melodic success sub-dimension of the Musical Hearing Test. When the changes within the groups were examined, it was seen the melodic and musical pitch success scores of the experimental group increased significantly. When the results of "Basic Music Knowledge Test" were examined, statistically significant difference was observed in favor of the experimental group in terms of all dimensions.

Keywords: Music education, Kodaly method, preservice teachers, music teaching methods

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INTRODUCTION

Music is an art of sound in time that expresses ideas and emotions in significant forms through the elements of rhythm, melody, harmony, and color and is contained in all phases of life. The planned growth and development of these emotions is possible through music education. In the simplest sense, music education can be defined as the process of development of an individual's musical behavior by feeding it on the cultural background coming from family and society. Planned music education is an educational process that starts from pre-school period and lasts until the higher education years. In this process, general music education has an important place for individuals to make positive behavioral changes in their musical development and for the formation of their musical identities. Studies emphasizes that music education plays a significant role at pre-school and primary school periods (Ali, 2017; Nart, 2016; See and Ibbotson, 2018; Uçan, Yıldız and Bayraktar, 1999; Yavuzer, 2012). "Music education given at pre-school period is a very effective way for children to gain concepts and values such as spiritual, cultural, social and intelligence development." (Şen, 2006, p. 338). Yener (2011) argued that the more frequently and earlier the music enters the world of children, the more sensitive, responsive and conscious adults they will be in later life.

In general music education, besides the qualified music education of the students, classroom teachers who will teach music to them should be trained as competent and equipped in music education. Music courses, which have an important place in both musical and emotional development of children, should be included in the teacher training programs for future classroom teachers and be given importance to such training (Mete, 2019). The Council of Higher Education issued a special field competencies document for classroom teaching which includes an item about the competency of "Art and Aesthetics" that contains a sub competency of "having general information about fine arts". Based on this, classroom teachers are expected to be familiar with fine arts including visual arts and music and to employ quality sample of them in various activities. For this reason, it is important to improve the musical knowledge and skills of classroom teachers who will teach music using their knowledge on music education they received in the teacher training programs.

The curriculum of classroom teaching department has been modified several times. It was last modified by the Council of Higher Education on 16 May 2018 and began to be implemented from the academic year of 2018-2019. Within this program the course of music is delivered to pre-service teachers at the first semester of the fourth grade (at the seventh semester). Table 1 shows the class hours of the music courses within the teacher training programs for classroom teachers per year. This study focuses on the classroom teaching program which was implemented between the academic year of 2006-2007 and the academic year of 2017-2018.

Table 1. Hours of the music courses within the teacher training programs for classroom teachers

Year	Course Name	Semester/Grade	Course Hour*
1998-1999	Music I	III. semester - 2. grade 1. term	2 hour
	Music II	IV. semester - 2. grade 2. term	2 hour
	Music Teaching	V. semester - 3. grade 1. term	2 hour
2006-2007	Music	III. semester - 2. grade 1. term	3 hour
	Music Teaching	IV. semester - 2. grade 2. term	3 hour
2018-2019	Music Teaching	VII. semester 4. Grade 1. term	3 hour

*1 course hour is 45 minutes.

The content of the music course included in the teacher training program (2007) is given as follows:

"Basic components of music, basic music knowledge; musical note knowledge, the concept of interval in music, the concept of rhythm in music, creation of a song repertoire; the types and forms of music in Turkey and the world; transition from traditional music to contemporary music, teaching musical instruments, collective playing and singing, the role of music in education, musical hearing in improving creativity" (p. 32).

Uçan (2005) states that music education has the following contents: "sound training, hearing training, instrument training, musical movement and rhythm training, training on musical knowledge, creativity training, appreciation training, musical personality training, musical sensitivity training, musical communication and interaction training, musical use and training on the use of music." Of them sound training is defined as follows: "It is an interdisciplinary special field education which includes the steps of speaking, singing and singing training in which individuals are taught the behaviors necessary to use their voice correctly, effectively and beautifully in speaking and/or singing." (Töreyn, 2015, p. 82). Training on the use of musical instruments is defined as follows: "this training is basically designed to improve the love of music among students and to increase their knowledge of music by making them play an instrument with a certain level of competency as well as to improve their ability to play the instrument." (Dündar, 2001). Uçan et. al. (1999) point out that training on the use of instruments is delivered mostly simultaneously with song training at primary school level. The training on musical hearing is defined as follows: "it is consisted of methodical studies on the development of the perception, identification, discrimination and analysis of sounds." (Say, 2002, p. 270). Concerning training on musical knowledge teaching focuses on the basic elements of music, music alphabet (basic knowledge on musical note, rhythm, measure, terms and symbols, etc.) and components such as music culture. For classroom teachers to be able to gain competence in these dimensions and in the basic components of music specified in the course content in teacher training programs, including basic musical knowledge, musical note knowledge, rhythm concept, collective playing, collective singing and so on those methods and techniques to be used in the course should be well planned.

"The teaching methods used in music education showed great development especially in the late 19th and 20th centuries, and have continued to improve today." (Türkmen, 2019, p. 76). Although the tools these methods employ and the elements these methods focus on differ from each other, the common feature of these methods is that they are student-centered in line with

literacy. Choksy (1981), Kirk (2000), and Kodaly (1974) emphasized the significance of singing songs and improved musical ear. However, they also pointed out that that singing should not be a stand-alone activity and that young children need more action to learn music (Ratcliffe, 2018, p. 1). In this method, a repertoire initially includes folk songs (nursery rhymes, children's songs, lullabies, etc.) and then it gradually increases to the outstanding examples of international art music.

In this study, the Kodaly method was used as a teaching method. The reasons for choosing this specific method are as follows: Its tools are eligible for general music education -for instance, a more concrete perception of sonority with hand signals -; the method emphasizes voice training without an assistance of a music instrument; this method is suitable for collective singing and collective playing instruments and this method performs music teaching based on folk culture. Researches indicates that in-service and pre-service teachers are not familiar with the Kodaly method and therefore, teachers do not employ it in music education (Çelik, 2001; Ercan, 2006). In Turkey an activity entitled I. International Kodaly Training Days was organized by the cooperation of Marmara University Atatürk Education Faculty, Hungary Culture Center and Kodaly Institute (Kecskemet) in 2017 to make this method much more familiar. The activity was again carried out in September 2019. The goals of these activities are to have better understanding about the implementation of the method, the philosophy of practices through training.

Çevik (2011) emphasized the necessity of the music education that the pre-service classroom teachers received in order to educate primary school children in music courses in their future teaching profession. Çevik (2011) also pointed out that it is important that pre-service teachers should gain musical knowledge and skills, the skills to employ the theoretical knowledge they learned and that their training in this subject should be a quality one. The aim of this study is to investigate the effect of the Kodaly method on the musical knowledge and musical hearing skills of preservice classroom teachers who are at the second year of a teacher training program.

METHODS

Research Design

In this study, a semi-experimental design part of the quantitative research methods was used to reveal the effect of the Kodaly method on the musical knowledge and musical hearing skills of preservice classroom teachers. A semi-experimental design is often used when a true experimental design is not feasible (Leedy and Ormrod, 2005) and in such designs the causality between an implementation and the results is revealed. In short, the study was designed as a semi-experimental research which includes control and experiment groups with pre-tests and post-tests which Cohen, Manion and Morrison (2007) consider as one of the most widespread semi-experimental designs employed in educational research.

Participants

The participants of the study are the second-grade pre-service teachers attending a teacher training program at a public university during the academic year of 2015-2016, and they attended the classroom teaching branch. An ethical permission was obtained from the related university before the implementation process was started, and then written consents were obtained from the participants. The participants were chosen from those who were registered to the course of music. Participants were divided into two groups by random sampling method. The number of participants in the experiment group is forty-three and that in the control group is fifty-four.

Data collection tools

author collected the data and implemented the courses. She is also the music teacher of the experimental and control groups.

In order to employ the Kodaly method in the courses taught in the experimental group, eight weeks' lesson outlines were developed by the authors using the materials included in the Kodaly method (hand signs, rhythm syllables, folk melodies, rhymes, etc.) (For the details about all course outlines and flow charts see Mete, 2019). The same content (same songs, topics, etc.) for the courses taught in both the experimental and control groups is the same. The selected rhymes, songs and folk songs are chosen from folk melodies as Kodaly emphasizes.

Lesson plans developed using the Kodaly method

In the development of the lesson plans, the sample plans contained in national and international studies were examined. In addition, the description of music courses in the classroom teaching training program (See, CHE, 2007) and the current education program for primary school music courses (MONE, 2012) were taken into consideration. On the other hand, in the development of the course plans course outline templates developed by Özeke (2007) which also follow the Kodaly method and other templates included in the studies by Feucht (1998), Gerling (2003), Sullivan (2014) and Vinnard (2014) were reviewed. Based on all these materials the outlines for the music courses were developed following the principles of the Kodaly method. An example of a weekly lesson plan (3 class hours) used in the implementation process is presented below.

In order to determine the musical levels of the experimental and control groups before the implementation the Test on Musical Hearing developed by Gürgen (2007) was administered to these groups. Following the implementation, it was administered to the participants as a post-test, and the difference between pre-test scores and post-test scores was calculated and analyzed. In addition, the Basic Musical Knowledge Test was administered to the participants in the experiment group as a pre-test before the lessons started. It was also used as a post-test at the end of the process. Then the differences between pre-test scores and post-test scores were analyzed.

Data analysis

In the study, the pre-test and post-test scores of the participants obtained from the Musical Hearing Test and Basic Musical Knowledge Test were analyzed. Before the analyses, the assumption of normality was examined using the Kolmogorov-Smirnov and Shapiro Wilk tests, and it was found that the data were not distributed normally. Therefore, the non-parametric statistical techniques were used in the comparisons. Since non-parametric techniques are used in the statistical analysis of the data, the median and mean rank values are given in addition to the mean and standard deviation values in tables. The Wilcoxon test was used for pre-test and post-test comparisons. The Mann-Whitney U test was employed for the comparison of the experimental and control groups. Comparison of experimental and control groups was performed based on their pre-test scores, post-test scores and difference scores. Difference scores indicate the difference between the scores of the participants taken from the tests in the pre-test and the post-test. The data were analyzed using the SPSS 22.0 and significance levels were set at 0.05 and 0.01.

FINDINGS

In this section, the findings obtained by comparing the pre and post test scores of the participants obtained from the Musical Hearing Test and Basic Musical Knowledge Test administered to the experimental and control group students are discussed.

Findings obtained from the Musical Hearing Test

The findings obtained from the Musical Hearing Test are given below based on its four sub-dimensions, namely sonority, melodic success, rhythmic success and sound success.

Following the course plans developed and implemented based on the Kodaly method, the data collection tools were re-administered as post-tests. After this application, a statistically significant difference was observed in favor of the preservice teachers in the experiment group in the pre-test and post-test findings concerning the melodic success sub-dimension of the musical hearing test (see Table 2). Concerning intragroup changes it is found that the experiment group students' melodic success scores (see Table 2) and sonority success scores (see Table 1) statistically significantly increased following the music course in which the Kodaly method was employed. This finding is consistent with the findings of other studies carried out on sonority and melodic success. Göncü and Türkmen (2018) employed the Kodaly method for amateur choral students and conclude that the sonority activities implemented in consistent with this method (sound exercises can also be evaluated within the scope of these studies,) are both informative and fun. In study by Ryman (2019) which deals with the significance of hand signs in teaching sonority on a sample of high school students it is found that the Kodaly method, when combined with the use of Curwen-Glover, hand signs can be especially effective in improving the singing skills of choral students at the secondary school level.

There was no statistically significant difference between the pre-test and post-test scores from the rhythmic success sub-dimension of the Musical Hearing Test for the pre-service teachers in both the control group and the experimental group and also, there was no statistically significant difference between the pre-test and post-test scores from the same sub-dimension for the participants in the experimental and control groups (see Table 3). The pre-test and post-test findings obtained from the sub-dimension of musical success in the Musical Hearing Test suggest that the control and experiment significantly vary before and after the music course in which the Kodaly method was employed (see Table 4). This shows that the reason for the fact that the scores obtained following the implementation were in favor of the experimental group is not only the use of the Kodaly method, but may be other factors.

Another data collection tool employed in the study is the Basic Musical Knowledge Test which was administered to the experimental group who was taught through the Kodaly method. The findings from this test which was used both as a pre-test and a post-test (see Table 5) show that the participants' mean scores from the dimensions of Knowledge Rhythm and Musical Note, Number of Measures, Musical Terms and Symbols and Music Culture significantly increased. Wolf (2019) citing Lane who emphasizes the significance of music literacy argues that "the Kodaly approach defines music literacy as the ability to look at a musical score and think the sounds just as easily as one thinks the words on a page of writing." Similar to the previous findings the findings of the study indicate that the Kodaly method significantly improves basic knowledge of the pre-service teachers on music (Bowyer, 2015; Göncü and Türkmen, 2018; Luen, Ayob, Wong and Augustine, 2017; See and Ibbotson, 2018). These researchers showed that the musical activities implemented based on the Kodaly method could contribute to the developmental processes of the participants. They also found that by using hand signs, students could improve their voice development, sound heights and rhythm skills. This clearly demonstrates the effect of this method on musical knowledge and hearing.

Studies carried on a sample of teachers (classroom teachers and music teachers) and on a sample of pre-service teachers (preservice classroom teachers and preservice music teachers) (Andirici, 2006; Aydemir, 2018; Çelik, 2001; Ercan, 2006; Koç, 2006; Yazıcı, 2015) conclude that the Kodaly music teaching method is not well known in Turkey and that both in-service teachers and pre-service teachers do not find themselves sufficient about using this method in classrooms. The first thing that needs to be done for the recognition of the Kodaly method and making it more widespread is the restructuring of teacher training programs. The scope of the music courses given in the teacher training programs should be expanded, and other methods and techniques of music teaching including the Kodaly method should be introduced and taught in depth to preservice teachers. It is expected that classroom teachers who deliver or will deliver music courses at elementary schools should have a good background in music and music education and will be individuals who recognize, promote and understand other cultures in the teaching the course.

Figure 12. Okeyo, Shithandi and Kanake (2022)

INTRODUCTION

The Kodály pedagogical approach to music grew from the ideas of the Hungarian composer Zoltan Kodály (1882-1967). The approach advocates for the use of folksongs to teach music in schools for all levels of education. The components of the Kodály approach are tonic sol-fa, hand signs and rhythm duration symbols. The competencies developed if Kodály pedagogical approach is effectively used include critical thinking and problem solving developed through the selection of appropriate songs and folk songs for use in facilitating learning in primary education; communication and collaboration achieved through group work activities such as the use of hand signs to perform sol-fa ladder while creativity and innovation achieved through creating rhythms using French rhythm names.

In the United Kingdom, music education scholar Bidner (2016) reports that the Kodály music teaching approach uses the folk music repertoire in the classroom for students to learn what music is. The use of folk songs as classroom activities in a music class enhances students' overall academic achievement. In the Philippines, a research study by Morallista (2016) found that using the Kodály approach positively impacts students' academic performance. Korarit et al. (2012) report that Conservatories in the Philippines apply Kodály to teaching music education to develop and improve knowledge in higher education.

Academic performance is apparent phenomena in many countries. In the United Kingdom, performance in examinations provides an objective yardstick for judging educational standards (Eze & Henry, 2015). Academic achievement is measured by how well the students have met the standards set by the examination council. In South Africa, the scholastic accomplishment of studies is estimated by evaluations at whatever level. The evaluations are markers of a person's scholastic capacity, and educators, guardians, and the general population everywhere hold the individuals who do well in high regard (Schreiber & Yu, 2016). Hasnoor et al. (2013) report that students' performance in teacher education is significantly correlated with academic environment and teachers' instructional approaches. A study by Watson (2013) observes that appropriate instructional approaches

facilitate effective learning at the high school level of education.

The Ministry of Education (MOE) in Kenya justifies the teaching of music in primary teacher education (PTE) curriculum because of its contribution to the attainment of National Goals of Education, such as promoting national unity, individual development and self-fulfilment. The current PTE music curriculum (KIE, 2004) advocates for the use of Kodály's pedagogical approach to music education. However, several studies report that regular low academic performance by the majority of students is linked to ineffective use of pedagogical approaches. Therefore, the level of use of the music-based pedagogical approaches could cause a decline in teacher trainees' academic performance, resulting in widespread concern over the music performance at the PTE level.

According to Kenya National Examination Council (KNEC, 2018) teacher, trainees' performance in Music as a subject has steadily decreased over the past five years in all Kenyan primary teacher-training colleges (PTTCs), with an overall mean grade ranging between 4.5 and 6.5. The Nandi County Director of Education (2018) observes that the PTTCs have continually posted unsatisfactory music results for the last five years. The decline in music performance creates a vicious cycle that affects the quality of teaching and learning music in the County TTCs. This may lead to ineffective content delivery of the curriculum, thereby hindering the attainment of National Goals of Education such as national development, individual development and self-fulfilment. In addition, hampering Kenya Vision 2030, which commits to providing globally competitive quality education, training and research for all citizens. Further, hindering Sustainable Development Goal number four (ensuring quality education) and 21st-century learning skills and approaches. On this premise, the current study sought to determine the impact of the use of the Kodály pedagogical approach (KPA) on teacher trainees' performance in basic music skills.

LITERATURE REVIEW

The Kodály approach to music grew from the ideas of the Hungarian composer Zoltan Kodály (1882-1967). The approach advocates for the use of folksongs to teach music in schools for all levels of education. This

49

is in line with Gault (2013), who observes that the use of folk music leads to learners reconnecting and associating with the music learned within their environment. The choice of folk songs, as proposed by Kodály, encourages the learner to identify with the music of his/her people (Gault, 2013). Smuta (2017) emphasises that the Kodály approach encapsulates a successive procedure by which a culture's society tunes and dynamic, bona fide singing games are executed to mood, song, and amicability notwithstanding the abilities of singing, tuning in, moving, perusing and composing documentation. The authors' discussions on the choice and use of folk songs as found in the Kodály approach were relevant to the current study in two ways; first, how the Kodály approach places singing at the centre of music guidance, and second how singing is utilised as the essential method for building up every melodic expertise. This study used these positions to find out the various uses of singing, specifically folk songs, in the Kenyan context.

The components of the Kodály method are tonic sol-fa approach, where the movable 'doh' system is applied. The 'doh' is the home tone in major scales, while 'lah' is the home tone in minor scales, a series of hand signs showing different pitches in the scale. This helps the listener hear patterns, intervals, phrases and forms, and a system of rhythm duration symbols.

Tonic Sol-fa System

Sol-fa syllables have long been used in music education. Tonic sol-fa is a system of notation that uses sol-fa syllables (Dilek, 2012). It is a holistic approach to music education through singing. It builds a comparative relationship between the tonic and other degrees of the scales, which assists in pitch discrimination in music (Sarrazin, 2016). The sol-fa syllables represent seven different pitches of the diatonic scale. They are written using the first letter of the syllable:

d=doh is the keynote of the tonic

r=ray the supertonic, which is a major second above the tonic

m=me the mediant, a major third above the tonic

f=fah the subdominant, a perfect fourth above the tonic

s=soh the dominant, perfect fifth above the tonic

l=lah the submediant, a major sixth above the tonic

t=te the leading note, a major seventh above the tonic.

The movable 'doh' system in which 'doh' is the home tone in major scales and 'lah' in minor scales is to be used. Movable 'doh' is a system where every scale note is given its unique syllable that is used to sing that note every time it appears (Dilek, 2012). For example, C is 'doh' in C major; D is 'doh' in D major. In F major scale, the seven notes include F, G, A, Bb, C, D and E (often continuing on to F an octave above the first 'doh'). If we sing the scale of F major on sol-fa, the F would always be sung as 'doh', G would be sung as ray and so on. The whole scale looks like this on sol-fa

Example 1: Movable 'doh' for F major

F G A B^b C D E
doh ray me fa soh lah te

Example 2: Movable 'doh' for E minor

In minor scales, 'lah' is considered the tonal centre. So, for example, in E minor, the notes are E F[#] G A B C and D (often continuing on to E an octave above the first 'lah').

Example 2: Movable 'doh' for E minor

E F[#] G A B C D
lah, te, doh ray me fah soh

Hand signs

Hand signs are physical gestures that represent sol-fa. Hand signs were introduced by John Curwen in 1870. They are useful for reinforcing intervallic feelings (Dilek, 2012). It is a method where each syllable is represented with a particular hand sign (Benson, 2016). The use of hand signs presents visualisation in the space of the high-low relationship among the notes being sung (Lihan, 2018). Each hand sign represents a particular sol-fa syllable and is made in front of the body. The distance between the hand signs, to some extent, reflects the size of the interval to be sung. Octaves are shown by the same sign, with the lower 'doh' sign occurring at the waist level and the higher 'doh' above the eye level. The sign for the half steps fah points down to me while 'te' points up to 'doh', thus emphasising the smallness of these half steps. Refer to Appendix IX

Hand signs were created by John Curwen as a way of showing the tones. Kodaly borrowed the hand signs and emphasised their use in music education. Benson (2016) affirms that Kodály also used Curwen hand

signs to represent each pitch in the scale. In the use of Hand signs, music teachers can use only one hand for pitch or both hands to show two different pitches. The music teacher can also present chord changes by use of hand signs. This study used these positions to find out how it helps the teacher trainees to visualise the distance between the pitches and match pitches given the right sound in Kenya.

Rhythm Duration Symbols

A rhythm duration syllable is a system where different syllables represent each rhythmic pattern and are counted verbally using mnemonic sounds (Dilek, 2012). The rhythm names have been used in the Kodály approach to make students understand the concept of time in music. The students clap/tap rhythmic patterns while saying the names representing individual beats in the pattern. The counting of rhythm is done using French rhythm names.

In this method, Kodály trained teachers to begin by teaching one beat, which is the quarter note and later notes of longer and shorter duration are incorporated. All quarter notes are counted as 'taa'; all eighth notes are counted as 'ta' while two eighth notes would be counted as 'ta-te'. Half notes counted as 'taa-aa' and whole notes as 'taa-aa-aa-aa'. However, a grouping of four sixteenth notes is counted as 'ta-fa-te-fe'. For example;

Duration	French rhythm names
One beat (quarter-note)	taa
Two half beats (eighth- notes)	ta-te
Four-quarter beats (sixteenth- notes)	ta-fa-te-fe

Kodály also uses rhythmic and melodic patterns that are encountered in songs and later in visual form. The rhythmic names are used to represent the duration or length of a note or rhythmic pattern. The rhythmic system of mnemonic syllables is considered an efficient means of learning rhythmic values and their relationships in a pattern. The chanting of ta-fa-te-fe is used by students of every level to master difficult rhythms. The study found the discussions and explanations of the components of the Kodály approach relevant and utilised them to highlight the key features and uses of the Kodály approach. The Kodály approach is described by the utilisation of singing as the essential vehicle for music support, society music as the underlying collection and

musicianship as the objective for all kids (Benson, 2016). West and Clauhs (2015) state that music exercises, for example, singing, creating rhythmic patterns, making cadenced examples, and playing instruments, dramatically affect perusing and education. For example, Sheridan (2015) found that in the Kodály approach, students' understanding of musical and melodic components and singing improved amazingly. The Kodály way to deal with learning music improves further learning and more prominent commitment in music components, for example, beat, tune and agreement. This agrees with Smuta (2017), who saw that the Kodály approach of training music could invigorate students' information on cadenced and melodic components through perusing and composing exercises. Students construct a superior comprehension of music ideas while encountering the Kodály approach all the more adequately when they draw in to take care of issues during class exercises (Smuta, 2017). These arguments were relevant to the current study in finding how the learning activities used in Kodály can be adopted as a variety of songs and musical activities.

Lowe (2011) highlights that learning activities such as singing folk songs are described by students as more relevant to them when they can engage practically with topics. Lowe (2011) further observes that the value students attach to any subject is enhanced through active participation in a classroom setting, hence improving academic performance. The study used this position to emphasise that learning activities, especially music activities, are designed to follow creative learning processes that suit the students.

According to Gault (2013), Kodály - based approach to teaching music utilises a clear sequence of musical concepts that are presented based on when they appear in the repertoire used during instruction. This is consistent with Gordon's theory of Music Learning, as Valerio (n.d) reported that the key component to Gordon's approach to music learning is the idea and the role of instructional sequencing. Luhan (2015) remarked that the Kodály approach uses a sequential building of concepts that enable each student of whatever age to become so musically literate that she/he understands the music without a score as well as understands the score without music. Lori (2012) affirms that the structure and content of music theory

are beautifully arranged for spiral learning, which compliments the hierarchy of overlapping and recurring theoretical concepts embedded in Kodály's pedagogical principles. The study deduced from the argument of the above-mentioned authors that Kodály is organised in a progressive fashion, while the current study investigated how Kodály is an analytical, creative learning process.

According to Smuta (2017), sequence accounts systematically for the readiness needed to learn each new musical skill. For instance, the pre-requisite for educating music experts is the acquisition of music skills and the application of the skills to learning to read and write notations in music. This sequential process teaches the music educator to gradually introduce more abstract concepts and skills through sequential learning (Carlton, 2016). Abril and Gault (2016) note that educators using the Kodály approach provide music instruction that is learner-centred and in a logical and sequential process. Hence, the approach is experiential. This implies that students participate in musical experiences and then use the experiences to develop a conceptual understanding. Kodály's approach was useful to the current study regarding the use of folk music in teaching music in primary teacher training colleges. This is because the songs used were familiar to trainees and enabled them to experience the melodic and rhythmic concepts that were taught.

Onyuke (2016) observes that instructional materials for teaching and learning music should be presented in integrated and well-structured sequences to allow learners to build upon previously acquired knowledge and skills. The study concurred with the perspectives of the various researchers and construed that the music curriculum should be organised in order to present the fundamental structure of music that may lead learners to more discoveries for themselves. However, the study maintained that music teachers should select, organise and present materials in a developmental sequence appropriate to their learners' level of performance. In addition, music teachers should use a variety of pedagogical approaches to address different learning preferences.

METHODOLOGY

The study was guided by Music Learning Theory by Gordon and complemented by the theory of Multiple Intelligences by Gardner. The study adopted mixed methods quasi-experimental research design. The selected experimental group was exposed to the music-based pedagogical approaches, while the control group continued with the traditional teaching approaches used by music tutors. The target population was 344, comprising 341 teacher trainees in their second year and 3 college music tutors. Purposive sampling was used to draw participating tutors teaching music, while census sampling was used to select teacher trainees studying music in the second year. A sample of 3 tutors teaching music and 170 teacher trainees studying music in the second year participated in the study. Questionnaires, an interview schedule, and pre-test and post-test evaluations were used in the collection of data for the study. A pilot study was done to find out the reliability of the research instruments. Cronbach's alpha was used in estimating the reliability of the instruments. A correlation coefficient value of 0.748 was achieved. The research instruments were validated with the help of the supervisors and experts from the School of Education and the School of Music and Media. Frequencies, percentages and means were used to summarise and describe data, whereas Analysis of Variance (ANOVA) and T-test were used to establish the impact. All hypotheses were tested at $\alpha = 0.05$ level of significance.

RESULTS AND DISCUSSION

Impact of the use of KPA on TTP in Basic Music Skills

The hypothesis stated that there is no statistically significant impact of the use of KPA on teacher trainees' performance in basic music skills. The impact of the use of the KPA on teacher trainees' performance in basic music skills was determined using descriptive and inferential analysis.

Descriptive Statistics on the Impact of the use of the Kodály Pedagogical Approach

The impact of the use of the Kodály pedagogical approach was measured using a set of 8 statements in the questionnaire. Respondents were requested to rate the extent to which they experienced the use of the Kodály approach in music lessons. The information

Journal of Education and Learning

was analysed by determining the percentages, the mean and standard deviation on eight items on a 5-point Likert scale: To a Very Large Extent=5; To a Large Extent=4; To Moderate Extent=3; To a Small Extent=2; To a No Extent at All=1. Table 15 presents the results of the analysis.

Table 1: Descriptive Statistics on the use of the Kodály Pedagogical Approach

Kodály Pedagogical Approach (KPA)	To no extent at all (1)	To a small extent (2)	To a moderate extent (3)	To a large extent (4)	To a very large extent (5)	Mean	Std. Deviation
To what extent do you clap rhythmic patterns before writing them down				11.39	88.61	4.5689	.68967
To what extent do you engage in chanting the rhythms using the French system of 'ta's and 'ti's			17.72	16.46	65.82	4.5689	.68967
To what extent do you sing back melodic patterns before writing them?			22.15	22.15	55.7	4.1737	.61096
To what extent do you participate in creating/composing your own rhythms that contain particular rhythmic patterns			14.56	13.92	71.52	4.5689	.68967
To what extent do you participate in creating/composing your melodies that contain particular pitch patterns		11.54	22.44	23.08	42.95	2.7665	.66978
To what extent do you practice folk songs in your music lesson?	11.39	12.66	39.24	31.65	5.06	4.1629	.62025
To what extent do you sing melodic phrases using Hand signs in music lessons?	6.33	22.15	29.11	31.65	10.76	2.7844	.68206
To what extent do you play the simple accompaniment on pitched and non-pitched musical instruments to teach?	2.58	5.81	27.1	12.26	52.26	4.5928	.63203

Overall 4.0712 .64375

As reflected in table 1 above, the overall mean of all the respondents was 4.07 (SD=0.64) out of the maximum mean score of 5 points. This suggests that teacher trainees' experienced the use of the Kodály approach to a large extent. Teacher trainees' to a very large extent, experienced the use of the Kodály approach in the clapping of rhythmic patterns before writing them down, as indicated by 88.61 per cent of responses and the mean of 4.56 (SD=0.68), although 11.39 per cent to a large extent. Creating/composing own rhythms was experienced to a very large extent, as reported by 71.52 per cent and the mean of 4.56 (SD=0.68) while 13.92 per cent to a large extent. Chanting the rhythms using the French system to a very large extent, as indicated by 65.82 per cent and the mean of 4.5 (SD=0.68). Singing back melodic patterns before writing constituted 55.7 per cent and the mean of 4.1 (SD=0.61). However, playing simple accompaniment on pitched and non-pitched musical instruments was very much experienced, as reported by 52.26 per cent and the mean of 4.59 (SD=0.63). The respondents experienced creating/composing their own melodies to a very large extent, as was confirmed by 42.95 per cent and the mean of 2.76 (SD=0.66), while 11.54 per cent to a small extent. Singing folk songs to a moderate extent, indicated by 39.24 per cent of responses and a mean of 4.1 (SD=0.62).

Moreover, singing melodic phrases using hand signs had 31.65 per cent and a mean of 2.7 (SD=0.68). It can be observed that there was teacher trainees' greater experience of KPA in a music lesson. This concurs with Smuta (2017) that Kodály's pedagogical approach has the ability to stimulate students' knowledge of music through reading and writing activities. Students build a better understanding of music concepts while experiencing Kodály Pedagogical Approach more effectively when they engage in solving problems during class activities. This help to improve students' music performance (Smuta, 2017).

Kodály pedagogical approach improves students' understanding of rhythmic and melodic elements, and singing improves remarkably (Tabuena, 2020). This agrees with the results in Table 1, in which the teacher trainees' 'to a very large extent' experienced the use of the Kodály Pedagogical Approach in the clapping of rhythmic patterns, as confirmed by 88.6 per cent. Composing own rhythms 71.52 per cent, chanting

rhythms 65.82 per cent, singing back melodic patterns 55.7 per cent and playing simple accompaniment on pitched and non-pitched musical instruments, as indicated by 52.26 per cent. The Kodály pedagogical approach to learning music enhances deeper learning and greater engagement in music elements such as rhythm, melody and harmony (Tabuena, 2020).

The finding is supported by music tutors' interviews that they are knowledgeable in the use of the Kodály Pedagogical Approach and use it to a large extent (4). In affirmation, music tutors agreed that Kodály Pedagogical Approach is a practical-oriented approach that motivates the teacher trainees and hence improves their academic performance. This finding reinforces the idea that the Kodály Pedagogical Approach is effective in the improvements and achievements of teacher trainees studying music. In addition, responses given by the music tutors regarding the experience and the use of the Kodály Pedagogical Approach were that the Kodály approach is practical in nature and requires more time. This is supported by Goopy (2013), who noted that increased time allocation to Kodály based music instruction in a music program enhances academic results significantly. Furthermore, Gault (2016) asserts that music students experiencing the Kodály approach be given more time to train with a balance between artistic aspects of music and technical mastery of music interpretation and expressivity.

Further, responses given by music tutors indicated that in the primary teacher education (PTE) music curriculum, the practical aspect of music is not tested, and teacher trainees' do not appreciate what is not tested nationally (PTE music examinations). Hence, the Kenya National Examination Council (KNEC) should strive to evaluate both theory and the practical aspect of music in TTCs using either the formative or the summative evaluation. This is supported by Emel and Ilkrun (2018), who found that in evaluation and grading in teaching music, students should receive marks for their practical skills as well as their theoretical knowledge. According to Emel and Ilkrun (2018), what is certain is that the more practical activities the teacher issues, the more student love music and cultivate a positive and lifelong relationship with music. Therefore, the aim of the music teacher should be to bring students to love music and show

In regard to classroom music activities other than Kodály Pedagogical Approach activities, table 2 indicates that 34 (20.36%) of the respondents reported Movement, Movement and dancing, while 15 (8.98%) of the respondents indicated Movement and singing. Some 13 (7.78%) of the respondents considered Clapping, while 12 (7.19%) Movement and clapping. Dancing constituted 11 (6.59%), while 10 (5.99%) constituted Clapping and tapping, with 9 (5.38%) reporting dancing and jumping. In addition, 7 (4.19%) of the respondents indicated Movement and tapping, while 6 (3.59%) Movement, clapping and tapping. Clapping and dancing, Movement, dancing and

stumping, Movement, dancing, tapping and Singing all constituted 4 (2.4%). It can be deduced from the findings that music activities experienced in the classroom other than Kodály Pedagogical Approach activities were movement and dancing.

Additional Instructional Approaches Used by Music Tutors

With regard to the above concern, the respondents were asked to suggest additional approaches in which their tutors engaged them during music lessons. Table 3 presents the results of the analysis.

Table 3: Additional Instructional Approaches

Additional Approaches	Frequency	Per cent
Demonstration	22	13.17
Imitation	8	4.79
Imitation and recitation	5	2.99
Lecture	90	53.89
Participatory, demonstration and others	3	1.80
Lecture and participatory	4	2.40
Lecture and recitation	8	4.79
Participatory	5	2.99
Recitation and demonstration	4	2.40
Imitation and lecture	9	5.39
Non-response	9	5.39
Total	167	100.00

The findings in Table 3 indicate that most music tutors taught using the lecture method, which constituted 90 (53.89%), while 22 (13.17%) of the music tutors used demonstration. It is clear that 9 (5.39%) of the music tutors used imitation and lecture methods, while 8 (4.79%) of the tutors preferred to use lecture methods, recitation and imitations. It is evident that 5 (2.99%) of the tutors used imitations, recitation and participatory, while 4 (2.4%) reported that tutors used to lecture, participatory, recitation and demonstration. In addition, 3 (1.8%) of the respondents indicated that tutors used participatory, demonstration and others, while 9 (5.39%) constituted non-response. The results show that varieties of additional approaches were used, but the least utilised were participatory, demonstration and others, while the most used was a

lecture. As observed, a high percentage (53.89%) uses lecture, which is teacher-centred. The findings concur with Maina (2015), who established that teachers in Kenya commonly use the lecture method. This is a reflection that music tutors emphasise content and knowledge acquisition in Teachers Training College (TTC). This makes teacher trainees passive with little participation, which could possibly have a negative impact on their understanding of the music curriculum content. This is contrary to the PTE music curriculum requirements that emphasise learner-centred approaches that engage the learners in musical experiences in the classroom.

Inferential Statistics for the Use of Kodály Pedagogical Approach

The impact of the use of the Kodály pedagogical approach (KPA) on teacher trainees' performance

(TTP) in basic music skills was determined by performing a One-way Analysis of Variance (ANOVA) analysis. Table 4 presents the findings.

Table 4: One-way ANOVA: Kodaly versus TRT

Source	Df	Ss	Ms	F	P-value
TRT	3	708.1	236.03	2.79	0.043
Error	147	12432.7	84.58		
Total	150	13140.9			

From Table 4 above, a one-way ANOVA revealed that the probability value (p-value) is less than 0.05 ($p=0.043$). Hence, there is a significant difference in the performance of teacher trainees in different groups (each experimental and control group). This means that each group showed significant growth in the use of the Kodály Pedagogical Approach and that training the teacher trainees' using Kodály pedagogical approach improves both music and academic performance.

This study's findings above concur with a study by West (2012), 'on teaching music in an era of 21st century high-stakes testing', who found that there was an improvement and the achievements of the students who were preparing for final external academic examinations. This finding is similar to Sheridan's (2015) observations that Kodály's approach to music teaching and learning provides music teachers with methodological techniques that can be applied in the classroom to build learners' music literacy and understanding hence increase in auditory and improvement in academic performance. A research study by Lori (2012) in Canada showed that Kodály based music instruction could result in increased academic achievement, creativity and self-esteem. These findings suggest that the use of the Kodály Pedagogical Approach improves not only students' musical growth and maturity but also their academic performance.

Studies regarding the use of the Kodály Pedagogical Approach show that there is a significant effect of the use of the approach on students' academic

performance. A study by Moralista (2016) on 'factors affecting music education in the Philippines' confirmed that the use of the Kodály approach has a positive influence on students' academic performance. Smuta (2017) states that Kodály based music instruction improves spatial recognition (reasoning skills) and non-spatial abilities (general intelligence) though not significant. Goopy (2013) observed that Kodály music instruction significantly enhanced the spatial-temporal reasoning of the learners exposed to the instruction.

See and Ibbotson (2018) reported that Kodály's approach to music learning improves IQ scores, psychomotor skills, and perception ability, as well as other academic areas such as reading and mathematics. This finding resonated with Goopy's (2013) assertion that Kodály-based music groups had reliably larger increases in full-scale IQ, whereas the non-Kodály based music groups exhibited increases in IQ. Music education programs founded on Kodály philosophy nourish learning skills and ways of thinking that correlate to other areas of learning (Goopy, 2013).

ANOVA reveals statistically significant differences between experimental and control groups, but it does not indicate where the differences between the groups lie (Eva & Oska, 2015). After a significant difference is found, it is necessary to carry out further analysis to examine which groups differ. A possible further analysis of an ANOVA was applied as post hoc tests. Hence, Fisher Pairwise Comparisons (FPC) follow-up test was used to determine if any of the means were different. Table 5 presents these findings.

Grouping Information Using the Fisher LSD Method and 95 per cent Confidence.

Table 5: Fisher Pairwise Comparisons

TRT	N	Mean	Grouping
EXP POST	44	44.810	A
EXP PRE	44	44.543	AB
CONTROL POST	43	40.67	BC
CONTROL PRE	43	40.11	C

From the analysis of the post hoc test in Table 5 above, it was established that there exists a significant difference in the mean performance of the experimental post-test, experimental pre-test, control post-test and control pre-test groups. The mean performance of experimental post-test mean scores (44.810 means) showed significant growth over the mean performance of control post-test mean scores (40.67 mean). This suggests that after treatment, the experimental group performed better in the post-test than the control group. This could be due to the emphasis on the planning, preparation and use of the Kodály Pedagogical Approach during the treatment period, where a high level of methodological control within the lesson was possible.

From the previous and the present study, the findings reveal that there is a significant gain in the use of the Kodály Pedagogical Approach on teacher trainees' performance in music leading to high mean scores, musical development and technical competencies. Kodály's Pedagogical Approach enhances the music learning experience, and this is developed through the presentation of music concepts in a sequence. The teacher trainees' involvement in the learning process and the learning activities raised their ability levels in music performance.

DISCUSSION

The study's first objective was to determine the impact of the use of the Kodály pedagogical approach (KPA) on teacher trainees' performance (TTP) in basic music skills. The teacher trainees were first asked to indicate to what extent they experienced the use of KPA. It was found that the teacher trainees, to a very large extent, experienced the use of KPA in the clapping of rhythmic patterns, as confirmed by 88.6 per cent. Composing own rhythms 71.52 per cent, chanting rhythms 65.82 per cent, singing back melodic

patterns 55.7 per cent and playing simple accompaniment on pitched and non-pitched musical instruments, as indicated by 52.26 per cent. From these findings, there is a clear indicator that there was teacher trainees' greater experience of KPA in music lessons. A one-way analysis of variance (ANOVA) was used to test the effect of the use of KPA on TTP in basic music skills. It revealed that there was a significant difference in the control and experimental groups' performance. The data suggest that teacher trainees taught by KPA performed better in music examinations than those taught by conventional approaches. Hence, there was a positive effect of the use of KPA on teacher trainees' performance in basic music skills.

A post hoc test using the Fisher Pairwise Comparisons of means revealed the study notes a significant difference in the mean performance of the groups. The mean performance of experimental post-test mean scores (44.810 means) showed significant growth over the mean performance of control post-test mean scores (40.67 mean). This could be due to the emphasis on the planning, preparation and use of KPA during the treatment period, where a high level of methodological control within the lesson was possible. The research findings also revealed that KPA is practical in nature and needs more time. The Kenya Institute of Curriculum Development (KICD) could provide more time in the primary teacher education music curriculum for the use of the KPA in the current curriculum reform. In addition, it was noted that in the primary teacher education music curriculum, the practical aspect of music is not tested, and teacher trainees' do not appreciate what is not tested internally (Mock exams) or nationally (PTE music examination). Therefore, the Kenya National Examination Council (KNEC) evaluation and grading system for the PTE music examination should not only

receive marks for teacher trainees' theoretical knowledge but also their practical skills.

CONCLUSIONS AND RECOMMENDATION

Conclusions: The study established that Kodály's pedagogical approach has a great impact on teacher trainees' academic performance. Research studies by Tabuena, 2020; Moralista; 2016; Sheridan, 2015 and Lori, 2012 observed that the use of the Kodály pedagogical approach has a positive influence on students' academic achievement, creativity and self-esteem. This finding is similar to the responses from the music tutors and teacher trainees who studied music at the time of the research, and the analysis showed that the Kodály pedagogical approach greatly improves the teacher trainees' academic achievement. These results greatly prove that Kodály's pedagogical approach (KPA) promotes teacher trainees' participation and builds the required level of reasoning among the teacher trainees. The KPA is effective in the improvements and achievements of teacher trainees' performance in basic music skills and academics. It should be noted that KPA assists music tutors in planning more and talk less, and trainees learn more while interacting in-group activities.

Another important finding was that KPA is a practical-oriented approach that motivates the teacher trainees in a music lesson and needs more time in the primary teacher education (PTE) music curriculum. The sentiments shared by the music tutors are that more time should be given to music lessons since they are various skills that need to be taught. Obeng and Osei-Senyah (2018) indicated limited time as one of the major challenges teachers of music encounter when teaching music in selected schools in the Ashanti region of Ghana. The finding of this study concerning time allocation agrees with the findings of a study by Akuno (2005) that established that music teaching is not given priority because of the time factor. More

time should be given to basic music skills development because the teaching of music skills is usually done in a gradual manner, and many musical aspects are interconnected. The conclusion is that music teaching and learning should be given more time in the primary teacher education (PTE) music curriculum.

Further, the study revealed that in the PTE music curriculum, the practical aspect of music is not tested, and teacher trainees do not appreciate what is not tested nationally (PTE music examinations) and internally (Mock, tests and quizzes). A research study by Jacksova (2015) notes that a lack of assessment of practical music results in the complete stagnation of musical growth. All music tutors agreed that the unexamined part of music is practical. When music examination focuses only on knowledge, it influences the acquisition of the required skills hence working against the goal of education, which is to produce an all-round individual who can fit in the society (Gantan et al., 2015). The implication is that teacher trainees are taught content that is predicted to be examined, and music tutors prefer pedagogical approaches that help in passing the examination compared to other pedagogical approaches required by education goals. The study concludes that the practical aspect of music in the PTE music curriculum should also be examined because Kenyan education is examination-based, and examination is used as a way of improving college pass rates.

Recommendation: The study recommends more planning and preparation on the use of KPA by music tutors for continual improvement in music development in teacher training colleges. Aspects of KPA should be polished from time to time; for instance, music tutors' re-training should be ongoing. This will go a long way in not only enhancing teacher trainees' music performance but also boosting their academic achievement and graduation rates.

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Figure 13. Okeyo, Shithandi and Kanake (2020)

RELATIONSHIP BETWEEN THE USE OF KODALY APPROACH OF TEACHING MUSIC AND PRIMARY TEACHER TRAINEES' PERFORMANCE IN MUSIC EXAMINATION IN NANDI COUNTY, KENYA

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ABSTRACT: Music education is a field of study associated with the teaching and learning of music. Music teachers should apply appropriate pedagogical approaches that best suit specific level outcomes. Over the years, practitioners and educationists have noted a decline in teacher trainees' performance in music at primary teacher education level. There is little indication on whether the use of music-based pedagogical approaches relate to the teacher trainees' performance in music examination in teacher training colleges. The current study is prompted by the need for pedagogical approaches that would help in raising efficiency in teaching music. The purpose of this study therefore is to establish the relationship between the use of Kodaly approach and teacher trainees' performance in music examination in Nandi County, Kenya. The study adopted quasi experimental research design and was conducted in Nandi County, Kenya. Selected experimental group was exposed to the Kodaly approach while control group continued with the traditional approaches used by the tutors. Purposive and census sampling was used to draw participating tutors teaching music and teacher trainees studying music in year two. A sample of 3 tutors teaching music and 167 teacher trainees studying music in year two participated in the study. Data was collected and generated through questionnaires, interviews and pre-test and post-test. This served as an opportunity to check and triangulate the observation data. Findings indicated that the use of Kodaly approach relates to the teacher trainees' performance in music examination and has beneficial effects on teacher trainees' learning outcomes which include cognitive and non-cognitive skills. Improvements on melodic and rhythmic elements were apparent. The study also found out that the Kodaly approach tested in this study is an effective tool to aid in the teacher trainees' music performance. The findings will sensitize the policy makers and educational planners plan for relevant, efficient and effective music pedagogical approaches. The findings will also help music teachers adopt music pedagogical approaches that will gear towards equipping teacher trainees' with musicianship skills.

KEY WORDS: Kodaly approach, music education, music pedagogy, Primary teacher education

I. INTRODUCTION

Music is a significant tool of education in terms of gaining certain behavior to students within the education system in a constructive way. The opportunity of music as an education tool has paved the way for its being in the teaching program as an important field of education (Moralista 2016). Most of the music teachers suffer from poor conditions and inadequacies of curriculum, course books and the songs in them, instructional approaches and excessive theoretical information (Emel & Ilkrun, 2018).

Kodaly approach is regarded as an approach providing music education with efficient opportunities and enables effective proceeding of music education with teaching methods it involves (Breen, 2011). According to Breen (2011), the philosophy of Kodaly enabled the development of pedagogy where the music teaching elements are gathered under one method. Hence, it is possible to offer students several instructions within one experience. In Kodaly approach, the application is prior to the theoretical knowledge. Within this, the scope of music education and sound characteristics can be analyzed (Emel & Ilkrun, 2018).

The Kodaly approach was advocated by a Hungarian known as Zoltan Kodaly (1882-1967). He advocated for the use of folk music in teaching music in schools. He believed that folk music of a people contains all the basic characteristics needed to teach the foundations of music. This is in line with Gault (2013) who observes that the use of folk music leads to learners reconnecting and associating with the music learned

within their environment. The choice of folk songs as proposed by Kodaly encourages the learner to identify with the music of his/her people (Gault, 2013).

According to Blom, Diana and Poole (2015) Kodaly music teaching approach uses the folk music repertoire in the classroom for students to learn what music is. The use of folk songs as classroom activities in a music class enhance students overall academic achievement (Blom, Diana & Poole, 2015). Kodaly approach was useful to the current study when it comes to the aspect of the use of folk music in teaching music in primary teacher training college as the songs used are familiar to trainees and will enable them to experience the melodic and rhythmic concepts that are taught.

The Kodaly approach is characterized by the use of singing as the primary vehicle for music participation, folk music as the initial repertoire and musicianship as the goal for all children (Benson, 2016). Ann and Tillman (2015) posit that music activities such as singing, composing, rhythmic patterns, playing instruments have a dramatic effect on reading and literacy. Lowe (2011) in the article 'Class Music Learning Activities' highlights that learning activities such as singing folk songs are described by students as being more relevant to them when they have the opportunity to engage practically with topics. Lowe (2011) further observes that the value students attach to any subject is enhanced through active participation in a classroom setting hence improvement in the academic performance. However, Kenyan music tutors tend to be more teacher centered than learner centered which denies the teacher trainees an opportunity to work with various musical sounds that would lead to a wholesome musical experience.

The Kodaly approach incorporates moveable-doh, solfa-hand signs and rhythmic syllables (Hanson, 2003). The tonic sol-fa approach is where the moveable 'doh' system applies. The 'doh' is the home tone in major scales while 'lah' is the home tone in minor scales; a series of hand signs showing different pitches in the scale. This helps the listener hear patterns, intervals, phrases and form; and a system of rhythm duration symbols used to emphasize the concept of time in music.

Tonic Sol-fa System

Sol-fa syllables have long been used in music education. Tonic sol-fa is a system of notation that uses sol-fa syllables (Dilek, 2012). It is a holistic approach to music education through singing. It builds a comparative relationship between the tonic and other degrees of the scales which assists in pitch discrimination in music (Sarrazin, 2016). The sol-fa syllables represent seven different pitches of the diatonic scale. They are written using the first letter of the syllable:

d=doh is the key note of the tonic

r=ray the supertonic which is a major second above the tonic

m=me the mediant, a major third above the tonic

f=fah the subdominant, a perfect fourth above the tonic

s=soh the dominant, perfect fifth above the tonic

l=lah the submediant, a major sixth above the tonic

t=te the leading note, a major seventh above the tonic.

The moveable 'doh' system in which 'doh' is the home tone in major scales and 'lah' in minor scales is to be used. Movable 'doh' is a system where every note of a scale is given its own unique syllable, which is used to sing that note every time it appears (Dilek, 2012). For example, C is 'doh' in C major; D is 'doh' for D major. In F major scale, the seven notes include F G A B^b C D and E (often continuing on to F an octave above the first 'doh'). If we sing the scale of F major on sol-fa, the F would always be sung as 'doh', G would be sung as *ray* and so on. The whole scale looks like this on sol-fa

Example 1: Movable 'doh' for F major

F G A B^b C D E
doh ray me fah soh lah te

Example 2: Movable 'doh' for E minor

In minor scales 'lah' is considered as the tonal center. For example in E minor the notes are E F^b G A B C D and D (often continuing on to E an octave above the first 'lah').

Example 2: Movable 'doh' for E minor

E F^b G A B C D
lah, te, doh ray me fah soh

Hand signs

Hand signs are physical gestures that represent sol-fa. Hand signs were introduced by John Curwen in 1870. They are useful for reinforcing intervallic feeling (Dilek, 2012). It is a method where each syllable is represented with a particular hand sign (Benson, 2016). The use of hand signs presents visualization in space of the high-low relationship among the notes being sung (Lihan, 2018). Each hand sign represents a particular sol-

fa syllable. The signs are made in front of the body and the distance between the hand signs to some extent reflects the size of the interval to be sung. Octaves are shown by the same sign with the lower 'doh' sign occurring at the waist level and the higher 'doh' above the eye level. The sign for the half steps fa points down to me while 'le' points up to 'doh' thus emphasizing the smallness of these half steps.

Hand signs were created by John Curwen as a way of showing the tones. Kodaly borrowed the hand signs and emphasized their use in music education. Benson (2016) affirms that Kodaly also used Curwen hand signs to represent each pitch in the scale. In the use of Hand signs, music teachers can use only one hand for pitch or both hands to show two different pitches. The music teacher can also present chord changes by use of hand signs. The use of hand signs will help to visualize the distance between the pitches and enable the teacher trainee to match pitches given the right sound.

II. RHYTHM DURATION SYMBOLS

Rhythm duration syllables are a system where each rhythmic pattern is represented with different syllables and counted verbally using mnemonic sounds (Dilek, 2012). The rhythm names have been used in Kodaly approach to make students understand the concept of time in music. The students clap/tap rhythmic patterns while saying the names representing individual beats in the pattern. The counting of rhythm is done using French rhythm names.

In this method, Kodaly trained teachers to begin by teaching one beat which is the quarter note and later notes of longer and shorter duration are incorporated. All quarter notes are counted as 'taa', all eighth notes counted as 'ta' while two eighth notes would be counted as 'ta-te'. Half notes counted as 'taa-aa' and whole notes as 'taa-aa-aa'. However grouping of four sixteenth notes is counted as 'ta-fa-te-fe'.

For example;

Duration	French rhythm names
One beat (quarter note)	taa
Two half beats (eighth notes)	ta-te
Four quarter beats (sixteenth notes)	ta-fa-te-fe

Kodaly also uses rhythmic and melodic patterns that are encountered in songs and later in visual form. The rhythmic names are used to represent the length or duration of a note or rhythmic pattern. The rhythmic system of mnemonic syllables is considered an efficient means in learning rhythmic values and their relationships in a pattern. The chanting of ta-fa-te-fe is used by students of every level for mastering difficult rhythms. The review highlighted the key features and uses of Kodaly approach which mainly aims at promoting creativity among teacher trainees when they create their own music.

According to Gault (2013) Kodaly- based approach to teaching music utilizes a clear sequence of musical concepts that are presented based on when they appear in the repertoire used during instruction. Abril and Gault (2016) note that educators using Kodaly approach provide music instruction that is child centered and in a logical and sequential process. Hence the approach is experiential, meaning that students participate in musical experiences and then use the experiences to develop a conceptual understanding.

Studies regarding the use of Kodaly approach show that there is a significant relationship between the approach and students' academic performance. A study by Moralista (2016) on 'factors affecting music education in Philippines confirmed that the use of Kodaly approach has a positive influence on students' academic performance. According to Laczó (1985) cited in Smuta (2017) Kodaly based music instruction improve spatial recognition (reasoning skills) and non spatial abilities (general intelligence) though not significant. However, Hurwitz (1975) cited in Hanson (2003) observed that Kodaly music instruction produced significant effect ($p=.05$) on students' spatial recognition and non spatial abilities using Raven's Progressive Matrices.

A study by Barker (2016) on adaptation of the Kodaly in USA found out that there was improvement and achievements of the students who were preparing for final external academic examinations. Sheridan (2015) observed that Kodaly approach to music teaching and learning provide music teachers with methodological techniques that can be applied in the classroom to build learners' music literacy and understanding hence increase in auditory and improvement in academic performance. A study by Lori (2012) in Canada found out that Kodaly based music instruction can result in increased academic achievement, creativity and self-esteem. These findings suggest that the use of Kodaly approach improves not only students' musical growth and maturity but also their academic performance.

III. FINDINGS OF THE STUDY

The study sought to establish whether there was statistically significant relationship between the use of Kodaly approach and teacher trainees' performance in music examinations in Kenya.

Respondents were requested to rate the extent of which they experienced the use of Kodaly approach in music lessons. The information was analyzed by determining the mean and standard deviation on eight items on a 5-point Likert scale where: To a Very Large Extent=5; To a Large Extent=4; To Moderate Extent=3; To a Small Extent=2; To a No Extent at All=1. The ranges of mean scores were interpreted as follows: To a Very Large Extent=4.2 – 5.0; To a Large Extent=3.4 – 4.2; To Moderate Extent=2.6 – 3.4; To a Small Extent=1.8-2.6; To a No Extent at All=1.0 – 1.8. The results of the analysis are presented in Table 1.

Table 1: Extent of Teacher Trainees' Experience the use of Kodaly Approach

Kodaly Approach	N	Minimum	Maximum	Mean	Std. Deviation
Clapped rhythmic patterns	167	1.00	5.00	4.5689	.68967
Chanting the rhythms using French	167	1.00	5.00	4.5689	.68967
Sang back melodic patterns before	167	1.00	5.00	4.1737	.61096
Participated in composing melodies	167	1.00	5.00	4.5689	.68967
Participated in composing rhythms	167	1.00	5.00	2.7665	.56978
Practiced folk songs in a music lesson	167	1.00	5.00	4.5629	.69025
Sang melodic phrases using hand signs	167	1.00	5.00	2.7844	.58206
Played simple accompaniments on pitched	167	1.00	5.00	4.5928	.63203
Overall mean	167	1.00	5.00	4.07125	.64375

Key N=Sample size

The results in Table 1 show that the overall mean of all the respondents was 4.07 out of the maximum mean score of 5 points. This suggests that teacher trainees' experienced the use of Kodaly approach to a large extent. Teacher trainees' to a very large extent experienced Kodaly approach in the clapping rhythmic patterns, chanting rhythms, composing own melodies, practicing folk songs and playing simple accompaniment on pitched and non-pitched musical instruments as indicated by the mean of 4.56 and 4.59 respectively. This finding corresponds with those of Wenona (2015) who found out that students understanding in rhythmic and melodic elements and singing improved remarkably. The Kodaly approach to learning music enhances deeper learning and greater engagement (Wenona, 2015). It was further established that teacher trainees to a moderate extent experienced Kodaly approach in composing own rhythms and using hand signs as it is depicted by the item mean of 2.76 and 2.78 respectively. These results suggest that there was teacher trainees' greater experience of Kodaly approach in music lessons which relates to their learning outcomes that is performance in music examinations in Kenya.

Similar findings were obtained from the interviews with the college music tutors who indicated that they had knowledge and experience in the use of Kodaly approach. Music tutors descriptions are given in Excerpt 1.

Excerpt 1

Researcher: To what extent do you use Kodaly approach in teaching music?
 Respondent 1: To a very large extent
 Respondent 3: To a large extent
 Researcher: What do you think about the use of Kodaly approach in teaching music?
 Respondent 1: The Kodaly approach is practical oriented and motivates the teacher trainees
 Respondent 3: Kodaly approach is sequential and develops a good rapport with the trainees
 Researcher: Which are your favorite approaches that enable teacher trainees to get most music concepts? Why are they favorable
 Respondent 2: Kodaly approach. Because it is the most sequential and orderly of all the approaches (Orff and Dalcroze). Also, it is interactive and its tenets of learning are multisensory
 Respondent 1: Kodaly approach. The fact that it is based on the theories of child development makes it very effective in providing a solid music foundation

The findings from the music tutors reinforce the experience of use of Kodaly approach. The music tutors were of the view that Kodaly approach is practical in nature and Kenya Institute of Curriculum Development (KICD) could provide more time in the music curriculum for the use of the Kodaly approach in the current curriculum reform. This is supported by Goopy (2013) who noted that increased time allocation to Kodaly based music instruction in a music program enhances academic results significantly. They further argued that in primary teacher education music curriculum, the practical aspect of music is not tested and teacher trainees' do not appreciate what is not tested nationally (PTE music examinations).

The music tutors reported that, it was through the experience of Kodaly approach that the teacher trainees acquire music skills and show good academic performance. The findings of the study confirm what Barker had found in his study on the adaptation of the Kodaly approach in USA where there was improvement and achievements of the students who were preparing for final external academic examinations (Barker, 2016). This finding is also in support of a study in China by Luban (2015) who found out that the students who received Kodaly instruction showed statistically significant gain in music theory performance.

According to the college music tutors, Kodaly approach is the most sequential and orderly approach of teaching and learning music. This is consistent with Gordon's theory of Music Learning as reported by Valerio (n.d) who posits that the key component to Gordon's approach to music learning is the idea and the role of instructional sequencing. The finding is in support of Smuta (2017) who observed that Kodaly approach embodies a sequential process by which a culture's folk songs and active, authentic singing games are implemented to rhythm, melody, harmony in addition to the skills of singing, listening, moving, reading and writing notation. Sequence accounts systematically for the readiness needed to learn each new musical skill. This sequential process teaches the music educator to introduce more abstract concepts and skills gradually, through sequential learning.

In addition to the teacher trainees' questionnaire and the music tutors interview, Pearson correlation coefficient was carried out to determine the relationship between the use of Kodaly approach and teacher trainees' performance in music examinations in Kenya. The result of the correlation analysis revealed that use of Kodaly approach was significantly related to teacher trainees' performance in music examinations. This raises a fundamental question as to why the teacher trainees' are not performing in music examinations especially the national examination (PTE music examination).

The results of the pre test and post test were interpreted in the light of literature reviewed and the theory used in this study. From the results of the experiment it was observed that there is a difference in achievement between the experimental and control groups. The experimental group performed better than the control group. However, the post test mean score for both groups was higher than the pre-test mean score. The effect size index calculated indicated that Kodaly teaching approach had a positive impact on teacher trainees' music performance. A possible explanation for effectiveness of the Kodaly approach was the teacher trainees' active involvement in the learning process coupled with systematic music instruction.

IV. CONCLUSION

The study has established that teacher trainees' experienced the use of Kodaly approach to a large extent. With a correlation coefficient (r) of 0.97, it is apparent that there is a strong relationship between the use of Kodaly approach and teacher trainees' performance in music examinations. In this case, regardless of music based pedagogical approaches used, the Kodaly approach is a strong predictor to teacher trainees' performance in music examinations. Teacher trainees' believed that experiencing Kodaly approach improves ones academic potential to undertake the music examination. It was also established that majority of the college music tutors had a positive attitude towards the use of Kodaly approach.

V. RECOMMENDATIONS AND FURTHER RESEARCH

Based on the findings of the study, the following recommendations are made:
 Extend the instruction treatment period beyond 4 weeks to possibly 12 weeks to determine if successive instruction would enhance teacher trainees' performance in music examination.
 Use a larger sample of teacher trainees' from different primary teacher training colleges in Kenya to improve generalization of results.
 There are advances in music technology involving E-learning and college music tutors would benefit from new information being developed.
 Further research on the use of computer technology in teaching music skills at the teacher training college level should be carried out to explore this rich resource.

Figure 14. Reifinger (2020)

Teaching Pitch Notation–Reading Skills

James L. Reifinger Jr.¹ 

Abstract

The teaching of music-reading skills has been cited as a neglected area of music education needing improvement. Music reading is the process of translating notation into sounds. Producing the notated sounds by singing, more specifically referred to as sight-singing, is especially demanding because it requires the individual to first mentally construct aural images of the sounds, an essential process that is challenging to teach and assess. This article describes a series of activities for teaching music-reading skills in general music or choir, focusing mainly on reading and singing pitch notation, though many of the ideas could also be used to teach rhythm reading. The activities are sequential, are easy to implement, and allow for the assessment of skill acquisition at various stages of development.

Keywords

audiation, literacy, notation, pitch, reading, sight-singing

The importance placed on teaching music notation–reading skills has varied historically and continues to be debated by the music education profession. Music notation is not incorporated in many music cultures or modes of music making around the world, and notation reading is generally associated with the Western classical music tradition. Even the meaning of the term *music literacy* is sometimes debated among music educators. Gault (2016) suggested that the association of music literacy with notational literacy resulted from the influence of Kodály, who believed that one of the goals of music education was to create a musically literate public. The National Core Music Standards define music literacy as “knowledge and understanding required to participate authentically in the discipline of music by independently carrying out the artistic processes of creating, performing, and responding” (National Coalition for Core Arts Standards, 2014, p. 7). Mills and McPherson (2016) pointed out that learning to read staff notation would be just one dimension of music literacy and that conventional staff notation is only one type of music notation.

Nevertheless, there are circumstances in which notation–reading skills are consequential, and music educators should have competency in teaching these skills. It seems that not enough emphasis is being placed on learning to read music, as the teaching of music-reading skills has been cited as an important but neglected area of music education in need of improvement (Asmus, 2004; Demorest, 2004; Gudmundsdóttir, 2010; Mills & McPherson, 2016). Brinson and Demorest (2014) suggested that a great number of music teachers may feel unprepared or unqualified to teach sight-singing. Published resources that specifically address the teaching

of music-reading skills are available (Choksy, 1999; Feierabend, 2001; Gordon, 1997; Houlahan & Tacka, 2015), but some music teachers who are unfamiliar with these resources may initially find them to be too extensive as a starting point for designing a sequence of music-reading activities. To address this situation, the information in this article focuses on a sequence of simple activities that music teachers can use to teach and assess music-reading skills.

Music reading is the process of translating the symbols of music notation into the sounds they represent. Music reading is not simply the process of identifying letter names of notes and the number of beats each note receives, tasks that do not require or engage any musical ability. Findings from research indicate that when performing the skill of music reading, the decoding of pitch information and of rhythmic information are separate processes that are then integrated during performance (for a review, see Gudmundsdóttir, 2010). Likewise, music teachers who teach music-reading skills often initially teach pitch reading and rhythm reading separately (Choksy, 1999; Gordon, 1997; Houlahan & Tacka, 2015). Music-reading skills are often taught and assessed using a sight-reading task, meaning the student is reading and playing music notation that he or she has not previously seen. For some instrumentalists, pitch notation can be perceived simply as an

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indication of what key to push, and the player does not necessarily have to mentally process the sounds of the pitch relationships. In this scenario, students may not be mentally linking the actual sounds of the pitch relationships to the corresponding visual notation; therefore, they may not be able to translate notated pitches into the sounds they represent without an instrument to do it for them.

The term *sight-singing* is sometimes thought of as a version of a sight-reading task in which the performer is translating the notation that he or she has not previously seen into sounds by singing. However, translating notated pitches into sounds by singing is an especially complex process because it requires the individual to first mentally construct aural images of the sounds and then produce them, all without the aid of a mechanical pitch source. Because the process of singing notation without the aid of an instrument can be particularly challenging, the term *sight-singing* is often applied in broader terms than *sight-reading*. Singers may have seen and practiced singing the notated music previously, but they are usually considered to be sight-singing when they are relying on the notation to guide the mental construction of auditory imagery and vocal production rather than singing by just recalling a long-term memory of the sound of the music.

Theories of how we learn may help to explain how music-reading ability develops and can provide some insight into how to teach music reading. Seminal educational theory by psychologist Jerome Bruner (1966) proposed that cognitive development progresses through three stages involving different modes of representation. The first stage of representation is the enactive mode, when the individual learns by interacting in the environment and demonstrates understanding through physical action. The second stage in Bruner's theory is the iconic mode, when the individual is able to use icons such as pictures or figures to visually represent those concepts that have been experienced and internalized during the enactive stage. The third stage is the symbolic mode, when the individual can represent the concepts with more abstract code, such as written language.

Examples of these stages can be illustrated with learning activities in music. When learning about pitch, students at the enactive stage would use their voice and body to aurally, orally, and kinesthetically learn concepts such as high and low or ascending and descending. Likewise, when learning about rhythm, students would use aural, oral, and kinesthetic modes to experience concepts such as long and short sounds, varying number of sounds on one beat, or one sound lasting longer than one beat. These enactive representations of concepts are action based. At the iconic stage, students would represent the previously experienced pitch and rhythm concepts in visual form. They might use pictures or lines positioned high and low to represent pitches, or made long and short to represent

rhythms. These icons are visual representations of concepts that have been internalized in the enactive stage. At the symbolic stage, students would represent pitch and rhythm concepts with more abstract and precise symbols. Symbolic representation uses the symbols of language or, in the case of music, music notation.

Gordon (1997) formulated a theory of how conceptual understanding develops when we learn music. Considering patterns to be the smallest units of meaning in music, he advocated the use of tonal and rhythm patterns as a means of building music understanding. He emphasized that students need to build their capacity to audiate music—to hear musical sounds in the mind and understand the relationships of the sounds. This is similar to what many teachers refer to as inner hearing, but Gordon argued that when individuals are inner hearing as opposed to audiating, they are not necessarily giving the sounds musical meaning, such as placing sounds within a harmonic context. The ability to formulate mental representations of sounds while reading notation without the sounds being physically heard is an essential skill when reading music. This skill was referred to by Gordon as *notational audiation*.

Gordon's (1997) music learning theory consists of several levels of learning and outlines what students need to know at a particular level in order to progress to the next level. At the first level of skill learning, the aural/oral level, students learn to recognize a pattern by hearing it over and over again, and they imitate what is heard by singing or chanting. At the verbal association level, students learn to associate the appropriate tonal or rhythm syllables to the notes in patterns. At the partial synthesis level, students should be using tonal and rhythm syllables unconsciously while they audiate. The teacher is directed to use a neutral syllable when performing patterns so that students are required to determine syllable names on their own through the process of audiation. At the symbolic association level students learn to read and write patterns. This is just a brief summary of Gordon's extensive music learning theory.

Activities for teaching music-reading skills that are presented here are congruent with these learning theories. They focus specifically on teaching pitch-reading skills, though many of the ideas presented can also be used when teaching rhythm reading. Tonal patterns are used initially, and similar to a Kodály teaching approach, solmization syllables and Curwen hand signs are incorporated as mnemonic aids to help teach and reinforce pitch concepts (Chokey, 1999; Houlahan & Tacka, 2015). In a review of research, Frey-Clark (2017) concluded that hand signs neither helped nor hindered the development of vocal music literacy, but their use as a pedagogical tool provided unique pragmatic benefits. In addition to adding visual and kinesthetic modes to the aural mode for the

learner, hand signs allow teachers to communicate pitch information without singing and provide a means for teachers to assess the students' understanding instantly with a quick visual scan (Reifinger, 2013).

These activities for teaching pitch-reading skills can be used in a group setting such as a general music class or a choral ensemble. They would comprise only a brief portion of a class period or rehearsal on a given day but should be incorporated into the lesson or rehearsal on a regular basis to allow students to develop their skills. They can be used with any age-group, though students who are not developmentally ready will not be able to progress from one level to the next. In a general music setting, the activities should be supplemented with engaging reinforcing activities such as singing songs, playing classroom instruments, moving, and playing singing games, using music material that includes the target pitches.

To guide students in developing the ability to sight-sing pitches accurately, learning has been divided into stages. At each stage students need to develop competency with certain skills that are helpful and sometimes requisite for the building of skills at the next stage. At the first stage, students need to develop singing accuracy. The second stage involves learning to aurally identify pitches by applying the correct moveable *do* solfège syllables. The third stage involves ensuring that students are able to formulate mental representations of the pitch sounds that can be imagined without the sounds being physically present. In the fourth stage, the students develop initial skill in sight-singing by reading icons. In the fifth stage, the students learn to sight-sing with standard music notation. While there may be some overlap, these stages would generally develop sequentially.

Singing Accuracy

The first stage in teaching students to sight-sing is to ensure that they are singing the targeted pitch relationships accurately. At this stage the students can also begin learning to associate the solfège syllables to the pitch relationships, as long as they are hearing accurate intervals. The teacher leads students in singing tonal patterns that use a limited set of pitches. For example, initially only the pitches of *so*, *mi*, and *la* could be used, or *do*, *re*, and *mi*. To avoid possible tonal memory issues, the patterns should be short. Four notes works well, especially when working with a limited number of pitches. Gordon (1997) recommended that tonal patterns consist of at least two, but never more than five, pitches. To focus exclusively on pitch, each pitch in the pattern should be performed with the same duration (without changing rhythmic values). It is not necessary to establish or sense an underlying pulse. Patterns can be presented in order

from easiest to more difficult. For example, if the pitches being used are *so*, *mi*, and *la*, several patterns with just *so* and *mi* can be presented first. When *la* is added, patterns starting on *so* will be easier than patterns starting on *mi* or *la*. The wide skip of *la* to *mi* will be more difficult than the smaller, more familiar interval.

At the initial stage, the teacher sings the patterns slowly using solfège while simultaneously showing the Curwen hand sign with one hand. While this happens the students listen and watch. Gordon (1997) suggested that the teacher pause for a few seconds after singing, before cueing the students to respond. This allows time for the students to audiate the pitches. The teacher then leads the students in echoing the pattern by showing the hand signs with the other hand. While the students are singing, the teacher should not sing but should listen for accuracy. The students should use hand signs as they sing their response, thereby engaging kinesthetic movement that reinforces the audiation. Any patterns that are sung inaccurately can be repeated. When the students are comfortable using the hand signs, the teacher should cue the response but not repeat the hand signs for the students as they respond. This will help ensure that students are working on developing tonal memory rather than just relying on the teacher's second presentation of the hand signs.

I refer to this type of activity as "hand-singing." Hand-singing can be used at or near the beginning of class and can be an effective routine to focus the students' minds and ears and warm up their voices. Students I have worked with have enjoyed this type of drill, but the activity should be limited to only a few minutes so as not to become tedious.

A variation of hand-singing at this stage is to sing the various intervals harmonically. While showing a hand sign with one hand (the right hand for example), tell the students that this is my part, then show the same hand sign with the other hand (left hand) and tell the students that this is their part. The teacher sings a pitch with solfège and shows the corresponding hand sign with the right hand. While sustaining the pitch, the teacher cues the class to sing the same pitch by showing the hand sign with the left hand. The students are led in sustaining the pitch with the left hand while the teacher moves to a different pitch and shows the new hand sign with the right hand. While the teacher is sustaining the pitch, the students are cued to move to that same pitch by showing the hand sign with the left hand. With this canon-like procedure, one part should always sustain while the other part moves. All the various intervals can be sung harmonically this way so that the students can hear and become increasingly familiar with the tonal context. When the students develop some proficiency, the class can be divided into two groups with each group following one

of the teacher's hands rather than having the teacher sing one of the parts.

When the students are proficient at echoing the patterns accurately, they can practice as a group singing the pitches indicated by the hand signs in real time, without an initial teacher model. This is a more difficult task because the students have to be able to produce the correct pitch rather than just imitating what was heard. The pitches, indicated with hand signs, are sung in a continuous flow of longer notes. The students will need to be taught to use staggered breathing for this activity. The teacher can sing the starting pitch, and then should not continue to sing with the students but rather listen for accuracy and provide help only if needed. After the students become familiar with the activity over the course of a few classes, the teacher can start the activity, and then select a student leader to come forward. The student-led segment can be started with the teacher giving the class the starting pitch if needed; the student leader does not need to sing with the class. In my experiences, student leaders usually lead only a few notes and then they are ready to choose a new student leader. Having two or three different students take a turn as the leader is usually about the right length of time for the activity. One disadvantage to having student-led hand-singing is that the desired variety of intervals based on difficulty might not be covered. The goal of the activities at this stage is to have the students learn how to accurately sing all of the intervallic relationships that are possible with the set of pitches and to build a mental association between the pitch relationships and the solfège.

Aural Identification

After the students have had a sufficient number of practice sessions echo-singing the patterns based on the set of pitches, the next step is for the teacher to be sure that the students are able to aurally identify the pitches they hear. To do this the teacher presents a tonal pattern by singing the pitches on a neutral syllable such as *loo* or *buh* without using the hand signs. When cued, the students echo the pattern but use solfège and hand signs. If a little extra help is needed, the teacher can initially show the hand sign while singing the pattern on a neutral syllable. However, the goal at this stage is for students to develop the ability to identify the pitches that they are hearing. If the teacher shows the hand sign, the students are being given the answer and are not being required to use their ears to give them the answer. They need to demonstrate their ability to identify pitches by singing and signing the correct solfège without it being given to them. To start the activity the teacher can help the students think about the solfège-pitch connections by having the students echo patterns presented with solfège and hand signs and then

repeating a very similar set of patterns using only the neutral syllable. As students become more proficient in the next few practice sessions, the teacher can reduce the number of patterns initially sung with solfège and can start adding in some more difficult patterns. Students can also be assessed on their ability to identify pitches with short dictation exercises in which they write down the solfège syllable of a pattern or a short melody that is being played or sung with a neutral syllable.

Formulating Aural Images of Pitches

The students need to be able to formulate a mental image of the sounds without the sounds being presented to them. Being able to "internally hear" sounds that are not physically present is an essential prerequisite skill that will later allow the student to see notated pitches and then produce them by singing. To ensure that this skill is developing, first lead the class in echo singing some tonal patterns as before, with one hand showing the teacher's part and the other hand showing the students' part. After a few practice patterns, tell the students that you will show your part with the hand signs but will not sing it this time; they will need to sing the teacher's part silently in their head while reading the hand signs to be able to sing their part. It is usually possible for the teacher to surmise which students are "hearing" the patterns internally and which students are not. While we can not be sure what student are or are not thinking, leading the pattern singing without first presenting the sounds is one way to nudge the students to develop and practice using auditory imagery. The teacher can assess the class as a whole or individual students with this activity to determine if they are ready to move to the next stage. It would seem that if students cannot produce the pitches when shown hand signs, they will not be able to produce the pitches when shown written music.

Iconic Notation Reading

Because the interpretation of standard music notation will initially be challenging, students can first learn to read and sight-sing by using iconic notation. An accessible set of icons to use when representing pitches is solfège letters. Because solfège letters are familiar and easy to read, students are not encumbered with the task of interpreting the visual in terms of the placement of note heads between lines and spaces within a staff. They can concentrate on developing the skill of thinking the sound and then producing the correct pitch that is indicated by the icon. At this stage, students are ready to read and sing short melodies. A great resource for melodies is *185 Union Pentatonic Exercises* by Denise Bacon (1978). The melodies are ordered by tone set, which can also serve as a

Figure 1. Examples of sight-singing exercises.

Note. From *185 Unison Pentatonic Exercises* by Denise Bacon from the first half of the book (A and C) and the second half of the book (B and D). Exercise 18 is from the *lm* section; exercise 50 is from the *mr*d section. Used with kind permission of The Kodály Institute at Capital University.

suggested sequence for the introduction of pitches. The book is divided into two parts with the first half of the book showing the melodies written with solfège letters and stick notation and the second half of the book showing those same melodies written in staff notation. The staff notation is written in a variety of keys so students will learn to read in moveable *do*. Figure 1 provides examples of the melodies in the section from the first half of the book (A and C) and the second half of the book (B and D). While the melodies in this resource are comprised of both pitches and rhythms, the rhythms are fairly simple. The inclusion of rhythmic variation contributes to making the exercises more aesthetically pleasing than tonal patterns. Rhythm-reading practice has likely been part of additional activities that have been occurring in class, so students should not experience a great deal of difficulty with the rhythm. The teacher can have the students chant the rhythm of a melody with rhythm syllables as a separate preliminary step if necessary.

Notation Reading

If the students have learned the skills addressed at the previous levels, such as aurally identifying pitches and formulating aural images, the process of singing while reading standard notation is not a momentous step. At this stage the students should be simply reading what they can already hear and understand internally. After initially using just the iconic notation for a couple of classes, the students can try reading and singing one or a few melodies

with the iconic notation and then singing the same melodies using the standard notation within the same lesson. To facilitate the transfer it is helpful for the students to sing the iconic notation in the same key that will be used with the staff notation.

Before the students sing using the staff notation, be sure they can visually spot and interpret the differences between the notated pitches. The students can be given some "rules" for interpreting the visual information presented by the notation. Visual relationships can be pointed out and expressed in the simplest of terms such as one of the following:

If *so* is on a line (or space), *mi* is on the line (space) below it.

So and *fa* are always different; if *so* is a line, *fa* is the space above it.

If *mi* is on a line, *do* is on the line below it.

Do and *re* are always different; if *do* is a space, *re* is the line above it.

This explanation on how to interpret the visual should be immediately followed by having the students interpret the visual. Some teachers may want their students to first speak the solfège syllable while reading the staff notation, and then sing it, while others may prefer to always sing when using solfège. Speaking rather than singing the solfège may have the effect of minimizing the audiation

Figure 2 consists of two musical exercises, A and B, for two-part singing. Exercise A is a melody line with solfège syllables (do, re, mi, fa, sol, la, ti) and a corresponding piano accompaniment. Exercise B is a similar exercise with a different melody line and piano accompaniment. Both exercises are marked '19.' and 'March like, in quick tempo'.

Figure 2. Example of an exercise for two-part singing.

Note. From *50 Easy Two-Part Exercises* by Denis Bacon from the first half of the book (A) and the second half of the book (B). Used with kind permission of Schott Music Corporation, New York, New York, publisher and copyright owner.

of the pitches, which is counterproductive. A useful step would be to give them the first pitch and let them sign and sing silently in their head. By observing the students' hand signs, the teacher can determine if the students are able to decode the notation. The teacher might sing a note occasionally during this process to encourage the students to continue to audiate.

While students need to recognize visual-position relationships of notes on the staff, at this stage they do not need to learn theory concepts such as letter names or key signatures. The teacher will tell the students the solfège syllable of the starting note. Much later, after the students develop competency in reading note relationships, the students can be taught how to use the key signature to find *do*. Minimizing the presentation of new concepts will help reduce the possibility that students become confused and will help students focus their attention on the most important aspects that are needed for immediate interpretation of the notated pitches into the sounds they represent.

By this stage the students should be ready to sight-sing and notate songs or parts of songs that are prudently selected so as to include only the known pitches and familiar rhythms. Students can also be working on part-singing skills while learning notation-reading skills. Denise Bacon's (1977) *50 Easy Two-Part Exercises* is a resource of similar exercises that can be used to teach sight-singing in parts (see Figure 2). When the students are proficient with reading and singing the targeted pitches, the same stages can be cycled through again with a new pitch added or a different set of pitches. A brief outline of the stages of learning pitch notation-reading skills and activities used at each stage are presented in Figure 3.

Additional Thoughts

As stated previously, the singing of patterns and exercises should be accompanied by the singing of actual songs using those pitches. Pitch patterns are like "sound words" that are prepared beforehand; complementary opportunities to practice singing and hearing those "sound words" in songs will facilitate transfer of learning to authentic musical contexts. To assure that music instruction has real-world relevance and fosters an enjoyment of music, instructional activities should not be limited to experiences with pedagogical exercises.

While the teacher can judge how the class is progressing as a whole, it is important to assess students individually at various stages of learning. As a case in point, in an experimental study, just the act of assessing sight-singing individually with no other changes in instruction had the effect of increasing student achievement (Demorest, 1998). Individual assessment can be accomplished at any stage by asking for volunteers or calling on students to individually sing a pattern, or a portion or all of an exercise. Students are usually enthusiastic for an opportunity to try it by themselves. When assessing in this manner in the class setting, alternating between whole class singing and individual singing can help in keeping all of the students engaged. It may be necessary to avoid spending too much time on this by assessing only a subset of the class on a given day. When assessing nonvolunteers, be sure that plenty of group practice has occurred beforehand. Also, calling on students randomly rather than going down the row may help to minimize anxiety for some students. Students can also be assessed with dictation exercises in which they write down what they are hearing in iconic or standard notation.

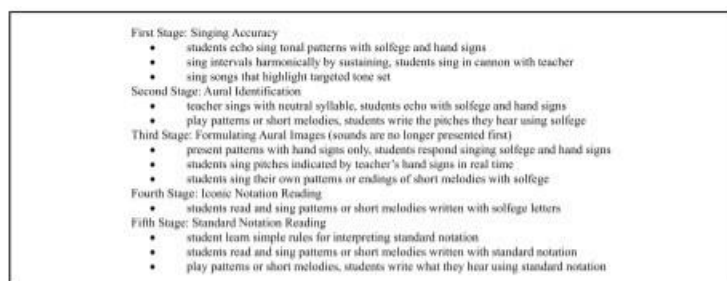


Figure 3. A summary of sequential activities to develop pitch notation-reading skills.

Improvisation activities can also be incorporated in the instruction. Students can be asked to sing their own pattern for the class to echo. This provides an opportunity to assess if students have developed competence to the level that they are able to integrate correct pitches, solfège syllables, and hand signs. Students can also be given the opportunity to create an original ending, or an "answer phrase" for a musical question phrase presented by the teacher.

Students should also be taught how to aurally orient themselves to the tonality of a piece of music. A strategy commonly used by successful singers is to sing the pitches of the tonic triad before singing and periodically as necessary to reorient to the tonality (Killian & Henry, 2005). Students should be taught how to use this technique in preparation for future sight-singing with more complex music and larger tone sets.

Some teachers may question if music-reading skills should be taught to all students or just those students who elect to participate in music ensembles. It is not possible to predict which students might decide to participate in a music ensemble at some point in the future. For many people, the music instruction received in school will be their only opportunity to learn how to read music, yet they will have opportunities to participate in music for the rest of their life. Music educators need to recognize the critical role they can play in giving every student the opportunity to become literate in reading music notation.

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improvements he described were the result of his own inventive genius or telling us how many of them were in general use at the time."⁷

Despite the controversies that may surround Guido's work, it is certain that his primary desire and goal in developing his methods was to aid students in the learning of chant. This objective was unique in his time, as previous theorists, such as Boethius, chose to focus their writings on the philosophical and mathematical implications of music rather than on the education of their readers. Guido states his aim in the opening of the *Micrologus*: "Desiring therefore to set forth my own so useful method of study for the general benefit, I summarized as briefly as I could. . . certain things that I believed would help singers."⁸ The *Prologus in antiphonarium* opens in a similar manner, with Guido again describing this goal: "I have determined to notate this antiphoner, so that hereafter through it, any intelligent and diligent person can learn a chant."⁹ As a closer examination of his work will reveal, Guido's innovations in the hexachord system, solmization syllables, and music notation are all directed towards the goal of improving the music learning process of his day. As a result of his passion and devotion to this goal, his developments had a profound impact not only upon the way music was taught but also upon the entire course of music history.

The first of Guido's major developments in the realm of music theory and education was his codification of the hexachord system. In his system, the notes of the musical gamut were described in interlocking six-note segments, known as hexachords, all of which shared the same interval pattern. This system, built on the existing modal system and similar in a sense to our modern concepts of scales and tonality, allowed singers to group the chants according to the particular hexachord to which each chant belonged. Guido's system also gave singers the ability to learn the intervals of a chant within the context of a specific hexachord rather than by merely listening and repeating patterns as heard on the monochord, an ability which would be furthered by his development of solmization. Finally, the hexachord system allowed singers to change between hexachords if the chant were to exceed the proper range of its original hexachord in a process known as mutation or transposition. As the hexachord system became codified in a manner that was more easily understandable, it "would quickly become an important tool for teaching the system itself and for teaching the important technique of transposition."¹⁰

⁷ W. S. Rockstro, "The Great Musical Reformers. III. Magister Franco," *The Musical Times and Singing Class Circular* 30, No. 556 (June 1, 1889): 333, <http://www.jstor.org/stable/3359740> (accessed September 2, 2011).

⁸ Guido of Arezzo, *Micrologus*, in Hucbald, Guido, and John on Music: *Three Medieval Treatises*, trans. Warren Babb and ed. Claude V. Palisca (New Haven: Yale University Press, 1978), 58.

⁹ Guido of Arezzo, *Prologus in antiphonarium*, in Guido D'Arezzo's *Regule rithmice, Prologus in antiphonarium, and Epistola ad michaelem: A Critical Text and Translation* by Dolores Pesce (Ottawa: The Institute of Mediaeval Music, 1999), 416-17.

¹⁰ Charles M. Atkinson, *The Critical Nexus: Tone-System, Mode, and Notation in Early Medieval Music* (New York: Oxford University Press, 2009), 230.

Although Guido was the first theorist to describe the hexachord system, the overall concept of modes, or the grouping of notes into specific interval patterns, dates back to ancient Greece. Working from a sixteen-note gamut that encompassed all the natural notes from B² to D⁴ and included B-flat as well as B-natural, the Greeks organized the notes into groups of four to create a system of five distinct tetrachords. This system, known as the Immutable System, allowed theorists to explore the mathematic relationships in the intervals between notes. Boethius, a scholar and theorist of the late fifth century, further developed the Immutable System in his work *De institutione musica*, which “offered the most comprehensive and detailed treatment of [the modes] available to the Middle Ages” and became one of the most widely circulated music treatises of the medieval period.¹¹

In *De institutione musica*, Boethius outlined his modal system, basing it on the Greek system by organizing the notes of the gamut into three types of tetrachords, each with a different interval pattern. The diatonic tetrachord, with an interval pattern of Semitone-Tone-Tone, “was the one taken over from Boethius into the medieval theoretical tradition” and was used by pre-Guidonian theorists such as Hucbald, St. Odo of Cluny, and the writers of the *Enchiriadis* treatises.¹² Building on this concept of tetrachords, Boethius also described a system of seven modes or scales, which he described as “an entire collection of pitches, brought together within the framework of a consonance.”¹³ The modes, spanning the range of an octave, each began on a different note of the gamut and possessed a unique interval pattern. These intervals and patterns were the outcome of specific mathematical ratios which further served to indicate consonance or dissonance between pitches. For Boethius, the tetrachords and modes were a means of describing the philosophical and mathematical nature of music, relating the music of instruments to that of humanity and the cosmos:

But to what purpose is all this? So that there can be no doubt that the order of our soul and body seems to be related somehow through those same ratios by which subsequent argument will demonstrate sets of pitches, suitable for melody, are joined together and united.¹⁴

As the Middle Ages progressed, Boethius’s ideas were utilized by other writers and theorists. Hucbald, St. Odo of Cluny, and the anonymous author of *Musica enchiriadis*, all writing around the late ninth and early tenth centuries, built upon Boethius’s ideas as they further developed the concepts of the tetrachord and modes that would lay the foundation for Guido’s theories. In the *Musica*

¹¹ Ibid., 25.

¹² Ibid., 11.

¹³ Anicius Manlius Severinus Boethius, *Fundamentals of Music*, trans. Calvin M. Bower and ed. Claude V. Palisca (New Haven: Yale University Press, 1989), 153.

¹⁴ Ibid., 7.

enchiriadis treatise, the author describes a tetrachord system in which tones are “joined together, ascending and descending in a natural way, so that they follow one another, always in similarly constituted groups of four,” organizing the gamut into a system of four consecutive, non-overlapping tetrachords.¹⁵ While still retaining the mathematical and philosophical focus of Boethius’s writings, *Musica enchiriadis* also provides additional information for students of music regarding the structure of the modes and melodies. According to the author, melodies may only end on particular notes, known as finals, which in modern nomenclature are D, E, F, and G. Each final serves as the focus of a particular mode, and the four types of modes can be further divided into two subtypes, “maior” or “authentic” and “minor” or “plagal,” based on their range around the final. In the authentic modes, the final was the beginning note of the scale, while in the plagal modes the final was placed towards the center of the scale.

Hucbald, a Frankish theorist and Benedictine monk, further elaborated upon the developments of the *Musica enchiriadis* treatise. His work “represents the first attempt to fuse Boethian theory with chant theory” and provided a basis for Guido’s innovations in the hexachord system.¹⁶ In his writings, Hucbald used the same Greek gamut as Boethius, expanding it slightly to cover a span of two octaves from A² to A⁴. He, like the author of the *Enchiriadis* treatise, organized this gamut into tetrachords to create the system which he presents as a basis for chant theory. Closely paralleling the work of Hucbald, St. Odo of Cluny, whose writings also had a significant influence on Guido, further described the system presented in *Musica enchiriadis*. Defining a mode as “a rule which classifies every chant by its final,” Odo confirmed the use of D, E, F, or G as suitable finals to be used in a chant.¹⁷ In addition, Odo established new names for the four main types of modes, referring to them as Protus, Deuterus, Tritus, and Tetrardus, titles which Guido later used in his writings on the modes and hexachords. By classifying chants according to their mode, Odo paved the way for Guido’s hexachord system, which uses this classification as a way to teach new chants rather than presenting it merely as a theoretical or compositional tool.

As Guido developed his hexachord system, he used the ideas of Boethius, Odo, and others to provide the foundation for his innovations. Basing his system on the gamut of Γ (gamma or G²) to D⁴ as described by Hucbald and Odo, Guido used the first seven letters of the alphabet to indicate pitches, repeating them at the octave as in our modern scale system rather than at the fifth as in the Greek system. This was a significant move from the four Greek letters used to indicate pitch in the scales of Boethius and the *Enchiriadis* treatise, which Guido criticizes in his *Regule rithmice*: “I am astonished that some have made four symbols for the pitches, as if they are the same at the fifth, of which some differ. Some,

¹⁵ Anonymous, *Musica enchiriadis*, in *Musica enchiriadis and scolica enchiriadis*, trans.

Raymond Erickson and ed. Claude V. Palisca (New Haven: Yale University Press, 1995), 2.

¹⁶ Atkinson, 149.

¹⁷ Pseudo-Odo of Cluny, *Dialogue on Music*, in *Source Readings in Music History*, ed. Oliver Strunk and Leo Treitler (New York: W.W. Norton, 1998), 207.

hexachord gave the singer a reference point for the chant, allowing him to place each note and interval exactly where it should belong and enabling "any piece in any mode [to] be understood and sung in terms of only one six-note pattern."²³ These three hexachords, beginning on C, G, and F, were known as "natural," "hard," and "soft," respectively, with the F hexachord including a B-flat instead of a B-natural. Although in *Micrologus* Guido does describe the use of B-flat "mostly in that chant in which F . . . recurs rather extensively, either low or high," he discourages its use in his later writings.²⁴ In the *Epistola ad michaelem*, he states that if B-flat were to be used to avoid the tritone interval when ascending a fourth from F, F-sharp would similarly have to be accepted to allow an ascent from B-natural, a practice which had not been popularly accepted: "but because no one has done the latter, no one ought to do the former."²⁵

In addition to providing a method of learning and organizing the intervals of a chant, Guido's hexachord system also allowed singers to change between hexachords in a process known as mutation. If a melody went beyond the range of one hexachord, the singer would change into another hexachord by finding a common tone between the two. This process, similar to our modern concept of modulation, was further facilitated by Guido's later development of solmization syllables.

Although the hexachord system shares similarities with the modal system of Guido's day, it is important to recognize that the two concepts are not identical. While the hexachord system is built upon the preexisting modal system and gamut, it was designed "to facilitate the teaching and learning of plainchant melodies"²⁶ and does not "reflect the scalar patterns, or modes, in which these melodies were written."²⁷ In short, the hexachord system provided a means of learning chant by giving a frame of reference for the intervals between notes, while the modal system allowed chants to be classified according to their finals, much in the way the modern scale system organizes music by the tonic scale degree.

As music theory progressed through the late Middle Ages, Guido's hexachord system became foundational to the development of tonality. The modal system and the hexachord continued to exist side-by-side, with the modal system becoming firmly entrenched in the church music of the day and leading to our modern church modes. However, with the development of polyphony during and after Guido's time, particularly in secular music, the limits of the hexachord and modal systems began to be tested. The necessity for consonance in polyphony, particularly at intervals of a fourth and fifth, led to the addition of chromatic notes in a practice known as *musica ficta*. The *musica ficta* notes were those outside the

²³ Léonie Rosenstiel, ed., *Schirmer History of Music* (New York: Schirmer Books, 1982), 31.

²⁴ Guido of Arezzo, *Micrologus*, 64.

²⁵ Guido of Arezzo, *Epistola ad michaelem*, 517.

²⁶ Hoppin, 63.

²⁷ *Ibid.*, 64.

traditional gamut and hexachord system, or, in other words, the placement of a semitone where none had previously existed. This led to the development of additional hexachords, known as *ficta* hexachords, beyond those on C, G, and F in order to accommodate these new notes: "we know, however, that at some point musicians began to go beyond these limits and that eventually it became possible to flatten and sharpen all the seven uninflected notes within an octave."²⁸

As the hexachord system began to disintegrate during the fifteenth century, "the entire rationale of medieval solmisation, namely to identify the semitone . . . and give surrounding context to it, was eroded."²⁹ Theorists throughout the Renaissance continued to propose solutions to this problem while at the same time shifting from the monochord to the keyboard as the basis of music theory. Writers such as Prosdocius de Beldemandus, Johannes Hothby, and Pietro Aaron devised new gamuts in which "every step could receive both a flat and a sharp," leading to the modern chromatic scale.³⁰ In the sixteenth century, Gioseffo Zarlino gave the "first recognition of the fact that there were only two types of modes, those which had a tonic major third and were cheerful, and those which had a minor third and were sad."³¹ His organization of the chromatic gamut into these two types "forced a dichotomization of modal theory which closely paralleled actual practice and pointed the way toward the major and minor tonalities."³² Although it is uncertain when exactly the transition from the modal and hexachord systems to our modern system of tonality occurred, it would seem that, as chromatic notes were added to the scale with the development of polyphony and counterpoint during the Renaissance and Baroque periods, the tonal limitations of Guido's hexachord system led to its eventual obsolescence.

The second of Guido's major innovations in music theory and education was his creation of a system of solmization syllables. Closely related to his previous development of hexachords, the solmization syllables allowed the hexachord system to be used as a practical tool in the learning of chants. Prior to Guido's time, students would learn new chants by imitating pitches as played on the monochord in a time-consuming, painstaking process which Guido himself describes as "childish—good for beginners, but very bad for those who continue further."³³ As the disadvantages of this method became apparent, "Guido's new system, in many ways the beginning of modern sight-singing technique, was

²⁸ Karol Berger, "The Expanding Universe of Musica Ficta in Theory from 1300-1550," *The Journal of Musicology* 4, No. 4 (Autumn, 1985-Autumn, 1986): 414, <http://www.jstor.org/stable/763749> (accessed February 2, 2012).

²⁹ Margaret Bent, "Diatonic 'Ficta,'" *Early Music* 4 (1984): 12, <http://www.jstor.org/stable/853845> (accessed February 2, 2012).

³⁰ Karol Berger, 421.

³¹ Robert W. Weinpahl, "Zarlino, the Senario, and Tonality," *Journal of the American Musicological Society* 12, No. 1 (Spring 1959): 30, <http://www.jstor.org/stable/829515> (accessed February 2, 2012).

³² *Ibid.*, 41.

³³ Guido of Arezzo, *Epistola ad michaelem*, 461.

badly needed as a method of learning the chant.³⁴ With the solmization syllables, singers could become familiar “with the intervallic context surrounding each syllable” within the hexachord, enabling them to determine the exact placement of pitches and, ultimately, to learn chants without the aid of the monochord.³⁵

Although Guido’s developments in the hexachord system built upon the theories of scholars before him, his solmization system is uniquely his own invention. While some writers have suggested that ancient Greek and Arabic music included the use of solmization syllables, there is little to no evidence to support this claim, and scholars generally recognize Guido’s innovation as exclusively his. The solmization system is detailed in his work *Epistola ad michaelem*, in which he describes the discovery of “a most excellent method for finding an unknown melody, recently given to us by God, and proven most useful.”³⁶ Because the syllables are discussed only in the *Epistola*, it is reasonable to assume that they were developed towards the end of Guido’s life as a culmination of his earlier innovations in the hexachord system and in music notation.

To create the solmization system, Guido took the first syllables of each phrase in the hymn *Ut queant laxis* to establish the syllable set “ut-re-mi-fa-sol-la,” as indicated in Figure 2.



Figure 2: *Ut queant laxis*

Because each phrase of the hymn began one note higher than the previous line, each step of the hexachord was given a unique syllable, allowing the singer to find the pitch of a note and to determine its position within the hexachord:

³⁴ Mark A. Leach, “‘His ita perspectis’: A Practical Supplement to Guido of Arezzo’s Pedagogical Method,” *The Journal of Musicology* 8, No. 1 (Winter 1990): 83, <http://www.istor.org/stable/763524> (accessed September 2, 2011).

³⁵ Stefano Mengozzi, *The Renaissance Reform of Medieval Music Theory: Guido of Arezzo Between Myth and History* (New York: Cambridge University Press, 2010), 1.

³⁶ Guido of Arezzo, *Epistola ad michaelem*, 457.

And thus do you see that this melody begins in each of its six phrases with six different pitches? If someone, thus trained, knows the beginning of every phrase so that he can without hesitation immediately begin any phrase he chooses, he will easily be able to sing the same six pitches according to their properties wherever they appear.³⁷

In addition to indicating the exact location of each pitch within the hexachord, solmization also drew attention to the center of the hexachord, the semitone interval, which was given the syllables "mi-fa." By highlighting this interval, the singer could determine the hexachord in which a chant fit and, thereby, the surrounding intervallic context of any given pitch in a melody. As singers learned the chant, each note and its appropriate syllable played "an active role in the complex chain of signification that linked the notes on the page with the sounds of the gamut and with the mnemonic traces of the basic intervals in the singer's mind."³⁸ Because the solmization syllables linked the notes of the new chant to a known interval pattern, Guido states that, by using this method, "you may competently sing unheard chants as soon as you see them written down, or, hearing unwritten chants, you can immediately set them down in writing well."³⁹

Under the solmization method, a singer would, upon receiving a new chant to learn, assign a syllable to each note based upon the particular hexachord to which that chant belonged. He would then know exactly which step in the hexachord each note matched and would be able to sight-sing the chant, taking time to correct intervals that were challenging or required mutation into a new hexachord. With this new method, the learning of chants became much easier and faster, and singers "could easily sing unknown chants before the third day, which by other methods could not happen for many weeks."⁴⁰

As the hexachord syllables were applied to the notes of the gamut, "some tones could be found in all three proprieties or hexachords and thus took syllables from all three."⁴¹ For example, the note C⁴ could belong to any of the three hexachords under the syllables "sol" (F hexachord), "fa" (G hexachord), or "ut" (C hexachord) and was therefore given the name "C-sol-fa-ut," while the note Γ (gamma) could belong only in the G hexachord as "Gamma-ut." As this system of nomenclature became more common, the name "Gamma-ut" was contracted to "gamut" and was used to refer to the entire set of musical notes. By naming notes with both letters and syllables, the notes of the gamut were given specific names to distinguish them from each other. Further, the process of mutating between

³⁷ Ibid., 469.

³⁸ Stefano Mengozzi, *The Renaissance Reform*, 105.

³⁹ Guido of Arezzo, *Epistola ad michaelem*, 471.

⁴⁰ Ibid., 465.

⁴¹ Robert Vladimir Henderson, "Solmization Syllables in Musical Theory, 1100 to 1600" (PhD diss., Columbia University, 1969), 2, <http://search.proquest.com/docview/288021635?accountid=26732> (accessed September 2, 2011).

hexachords was simplified as singers could immediately place the pivot note in the interval context of either hexachord.

With each note designated by a letter and its appropriate syllables, the gamut could be clearly understood as a system of overlapping hexachords. To aid in this understanding, the human hand was used as a learning device, known as the Guidonian Hand (Figure 3), to allow the student to visualize the gamut and recall the intervals between notes.



Figure 3: Guidonian Hand

Each note, with its appropriate letter and syllables, was placed on a joint of the human hand, mapping the gamut in a spiral pattern. Students could then use the hand to learn the gamut and its notes, while teachers could use the hand to indicate specific pitches in a chant to their students:

The hand was both a mnemonic and a pedagogical device. The association of a clef and its syllables with a specific place on the hand helped memory and provided the teacher with a convenient method of demonstrating and practicing the steps and intervals of the gamut.⁴²

Although named after Guido, the exact origin of the Guidonian Hand is unknown and is not mentioned in any of Guido's writings. It is thought to have arisen after Guido's time, likely as the invention of teachers and musicians who sought to memorize and teach the gamut, yet "it is clear that the developed hand was the final product of the search initiated by Guido."⁴³

⁴² Carol Berger, "The Hand and the Art of Memory," *Musica Disciplina* 35 (1981): 12, <http://www.jstor.org/stable/20532236> (accessed September 2, 2011).

⁴³ *Ibid.*, 32.

For Guido, the solmization syllables and the hexachord system were intimately connected as a single pedagogical system. As Guido's method spread, the hexachord became the "primary organizing agent of the ecclesiastical modal system from the 11th century onwards."⁴⁴ Despite the changes made to the hexachord system as chromatic notes were added to the gamut, the solmization syllables themselves remained largely undiscussed and unchanged through the centuries. As music progressed from the medieval modal system into modern tonality, the syllable "ti" was added to indicate the leading tone and the syllable "ut" was changed to "do" in an effort in ease pronunciation.

For the most part, the history of Guido's syllables remained largely undocumented until the development of the modern solfege system in the late nineteenth century. Known as the tonic sol-fa system, this method, like Guido's solmization, assigned a specific syllable to each degree of the scale, allowing students to understand the intervals of the scale and the pitch tendencies of specific notes. The system was first developed in the late nineteenth century by English music educator Sarah Glover, who "discovered a need for reform in the teaching of music reading skills."⁴⁵ Seeking a means of teaching music without relying on traditional notation, Glover adopted Guido's system, altering it slightly to produce the syllable set "do-ra-me-fa-sole-lah-te." Glover's method caught the attention of John Curwen, an English minister who, like Glover, sought to improve the music education of students. In his system, Curwen used Glover's syllables but also added specific hand signals "to individualize the syllables" and to aid in their memorization.⁴⁶

Although Glover and Curwen initiated the resurrection of Guido's solmization syllables, the solfege system gained popular acclaim and usage in the mid-twentieth century through the methods of Zoltán Kodály, a Hungarian music scholar and educator. His system, "almost entirely built round the use of solfa," used the Italian syllables "do-re-mi-fa-so-la-ti" and hand signs adopted from John Curwen.⁴⁷ Kodály's system, still a central part of music education, used solmization as Guido did to indicate a note's function within the scale, to teach students to notate heard melodies, and to allow singers to learn new melodies quickly and easily.

The third area of Guido's innovations in music education and theory were his developments in music notation. His improvements in this area laid the

⁴⁴ Mengozzi, *The Renaissance Reform*, 20.

⁴⁵ Peggy D. Bennett, "Sarah Glover: A Forgotten Pioneer in Music Education," *Journal of Research in Music Education* 32, No. 1 (Spring 1984): 52, <http://www.jstor.org/stable/3345280>, (accessed February 2, 2012).

⁴⁶ Ruth Zinn, "John Curwen: Teaching the Tonic Sol-Fa Method 1816-1880: An English Minister Proposed Teaching Music through the Sound of Tones and Only Later Using Notation," *Music Educators Journal* 70, No. 2 (October 1983): 47, <http://www.jstor.org/stable/3401212> (accessed February 2, 2012).

⁴⁷ Geoffrey Winters, "The Kodály Concept of Music Education," *Tempo*, New Series, No. 92 (Spring 1970): 16, <http://www.jstor.org/stable/943178> (accessed February 2, 2012).

interval in a chant, using this central half-step to discover the hexachord of a chant. Finally, with Guido's music notation, students could visualize the music they were learning, using the placement of the neumes on the staff lines to determine the exact intervals between notes as well as the location of the crucial "mi-fa" interval. As a result, the combination of these elements resulted in an easier, simpler, and more efficient way to learn music, one which "perhaps briefly and adequately open[s] the door of the art of music."⁶⁹

Imagine, once again, that you are a choirboy in the same Italian monastery. As before, the choirmaster announces the performance of a new chant for an upcoming feast day. This time, however, you are handed not the monochord, but rather a sheet of music. As you examine the music, you notice the colored lines and clef signs indicating the notes F and C. Using these markers, you can quickly determine the location of the half-steps and, with this knowledge, the hexachord to which the chant belongs. After discovering the hexachord, you re-examine the notation to determine the note names, mapping them onto your hand as you match the letter names to the proper solmization syllables. Once you have determined the syllables for each note in the chant, you play the starting pitch on the monochord. However, rather than relying upon the instrument to learn the melody, you instead sight-sing the chant confidently and accurately, using the notation and your knowledge of the solmization syllables and hexachord to sing each note and interval. After a few short days of practice, you are ready to perform the chant. As you sing the chant at mass, you know that you are singing every interval correctly. You are confident that, should you forget the tune, the notation will clearly remind you of each note, regardless of when you are next called upon to perform the chant. You are certain that the time and effort of the past several days have not been wasted, and you know that, due to the work of Guido of Arezzo, this is a better way to learn music.

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⁶⁹ Guido of Arezzo, *Epistola ad michaelem*, 529.

This awareness helps students translate their functional hearing more directly to and from musical notation and an instrument. (Appendix B contains suggestions for teachers using moveable-Do to help make these exercises work most efficiently in that context.)

The real benefit of Dalcroze's approach is that it fuses contextual and phenomenological thinking, since each exercise requires students to be aware of both.

Dalcroze's exercises easily adapt to any singing system, but they are most effective when an absolute system (letter names/fixed-Do) is combined with a relational system (scale degree numbers/moveable-Do). This combined approach prepares students for fluent sight singing and dictation of highly modulatory music by enabling them to think functionally within the context of all major and minor keys.⁶

I. C-TO-C SCALES

The C-to-C scales are Dalcroze's most significant contribution to ear training pedagogy. These scales are often referred to as "Dalcroze Scales" or "Do-to-Do Scales." The C-to-C Scales develop:

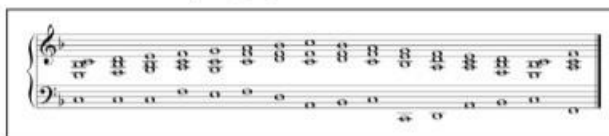
- Sensitivity to scale degree function and functional transformation/modulation.
- The ability to conceive of any tone as any scale degree function.
- An acute awareness of whole- and half-step patterns for all keys.
- Knowledge of one's position within a tonal context at all times.
- A strong memory for C, and the ability to identify the key of a musical passage based on the function of C within the passage.

Introduction To C-To-C Scales

C-to-C scales are major and minor scales performed within one octave (C4 to C5 for women; C3 to C4 for men). In keys where C is

⁶Two of the authors use a combined fixed-Do/scale degrees system at their respective institutions, and one uses a combined moveable-Do and letter names system. Two of the authors would like to personally thank William Marvin from the Eastman School of Music for introducing them to this combined approach. For a more thorough discussion of solfège systems and the use of a combined phenomenal and contextual approach, see Marvin's "A Comparison of four Sight-Singing and Aural-Skills Textbooks," *JMTP* 22 (2008): 131-148. [see esp. pp. 137-9].

Now sing the same scale again with the following harmonization. Conclude the scale by singing F, its tonic.



Example 2b: F Major C-to-C Scale Harmonized

The harmonization transforms the dynamic structure of the scale, making it nearly impossible to hear it as anything but a diatonic F major tonality beginning and ending on scale degree 5. If heard as a mode, the ear accepts the lowest tone as the main tone. When heard as a major/minor diatonic scale, the ear searches for clues that will lead it to its tonic.

Now, play just the initial dominant seventh chord of the harmonization above, sing the scale again, and resolve by singing a tonic F at the end. The dominant seventh chord is enough to direct the ear into hearing this in the context of F Major. Finally, with no accompaniment from the piano, imagine the sound of that dominant seventh chord, and sing the scale and tonic one last time. Now the ear is providing its own harmonic support for the scalar melody. Practicing C-to-C scales increases one's sensitivity to melodic direction and tonal harmony, which, in turn, promotes more expressive performance.

Singing a C-to-C scale is like jumping midstream into a scale already in progress. This is one of many practical pedagogical advantages to learning C-to-C scales, given that scalar passages in music often do not start on tonic. Students learn to identify scales as they unfold in real compositions. The C-to-C octave also provides a fixed frame of reference to compare and internalize the dynamic makeup of all twelve major and minor tonalities. Dalcroze viewed modulation as a change of scale, and believed once students could immediately swap between any given scale and another, they could handle all modulations with ease.

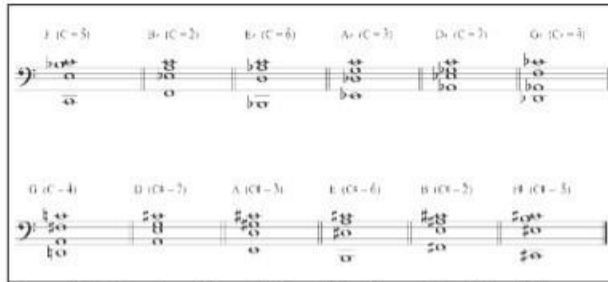
PEDAGOGY OF C-TO-C SCALES: INTRODUCING NEW KEYS

The sequence outlined above for introducing the F Major Dalcroze scale provides a model of the classic approach used by Dalcroze instructors to introduce each C-to-C scale for the first time, and it is the sequence we recommend. Prompt the class by saying, "Let's sing an F Major scale from C-to-C," and play a C on the piano. Accompany the students' singing of the scale (perhaps in a strict chorale style as above, or in a freer classical or jazz style of your choosing; refer back to Example 2c). Have students resolve the scale by singing the tonic note (F) at the end. Repeat the process a second time, but this time play only the V7 harmony as support for the singing, and perhaps a closing I chord when the students sing tonic. Repeat the singing a third time, with no harmonic support from the piano, encouraging students to hold on to the memory of the sound of the V7 as they sing.

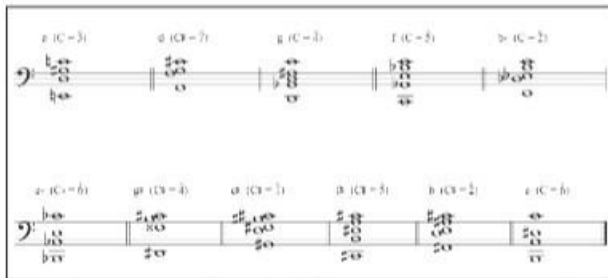
When you return to this same scale in a later class, instead of giving it harmonic support, you might test students' ability to summon a harmonic context for themselves by playing only the starting C and naming the scale. When only the starting note is played, students must think carefully about the half- and whole-steps as they sing the scale, until the ear orients itself and begins to supply a harmonic context for the key. As students gain familiarity with each key, it will take fewer and fewer notes for them to find this harmonic context, until eventually they can hear it from the starting C, C#, or G alone.⁸

Once students have been introduced to the F major C-to-C scale, they are usually eager to move into other keys. We recommend G major, followed by other closely related keys. Continue to introduce scales throughout the semester until all have been introduced. Example 3 shows dominant seventh chords for supporting the major and minor C-to-C scales. For minor keys, we suggest using a V¹² (the lowered scale degree $\hat{3}$ provides enough information to prompt the minor mode.) Note that middle C sits on the top of each chord; the dominant seventh chord transforms its function for each key.

⁸ Dalcroze wrote, "The first concern of the teacher must be to make the child appreciate the difference that exists between the *whole tone* and the *semi tone*. If the student grasps this difference only with hesitation, whether in singing or listening, there should be no thought of continuing to another subject." Emile Jaques-Dalcroze, *Les Gammes et Les Tonalités, Le Phrasé et Les Nuances*, 1.



Example 3a: Dominant Seventh Chords for Supporting Major Dalcroze Scales



Example 3b: Dominant Thirteenth Chords for Supporting Minor Dalcroze Scales (For the minor mode use a $\flat V^13$; the lowered scale degree $\flat 3$ provides enough information to prompt the minor mode).

EXPANDING THE C-TO-C SCALE MODEL: THE PROMPT, THE SCALE, THE CLOSING

As students gain familiarity with several C-to-C scales, the model for singing these scales can be expanded to add variety and challenge, to reinforce harmonic concepts from theory class, and to build musicality and improvisation skills. We refer to the three parts of the basic model for singing a Dalcroze scale as 1) the prompt, 2) the scale and 3) the closing.

The *prompt* tells students what scale they will be singing. A prompt can be musical or verbal. Prompts challenge students to

identify scale degree function, which benefits dictation work. The *scale* refers to variants in how the C-to-C scale itself is performed. These mainly include the scale's rhythm and what harmonic support (if any) is given from the piano. The *closing* is how the harmonic tension is resolved following the singing of a scale. Typically, the closing requires students to translate harmonic and functional thinking into an absolute solfège system (such as fixed-Do or letter names). Closings build the skills necessary for sight singing. They also provide opportunities for improvisation and creativity.

PROMPTS

In the context of our discussion on introducing new keys, we have already mentioned two methods of prompting a scale: 1) give the students the name of the key and an initial V7 to orient their ears to the key or 2) name the key and play only the starting C/C#/C♭, so that students must find the scale by half- and whole-steps or recalling a harmonic context for themselves.

It is also possible to use purely musical prompts, in which the students are given enough musical information to determine the function of C (its relative position in the scale) and, by extension, determine the name of the key itself. These musical prompts reinforce the work on key signatures and scales that generally takes place in a first semester theory course.

Mastery of these prompts enables students to identify scale degree function and harmonic context quickly. Prompts model the kinds of subtle changes in collection and scale degree function that listeners encounter when a tonicization or modulation occurs in a musical context. The goal is for students to discern the tonic of any given musical context instantly and effortlessly.

"V7 Plus C" Prompt:

Play one of the V7 chords with C on top from example 3a or 3b. Ask students to hum C, and if need be, hum up and down the scale to determine C's relative position in the scale. When they know how C is functioning, they should discretely hold up the number of fingers of its scale degree (or show its Kodály / Curwen hand sign). Once a majority of the class has the solution, have the class sing the scale together followed by an ending on tonic. (If C is sharped or flatted in the key, you can let students know this. Or, if they are

to comprehend and present in his mind harmonic sequences, chords, their roles and connections in music in a new way. The importance of harmonic inner ear cannot be overemphasized for musicians who specialise in playing harmonic instruments such as piano, guitar and organ, as well as for composers and arrangers who are responsible for working with the harmonic weave of a piece of music.

To develop melodic and harmonic inner ear, we need to use different teaching strategies and methods. To improve melodic hearing, we can practice singing by ear, intoning unaccompanied melodies, memorizing and playing melodic phrases. Harmonic hearing is developed through chord recognition exercises, music and harmony analysis, accompaniment exercises, and melody and voice training.

The two different types of inner ear play an integral and central role in music education and the professional life of musicians, which not only enriches their performance skills but also develops their creative abilities.

2. Interactions Between the Brain, Inner Hearing and Musical Creativity

2.1. Neuroscientific perspectives on inner hearing: how the brain processes musical information

The innate ability to hear is undoubtedly one of the most fascinating parts of human musical perception and cognitive expression. It has a significant impact on our understanding of the meaning of musical compositions and allows us to better understand the emotions and subtext expressed in them. Thanks to the rapid development of neuroimaging and other experimental techniques, modern neuroscience has made significant progress in studying how the brain processes musical information and generates internal auditory images.

The neural networks of the brain located in the primary and secondary regions of the auditory cortex in the temporal lobe of the brain are functionally interconnected through interactions between neurons and are therefore highly complex. Here, sound signals are initially analysed from which basic musical attributes such as pitch, tone quality, loudness and duration are extracted [1]. These attributes are transmitted to higher sensory neurons through neural mechanisms and affect the corresponding areas. Further processing of the musical information takes place in the associative auditory areas, resulting in a more complex perceptual image related to the recognition of melodic, harmonic and rhythmic patterns [2].

However, music perception is not limited to auditory analysis. This role is realised through the activity of the cerebral cortex. A large number of scientific studies have confirmed that auditory and motor areas of the brain closely interact when processing musical information [3]. Thus, when listening to music or playing it, premotor and motor cortical areas associated with planning and controlling movements are activated in the brain. This indicates a close connection between music and movement, which is initially embedded in the rhythm and rhyme of music [4].

The emotional core of the brain, especially the amygdala and limbic system, play an equally important role in music perception. The effects of music on emotion are mainly through specific areas of the cortex, including the insula, prefrontal lobes, and parahippocampal gyrus. Music has a

special ability to stimulate strong emotional responses ranging from happiness and joy to sadness and nostalgia. Music also affects emotional memory, language processing and attention, thereby altering mental states. Results of neuroscientific studies have shown that these responses correlate with the activation of ancient subcortical structures responsible for processing key emotional stimuli [5].

For professional musicians, the phenomenon of inner hearing is of particular interest. Music is the result of sensory signals generated by the cerebral cortex and transmitted to various parts of the body, which cause appropriate physiological activity. Numerous scientific studies indicate significant structural and functional differences in the brains of musicians and non-musicians [6]. In addition, musicians are more prone to convert visual signals into auditory signals than other types of people. After long-term music training, the auditory and motor cortex becomes thicker and the interaction between different parts of the brain increases, making the processing of musical information more efficient [7]. In addition, musicians can perceive the acoustic environment through the visual system, such as hearing the tones produced by instruments and seeing the colours of objects. Musicians have increased activity in both auditory and motor areas when they listen to or play music, and when music appears in their brain [8]. This means that a musician's auditory system is uniquely bright, detailed, and tunable.

2.2. Music, emotion and inner listening: emotional coding in the brain

Music has a special ability to stimulate and convey a wide range of emotions - from deep sadness to boundless joy, from quiet melancholy to euphoric delight. The emotional information contained in music is not only perceived, but also affects other systems of the human body in different ways. Music's ability to resonate deeply with our emotional world underlies its lasting effects on the human mind and makes it a unique area of neuroscientific research [9]. Therefore, it is crucial to analyse, understand and explain the different emotions embedded in musical compositions and their mutual transformation processes. In recent years, neuroscience has made significant advances in the study of how the brain processes the emotional content of music and the links between these processes and auditory sensations.

Numerous scientific studies indicate that the perception of musical emotions is influenced by a complex interaction between auditory, limbic and prefrontal brain regions [10]. The frontal lobe is one of the most important visual cortices compared to the other hemispheres of the brain. When you listen to emotionally charged music, it not only triggers the primary and secondary auditory areas responsible for acoustic analysis, but also activates structures of the limbic system such as the amygdala, hippocampus and cingulate gyrus. It can also influence the activity of a number of other higher brain regions by modulating the limbic system. These structures play a critical role in processing emotionally relevant stimuli, forming emotional memories, and eliciting emotional responses.

Of particular interest is the role of the amygdala in the perception of musical emotions. The amygdala, as an important brain region, is thought to be involved in many different emotion regulation processes. Numerous scientific studies have shown that amygdala activity increases when people listen to emotionally charged music, especially when confronted with negative emotions (e.g., sadness, fear, and

Internal Listening and Musical Creativity: A Study of Brain Function

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Abstract: The *relevance* of the chosen research topic lies in the fact that inner listening plays a fundamental role in musical creativity and performance. In the context of contemporary music education and performance practice, there is a growing interest in understanding the processes that occur in the musician's brain during musical perception and recreation. This study aims to expand knowledge of the relationship between inner hearing, brain function and musical creativity. The *aim* of this paper is to study the influence of inner hearing on the process of musical creativity and to identify the neuroscientific mechanisms underlying this interaction. The *object* of the study is the inner hearing of musicians, and the subject is the relationship of inner hearing with musical creativity and brain functions. The *scientific novelty* of the study lies in the integrated approach to the study of inner hearing from the point of view of neuroscience and musical creativity, which allows us to update the ideas about the influence of inner hearing on musical activity. The *structure* of the thesis includes an introduction, two main chapters touching upon the key aspects of inner hearing and its connection with brain functions, as well as a conclusion summarizing the results of the research.

Keywords: Musical creativity, Performance, Brain functions.

1. The Fundamental Role of Inner Hearing in Musical Performance

1.1. Definition and meaning of inner hearing

Internal hearing is the ability to hear and represent the sounds, melodies, harmonies and rhythms of music without external acoustic stimuli. **It includes the ability to clearly perceive information such as pitch, tone and timbre.** This ability to perceive and perform music is very important because it allows musicians to visualise and plan a piece of music in advance before they begin to play it, or while they are music-making.

The importance of inner hearing to musical performance cannot be overemphasized. The inner ear is a complex and sophisticated organ with unique physiological and functional characteristics that allow it to respond sensitively to sound. Musicians with a well-developed inner ear are not only able to reproduce musical works accurately, but also improvise, translate music into other tonalities, understand and interpret musical texts more deeply. This article examines the mechanisms of the inner ear's influence on musical intelligence and the changes it can cause through the lens of musical creativity. According to Sloboda J.A. 1985, the inner ear is closely related to musical intelligence and creativity.

Musicians improve their memory for music by actively using their inner hearing through the ability to reconstruct musical pieces in their brains, which is considered a highly effective method of memory training (Hallam S. 1995). Inner hearing refers to the sound system that people develop through their inner experience and which has unique individual characteristics. Furthermore, advances in inner hearing have played a key role in the development of empathic and emotional responses to music, allowing performers to more skillfully feel and communicate the emotion and uniqueness of a piece of music.

One of the key techniques for developing the inner ear is

solfeeggio, a training programme aimed at developing musical ear skills, covering sight singing, aural perception and tonal training. It enables the learner to understand the relationship between music and other disciplines and to acquire relevant skills. The solfeeggio programme aims to develop the ability to internally express the sound and form of music, which is **absolutely essential for professional musicianship.**

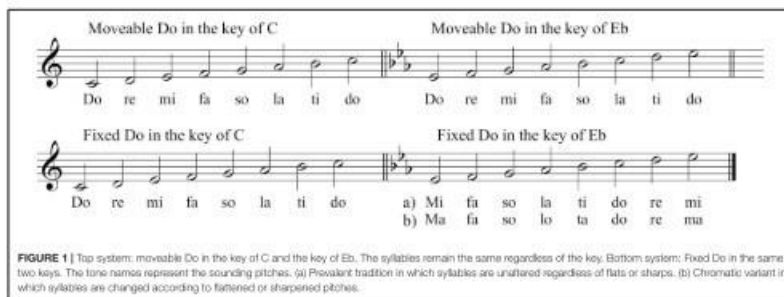
Thus, the ability of inner sense of hearing is a fundamental skill that musicians need not only to help them interpret music accurately and expressively, but also to gain a deeper understanding of the inner structure and emotional depth of music. In the process of learning music, in order to improve students' external sense of hearing, we should start by stimulating their senses to the deep meanings of musical works, and guide them to listen, experience and comprehend with their ears, so as to achieve the goal of enhancing their aesthetic ability in music. In order to develop this ability, we need to make systematic efforts, which is an integral part of music education.

1.2. Types of inner hearing: melodic and harmonic inner hearing

Performance in musical practice can be used to categorise inner hearing. The physiological and psychological activities of the subject of musical aesthetics, such as breathing and heartbeat, affect the perception of inner hearing. The two main types of inner hearing include melodic inner hearing and harmonic inner hearing. Each has its own unique form of expression and combines with the other two forms to create new content. These types of inner hearing reveal different differences in musical perception and information processing between musicians and listeners.

The main duty of the harmonic inner ear is to represent harmonic constructions in music. Thus, the harmonic inner ear is one of the most important and indispensable means of understanding the harmonic characteristics of a piece of music. It gives the listener and the performer the opportunity

Figure 18. Steenstrup et al. (2021)



Duke et al., 2011; Wulf, 2013; Mornell and Wulf, 2019) have investigated the influence of focus of attention on training and performance outcomes. Typically, they distinguish between internal focus as being mentally occupied with parts of one's own anatomy (for a trumpet player lips, tongue, breathing muscles), or external focus, thinking about the effect of the activity (musical elements, the sound of the music in the hall, where to direct the music or the wind etc.). The vast majority of studies (Wulf, 2013), whether in sports or musical performance, points to external focus as being most efficient and we hypothesized that there might be an influence when the participants are reporting familiarity with this aspect of practice and performance.

Sleep and Meditation

Sleep has been implicated as a crucial factor in learning and consolidation of motor skills (Walker et al., 2002). Motor-sequence learning has shown that sleep after motor skill acquisition can trigger significant improvements in both performance speed and accuracy on a finger-tapping task, and that these overnight learning gains correlate with the amount of stage-2 non-rapid eye movement (NREM)-sleep. As we go through sleep stages during the night, stage 2-NREM-sleep happens particularly late in the night leading to the notion that motor skill learning will benefit from increased sleep duration. This effect will also show in daytime naps (Nishida and Walker, 2007). The influence of sleep has also been shown in consolidation of motor skills in music (Allen, 2007) and in auditory learning (Gaab et al., 2004). Meditation has also been seen to have a positive effect on motor learning (Immink, 2016) and we hypothesized that sleep and meditation habits could have an impact on practice outcome.

Rationale and Hypotheses

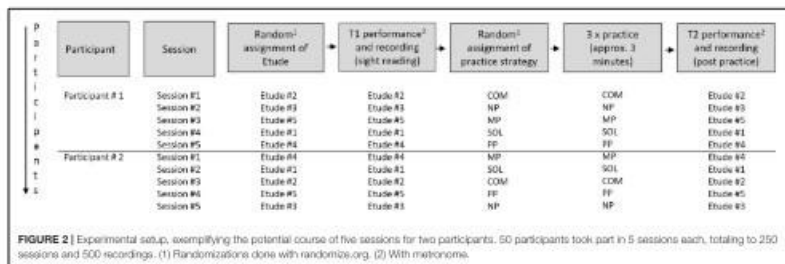
The aim of the study was to investigate the effect of auditory and motor imagery and overt singing practice strategies on performance quality (Ross, 1985; Rosenthal et al., 1988; Colfman, 1990). The study involved 50 participants, all of whom played trumpet at academy level. In line with both previous research and pedagogical traditions, we hypothesized

that a strategy in which physical practice is combined with motor and auditory imagery and overt singing will be equally effective in improving musical reproduction and quality as mere physical practice and more effective than strategies relying solely on either motor and auditory imagery or overt singing alone. Furthermore, we hypothesized that prior solfège, training and application of interleaved/ varied practice regimes, focus of attention, sleep habits and meditation as self-reported in a participant survey, would impact the general performance level as well as the ability to improve during acquisition. The study adds to the Ross study from 1985 by including a substantially higher number of participants; testing the use of singing voice as a practice strategy; involving all participants in all strategies; including the participants' self-reported data on musical training, practice habits and demographic information in relation to test data and involving an independent expert jury in assessing the pre- and post-test performances, assessing additional musical parameters such as intonation, sound quality and musical expression.

MATERIALS AND METHODS

Participants

Fifty academy level trumpet students (mean age 23 year, $SD = 2.9$, range 17–28, 11 F, 39 M), studying at leading institutions in Germany, Denmark and Switzerland were recruited for the study. The participants were not required to do any preparation before the test and would have no knowledge of the nature of neither strategy nor study prior to the experiment. Following completion of the testing, the participants filled out a questionnaire containing 34 questions on autobiographical information such as age, handedness, musical background and training, use of practice strategies, lifestyle habits etc. (Table 1, see also Supplementary Material, Appendix 2 for complete list of questions). The experiment was approved by the internal review board (IRB) at The Danish Neuroscience Center at Aarhus University, Denmark. All volunteers gave written informed consent before participation in this study and data were stored



pre-practice ratings, subtracting 1 to obtain only the difference in ratio, multiplying by 100 to derive the percentage change, and multiplying by -1 to invert the direction, so that higher percentage scores (instead of lower) indicate the percentage performance improvement.

The resulting percentage improvement scores were used to calculate a median improvement score across jury members for each study participant. For the purpose of visualization of the results, visual interpolation across the five-point Likert scales was achieved based on the mean results for these metrics across all study participants.

Effects of practice strategy on percentage performance improvement from T1 to T2 were tested with Friedman's 1-way ANOVA for repeated measures. Comparison of the performance improvement between T1 and T2, and follow-up pairwise comparisons of the percentage performance improvement compared to the percentage improvement with no practice, were conducted with Wilcoxon signed rank tests.

Correlation With Reported Practice Routines

To investigate how the specific types of solfège, focus of attention, and use of voice strategies used by the students affected their performance improvement, we applied the Kruskal-Wallis test for between-subject effects. For *post hoc* comparisons, and also for testing effects of gender and use of meditation, two-sample between-subject comparisons were conducted with the Mann-Whitney *U*-test. Since only one student was inexperienced with singing, the effect of previous singing experience was excluded from the tests. For testing these effects with each study participant and for each musical parameter, an overall performance score was applied, which was the median rating across practice strategy and pre/post practice scores. Moreover, an overall percentage performance improvement score was applied for each study participant and for each musical parameter, which was the median percentage improvement across practice strategies.

The possible relationships between years of music training, hours of daily practice, years of studying solfège, hours of sleep, hours of naps between practice sessions, and the performance scores as well as the percentage performance improvements were tested with linear regressions.

The resulting *P*-values were reported without correction for multiple comparisons. However, for tests of the main hypotheses regarding the effect of the four active practice strategies on performance improvement, *P*-values were reported also with the Benjamini-Hochberg FDR correction (Benjamini and Hochberg, 1995).

RESULTS

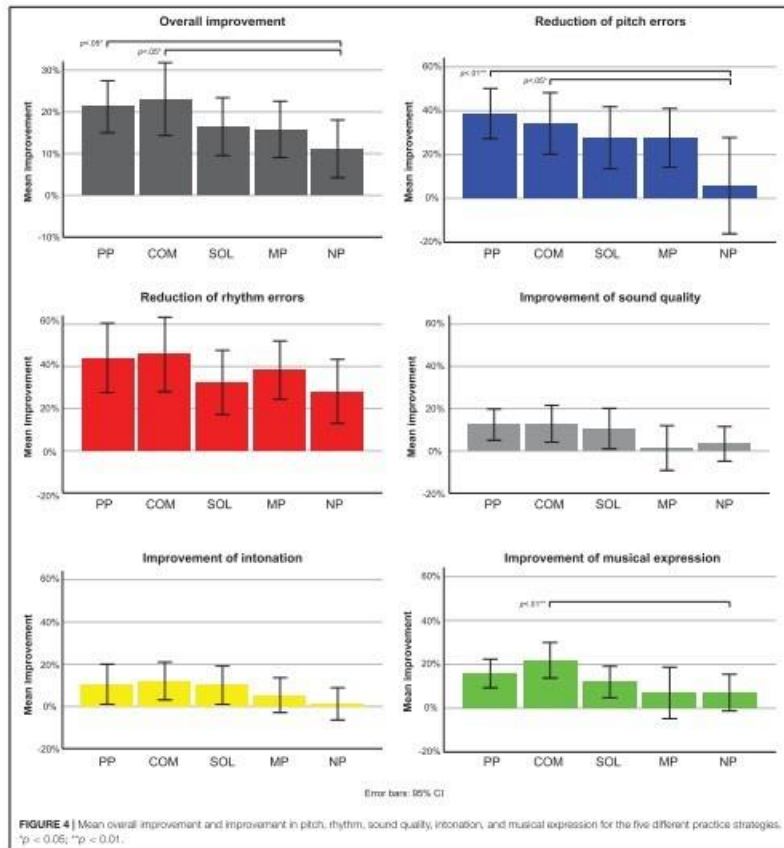
Effects of Practice Strategies on Performance Improvements

As stated in Table 1 the participants were to various degrees familiar with singing, auditory and motor imagery as well as physical practice and were able to apply these strategies during the experiment. All practice strategies resulted in improvements with regard to pitch and rhythm errors (Figure 3 and Table 2). The sound quality improved with physical practice (PP), combined practice (COM), singing (SOL) and marginally with no practice, but not with mental imagery (MP) alone. Intonation improved with all practice strategies, except with no practice. The musical expression improved with all practice strategies.

In the following, we report performance improvement for the active practice strategies in comparison with no practice (NP). It should be noted that the performance improvement scores were weighted by the individual T1-performance score, thereby taking the individual performance level into account (e.g., a reduction of 8% to 4% bars with pitch errors is regarded as a 50% improvement, as is a reduction of 50% to 25% bars with pitch errors). By contrast, the results reported in Figure 3 and Table 2 show the T1 and T2 performance ratings without individual weighting. Therefore, the above and the following results are not directly comparable.

Overall Improvement Across Musical Parameters

The Friedman ANOVA showed that overall improvement differed depending on the practice strategy ($\chi^2(4) = 9.62, n = 49, p = 0.047$) (Figure 4). Wilcoxon signed rank tests showed that across the five tested musical factors, both PP ($z = 2.33, r = 0.33,$



solfege training ($H(3) = 8.77, n = 50, p = 0.033$) (Figure 5). Fewer pitch errors were observed for students who reported having learned the fixed Do ($n = 5$) ($z = 2.30, r = 0.32, p = 0.023$), the moveable Do ($n = 17$) ($z = 2.21, r = 0.31, p = 0.025$), and both methods ($n = 12$) ($z = 2.20, r = 0.31, p = 0.029$) in comparison to students who reported not having learned solfege ($n = 16$). In addition, reported use of random practice ($n = 13$) appeared to

result in higher reduction of pitch errors as compared to reported use of blocked practice ($n = 21$) ($z = 2.79, r = 0.39, p = 0.005$) and use of a combination of blocked and random practice ($n = 16$) ($z = 2.21, r = 0.31, p = 0.027$) (Figure 5).

To verify that the low number of pitch errors was uniquely related to the use of solfege and random practice, multinomial logistic regression was applied to test whether these practice

TABLE 3 | Mean improvement in percentage after application of the five practice strategies as measured on five parameters.

Strategy	Pitch errors	Rhythm errors	Sound quality	Intonation	Musical expression	Average
PP	38.7% (38.2%)	44.1% (52.1%)	12.5% (25.6%)	10.5% (33.0%)	15.9% (22.7%)	24.3% (34.3%)
COM	34.2% (46.6%)	45.7% (56.0%)	12.9% (30.4%)	12.0% (31.3%)	21.9% (28.2%)	25.3% (38.5%)
SOL	27.7% (47.0%)	32.4% (48.2%)	10.5% (33.6%)	10.0% (31.5%)	11.9% (25.0%)	18.5% (37.1%)
MP	27.6% (44.6%)	38.3% (43.8%)	1.4% (36.6%)	5.3% (28.8%)	7.0% (40.9%)	15.9% (39.0%)
NP	5.8% (73.0%)	28.2% (48.2%)	3.4% (28.4%)	1.3% (26.5%)	7.0% (29.1%)	9.1% (41.0%)

Standard deviation is shown in parenthesis.

routines varied independently across the participants. The found effects of using solfege and random practice seemed independent, since the odds ratio of using random practice in relation to either blocked practice or a combination of random and blocked practice did not depend on the solfege strategy ($R^2 = 0.14$ (Cox & Snell), 0.16 (Nagelkerke); model $\chi^2 = 7.62$, $p = 0.267$; neither the odds ratio of using random practice in relation to blocked practice, $p = 0.315$, nor the odds ratio of using random practice in relation to both random and blocked practice, $p = 0.638$, depended on the whether the participants did or did not learn solfege).

Furthermore, for students practicing meditation ($n = 13$) there were tendencies of lower performance improvements regarding rhythm errors ($z = -2.15$, $r = -0.30$, $p = 0.031$) and intonation ($z = -2.7$, $r = -0.38$, $p = 0.007$) in comparison to students not practicing meditation ($n = 37$).

Duration of music training (any music training, trumpet or cornet, other instruments), early onset (before the age of 7), hours of daily practice, accumulated hours of music playing (years of training $\times$ 365 $\times$ hours daily practice) in childhood and adolescence and years of solfege practice did not significantly relate to neither the performance improvement scores or the overall performance scores. Also, there were no significant effects of using singing voice to learn, internal/external focus of attention, constant vs. varied practice, possession of absolute pitch or experience with using imagery.

The parameters hours of sleep and hours of naps between practice sessions did not significantly relate to neither the performance improvements nor the overall performance scores for any of the five measured musical parameters.

Furthermore, we found no significant gender-related differences in neither the performance improvements nor the overall performance scores for any of the five measured musical parameters.

Inter-Rater Agreement

The Spearman rank correlation analysis showed that the inter-rater agreement between all jury members was high for ratings of percentage of bars with pitch errors, percentage of bars with rhythm errors, sound quality, intonation, and musical expression (see Table 4). Also, the percentage of bars with pitch and rhythm errors counted by the jury members reflected the percentage of notes with pitch and rhythm errors detected with the semi-automatic CUEX analysis (see Figure 6 and Table 4).

DISCUSSION

This study investigated the efficiency of five different practice strategies on the initial learning of an unfamiliar musical piece in an experiment involving 50 advanced trumpet students, as measured by ratings from three raters. Interestingly, all of the strategies, including the NP strategy, in which the participants did not practice but simply played the piece a second time, yielded progress in rhythm and pitch accuracy, reflecting the very high level of expertise of the participants. However, for the overall musical reproduction and quality, and in accordance with our hypothesis, both the practice strategy which combined equal amounts of physical practice, singing and imagery, and the strategy which involved physical practice for the same amount of time, generated improvements that were significantly higher than those of the no practice strategy. Likewise, and more specifically, the combined strategy was as efficient as physical practice in improving the pitch accuracy. None of the two effects were found for the practice strategies that relied on motor/auditory imagery or overt singing/solfege alone. The result is in accordance with prior studies (Ross, 1985; Coffman, 1990; Pascual-Leone et al., 1995; Bernardi et al., 2013), with the important difference that, as opposed to those studies, the combined strategy in the present study included overt singing.

Neither PP, COM, SOL or MP were significantly more effective than no practice in reducing rhythm errors and improving sound quality and intonation, although PP and COM showed trends toward higher gains. Remarkably, however and exceeding our expectations, the combined practice strategy produced a significantly higher level of musical expression as compared to all of the other four practice strategies. In addition, the results suggest that previous solfege training was a predictive factor for improvement in pitch accuracy. Similarly, incorporation of random practice strategies in daily practice routines yielded larger improvement gains compared to those using blocked practice. Contrary to common wisdom, duration and onset of music training, number of hours of daily practice and accumulated hours of music training did not significantly relate to neither the performance improvement scores nor the overall performance scores on any of the five measured musical parameters.

Overall Musical Improvement

The implication that the complex task of learning to play a new piece of music on trumpet with high accuracy and quality can be achieved as efficiently by an equal mix of singing, imagining

reported improvement in singing over non-singing conditions in students who were experienced in singing and the opposite, when unfamiliar with singing.

In the present study we found no effect of reported use of singing voice as an isolated practice strategy. However, we did find reduced pitch errors in students who reported to have learned solfege as opposed to students who did not learn solfege (Figure 5), with the fixed-Do approach showing a trend toward being more efficient than moveable-Do and learning both. This is corroborated by Apostolaki (2012), who found a positive effect of fixed-Do solfege. In his study, however, this was measured as improvement in aural skills, while our study illuminates how solfege may benefit main instrument performance.

Solfege and Absolute Pitch

Surprisingly, during application of the SOL strategy, only 14 of the 32 participants who reported having learned solfege chose to use fixed-Do solfege. No significant improvement, however, was found in this specific group as compared to participants who sang without the use of solfege. Likewise, we observed no significant advantage of possession of absolute pitch, neither in terms of improvement nor on level of performance.

Improvement in Learning Due to Elements of Random and Varied Practice

In the present study the COM condition offered a random practice approach which may partly explain the strategy's added efficacy. In support of this argument is the fact that students who reported the frequent use of random practice exhibited an improvement in pitch accuracy, not found in students who mainly used blocked practice or both (Figure 5). This phenomenon could be partly explained by the increased involvement of dorsolateral prefrontal cortex in interleaved/random practice (Lin et al., 2013). This area is believed to be an essential component of the neural network responsible for procedural learning (Pascual-Leone et al., 1996) as it has extensive interconnections with regions involved in motor functions (Diamond, 2000; Lage et al., 2015), and it is also possible that this familiarity with random practice could prepare the participant for the rapid technique changes in the COM condition.

Focus of Attention

A substantial number of studies (see especially Wulf (2013) review of 68 studies across different athletic and musical disciplines; Zachry et al., 2005; Zentgraf et al., 2009; Duke et al., 2011; Mornell and Wulf, 2019) have investigated the influence of focus of attention on training and performance outcomes and the vast majority, whether in sports or musical performance, points to external focus as being most efficient. The present study did not show any significant improvement relating to direction of focus, partly owing to the fact that only three participants reported mainly using internal focus and therefore yielded little statistical value. However, the self-reported use of focus of attention did not relate specifically to acquisition and performance as required in the study but to a general state while practicing.

Music Training

The participants' self-reported data revealed that duration of music training (any music training, trumpet or cornet, other instruments), hours of daily practice, accumulated hours of music training (years of training $\times$ 365 $\times$ hours daily practice) and years of solfege practice did not significantly relate to neither the performance improvement scores or the general performance scores. The finding is consistent with Anders Ericsson et al. (1993) findings that the amount of time spent practicing does not qualify as being the sole determinant factor sufficient to achieve excellence. A number of reasons for this may be considered: whether practice has been deliberate; effect from neuro-active hormones, such as adrenalin, endorphins, dopamine and stress hormones that support neuroplastic adaptations (Altenmüller and Furuya, 2017); social factors such as family and community, influence from teachers, motivational and attentional factors (Wulf and Lewthwaite, 2016), and genetic influences.

Early start is considered an advantage in learning to play a musical instrument (Steele et al., 2013), as those individuals who later become professional musicians usually start their musical training very early, sometimes before the age of six, when the adaptability of the central nervous system is at its highest (Altenmüller and Furuya, 2017). Our study, however, provided no evidence of improvement nor general level in those who reported starting before the age of 7, compared to later starters.

Sleep and Meditation

Sleep has been implicated as an important factor in learning and consolidation of motor skills (Walker et al., 2002; Nishida and Walker, 2007). The influence of sleep has also been shown in consolidation of motor skills in music (Allen, 2007) and in auditory learning (Gaab et al., 2004). We did not include sleep as a factor in our study as students were tested right after practice. However, the participants' self-reported general sleep duration showed no significant relationship with neither performance improvements nor overall performance scores, which may be explained by one study (Tucker et al., 2016) suggesting that musicians have the capacity to consolidate a motor skill across waking hours. Meditation has also been seen to have a positive effect on motor learning (Immink, 2016), but surprisingly we found negative effects on improvement of rhythm and intonation in those who reported regular use of meditation compared to those who reported no use of meditation.

Gender

As expected, we did not find any significant difference in improvement or general level of performance related to gender.

Limitations of the Study

The study only measured short term improvements in a brief practice interval (approximately 3 min). It could have been interesting to have employed longer practice intervals and also to assess the long-term effects of the acquisitions. This, however, would have been a logistic challenge, considering the magnitude of the number of participants and their geographical diversity.

We did not measure the difference between auditory and motor imagery, since this would have required inclusion of a sixth strategy, adding significantly to the logistic complexity. However, prior to the imagery trial, the participants were instructed to practice utilizing both strategies simultaneously, as is often the approach. Observation of the potentially differentiated effect of these two strategies nonetheless might have provided an interesting aspect to the findings.

Finally, it is important to bear in mind that the correlation analyses between practice routines and performance improvement are based on a high number of exploratory tests, which should of course be taken into consideration when interpreting the findings.

CONCLUSION

This study investigated the efficiency of complementary practice strategies on the initial early learning and short time gains of an unfamiliar musical piece in an experiment involving 50 trumpet students. The results confirm and extend previous findings showing that, compared to no practice, a strategy combining physical practice, imagery and singing was just as efficient as extensive and repetitive physical practice in improving both the overall performance and the pitch accuracy, and more efficient than practice strategies that relied on motor/auditory imagery or overt singing/solfege alone.

Moreover, the combined practice strategy produced a significantly higher level of musical expression as compared to all other four practice strategies. The results indicate that application of mental imagery and singing may have a strong potential as complementary practice strategies, providing a less physically taxing alternative to physical practice and a more musical outcome.

Furthermore, among the trumpet students who reported to have learned solfege, there was an improvement in pitch accuracy relative to students who did not learn solfege. A similar result was apparent in students who reported to mainly apply random or interleaved practice compared to students reporting applying mainly blocked practice or both. Years of music training, early start, amount of hours daily practice, accumulated hours of music training, however, did not significantly affect the extent to which short-term training increased performance improvement scores nor the general performance scores before and after the training session. In conclusion, the findings suggest that applying practice strategies that complement conventional physical practice can reduce physical practice quantity while maintaining the same performance quality. Furthermore, the study adds valuable insight into brass instrument performance, which may generalize

to musical practice and, in a wider perspective, to many other forms of learning, in which cognitive processes and motor skills are involved.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Internal Review Board (IRB) at The Danish Neuroscience Center at Aarhus University, Denmark. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

KS was the main author of the manuscript. NH carried out the data analysis and statistics. BK, PV, and BP were the co-authors of the manuscript. CC carried out the experiments. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.757052/full#supplementary-material>

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Figure 19. Tabuena (2021)

contributes much to laying a sound foundation for the study of music. Also, psychologists agree that acting is a child's substitute for abstract thinking. Motor behavior is the most conspicuous characteristic of childhood. Associated sounds, physical movement, tactile experience, space relationships, through personal comparison - all provide a 'learning-in-depth.' Even at an elementary level, these games develop instantaneous coordinations, keener perceptions, and visual focus, and they demand constant memory discipline, all of which are literally 'brought into play.'

Philosophy. The psychological preparation of the [Carabo-Cone, \(1969\)](#) Method of teaching music, supported by the theory that structured subject matter can be grasped if translated into a concrete explorable environment, are discussed. A connection is made with other methods ([M Carabo-Cone, 1959](#)) (Dalcroze, Kodaly, Montessori, Orff, and Suzuki), and the room's arrangement and design as a learning environment and the musical staff as a mental platform are acknowledged. Attention is given to the child's body as a learning aid, motive, the mental and visual focus of concentration, developing skills, prevailing suggestions for teachers, and information of the rest of the method set pamphlets. The physical setup for playing the musical games, combined with creative and dramatic elements, introduces the basic requirements for learning music.

Methodology. The critical concepts linked with the ([M Carabo-Cone, 1959](#)) Method include sensory-motor, concrete environment, and musical games. This early-childhood method, sometimes referred to as the Sensory-Motor Approach in Music education, was formed by the violinist Madeleine Carabo-Cone. This method involves using costumes, props, and toys for children to discover basic musical concepts and notions of note duration, staff, and the piano keyboard. The specially organized classroom environment enables the child to acquire the music rudiments by exploring through the sense of touch. To be used in combination with all the games for every age group are the time-value, rhythm, and coordination games. Several activities and games such as Banners Flying, Feeling the Beat, Counting Measures, or Conducting Designs are vital in that they never outgrow their usefulness. Each game in classification has its learning goal clearly defined. The program aims to contribute musical literacy to all children instead of a random few.

Dalcroze Method

Proponent. Émile Jaques-Dalcroze (July 6, 1865 - July 1, 1950) was a Swiss composer, musician, and music educator who developed Dalcroze Eurhythmics, an approach to learning and experiencing music through movement. The Dalcroze Method is also connected with the "Sense of Rhythm." This method ensures learning the sounds, fundamental elements of musical hearing, rhythm, and tempo correctly, while it establishes learning with gymnastics and games for a student to have permanent musical knowledge.

Foundation. Dalcroze Eurhythmics is used to cultivate music appreciation, improvisation, and ear-training while advancing musical abilities. In this process, the body is the central instrument. Students listen to the rhythm of a piece of music and communicate what they hear through movement. Simply put, this method connects music, movement, mind, and body. Movement is the connection between ear and brain, directing the students to an integrated and deeply internalized understanding of music.

Philosophy. Dalcroze believed the first instrument that must be trained in music is the body. He produced techniques that merged hearing with a physical response, shifting to a physical response in singing and music reading ([Estrella, 2018a](#)). His primary goal was to amplify the inner ear to aid musical thinking, reading, and music writing without an instrument's aid. While advancing to develop his methodology, he recognized his students who could not play or perform in time in the music world could walk in time in the actual world. The walking was entirely spontaneous and straightforward.

Methodology. The key concepts associated with the Dalcroze Method include the following: eurhythmics, solfège, improvisation ([Mead, 1996](#)). Eurhythmics is a musical expression and interpretation through movement, strengthening musical skills through kinetic activities and exercises. The students can discover rhythm and structure by listening to music and expressing what they hear through spontaneous bodily movement. On the other hand, solfège helps improve ear-training and sight-singing skills. Dalcroze employed a fixed tonic solfège system (fixed-do), believing that all children can ultimately develop perfect pitch.

Further, improvisation is by using instruments, movement, and voice. Techniques of Dalcroze Eurhythmics, in 1905, he designed thousands of exercises and games by uniting beautiful music, intense

listening, and consciously improvised movement. According to Dalcroze, the teacher must improvise and devise the songs for the music class's pursuits. The motion addressed by Dalcroze were: accents, duration, dynamics, movements, postures, and gestures to express the tempo and other rudiments of music that generate rhythmic material (Estrella 2018b.)

Kodály Method

Proponent. Zoltán Kodály (December 16, 1882 - March 6, 1967) was a Hungarian composer, pedagogue, ethnomusicologist, philosopher, and linguist, known internationally as the author of the Kodály Method. The Kodály Method is also associated with the "Sense of Pitch." In this method, children are first introduced to musical concepts through experiences and participation, such as singing, listening, or movement. Kodály found movable-do solfège to help develop a sense of tonal capacity, thus developing students' sight-singing skills.

Foundation. The Kodály Method improves musical skills and teaches musical concepts to very young children (Dikkaya et al. 2019). This method employs folk songs, movable-do, Curwen hand signs, rhythm symbols, pictures, and syllables (Estrella 2019a). It was first organized in Hungary but now practiced in many countries, either in union or succession. To train a child a musical instrument without first providing him preliminary training or instruction and without forming singing skills, reading, and dictating to the highest level along with the playing is to build upon the sand (Choksy 1981).

Philosophy. Kodály's main goal was to impart a lifelong love of music to his students and sensed that it was the child's school's responsibility to give this essential educational study element (Estrella 2018a). Some of Kodály's trademark instructional methods involve applying solfège hand signs, stick notation such as the musical shorthand notation, and verbalization or rhythm solmization. The following are Zoltan Kodály's philosophies, as well as his goals towards the method: (a) advance the level of teacher training and enhance musical literacy in schools; (b) everyone is capable and has the right and freedom to musical literacy; (c) singing is the cornerstone of musical learning; (d) music education must commence with the very young; (e) the value of using folk music and music of high artistic purpose; (f) including movement, games, playing instruments, music reading and writing with singing; and (g) sequential method supporting a child's natural learning growth and development.

Methodology. The key concepts associated with the Kodály Method include the following: movable do, hand signs, rhythmic syllables. Although the Kodály Method supports a set sequence, the materials utilized in teaching musical concepts vary depending on age. The sequence followed may be simplified as listening, singing, understanding, reading, writing, and creating. Using this process under the supervision of a certified Kodály teacher, students can improve listening skills, sight-singing skills, ear-training abilities, learning to play musical instruments, composing, improvising, singing, dancing, analyzing, reading, and writing music. He initiates with sight-reading, learning primary rhythms, and acquiring pitch with a "hand-sign" method that helps children conceive the spatial relationship between notes. These hand-signs merged with solfège singing (e.g., do-re-mi) support in on-pitch singing. Kodály is likewise identified for a system of rhythmic syllables to form a steady beat, tempo, and meter. A student in music naturally advances into a mastery of sight-reading skills and ear training abilities within these blended lessons.

Orff Schulwerk Approach

Proponent. The Orff Schulwerk approach was introduced and amplified by Carl Heinrich Maria Orff (July 10, 1895 - March 29, 1982), a German composer and music educator, best known for his cantata Carmina Burana in 1937 (Rothstein, 1982; Estrella 2019b). The concepts of his Schulwerk (schoolwork) were influential for children's music education. The Orff Schulwerk approach is also associated with the "Natural Sense of Play." This approach starts with students' innate and natural abilities to engage in fundamental music forms, using basic melodies and rhythms. He acknowledges the whole body as a percussive instrument, and students are directed to improve their musical abilities to correspond to Western Music (Music et al. 2019).

Foundation. The Orff Approach is a means of educating children regarding music that involves their mind and body through a blend of acting, dancing, singing, and percussion instruments. For example, the approach usually employs instruments like glockenspiels, metallophones, and xylophones.

A fundamental component of this approach is that lessons are implemented with an element of play, which benefits the children to learn at their comprehension level and understanding. Composition, improvisation, and a child's natural sense of play are reinforced. Elemental music is never just Music (Orff et al., 1950). It is treated with dance, movement, and speech, and so it is a form of music in which one must engage not as a listener or audience but as a co-participant, a co-performer.

Philosophy. Carl Orff's philosophy of education in music focuses on providing all students with the opportunity to succeed (Estrella, 2018a). This approach contains a series of steps that may be completed in any order. Musical independence (freedom) and improvisation (discovery) are an essential part of a young child's musical involvement and learning process, and the application of the Orff Approach can be a flourishing way of empowering students to manifest these ways. The Orff Approach in Music education is a "child-centered process of musical learning" that treats music as an entire system like language. It upholds that just as every child can learn a language without formal education, so can every child discover and learn music by a considerate and friendly (cooperative) approach (Campbell, 2008).

Methodology. The critical concepts connected with the Orff Approach include the following: exploration, improvisation/creation, independence, literacy (Orford, 2013). Orff's approach, formed for children but recently adopted also with adults, was founded on his belief that the most straightforward music teaching approach is to draw out the student's inherent and natural inclinations for melody and rhythm and enable these to expand in natural ways. Orff's approach guides the child by his intuition and inspiration from primitive to more advanced expression through stages conforming to Western music's evolution. Orff achieves this by employing a deliberately planned program, starting with speech patterns, then rhythmic movements, followed by two-note tunes, next moving rationally into a pentatonic melody. Adult pressure or stress and mechanical drill (exercises) are discouraged; on the contrary, improvisation is encouraged. The primary and minor melodies are presented as the final stage of the curriculum. Orff created a select group of musical instruments, including drums, glockenspiels, metallophones, xylophones, and other percussion instruments, to meet the necessities of the Schulwerk (schoolwork) courses.

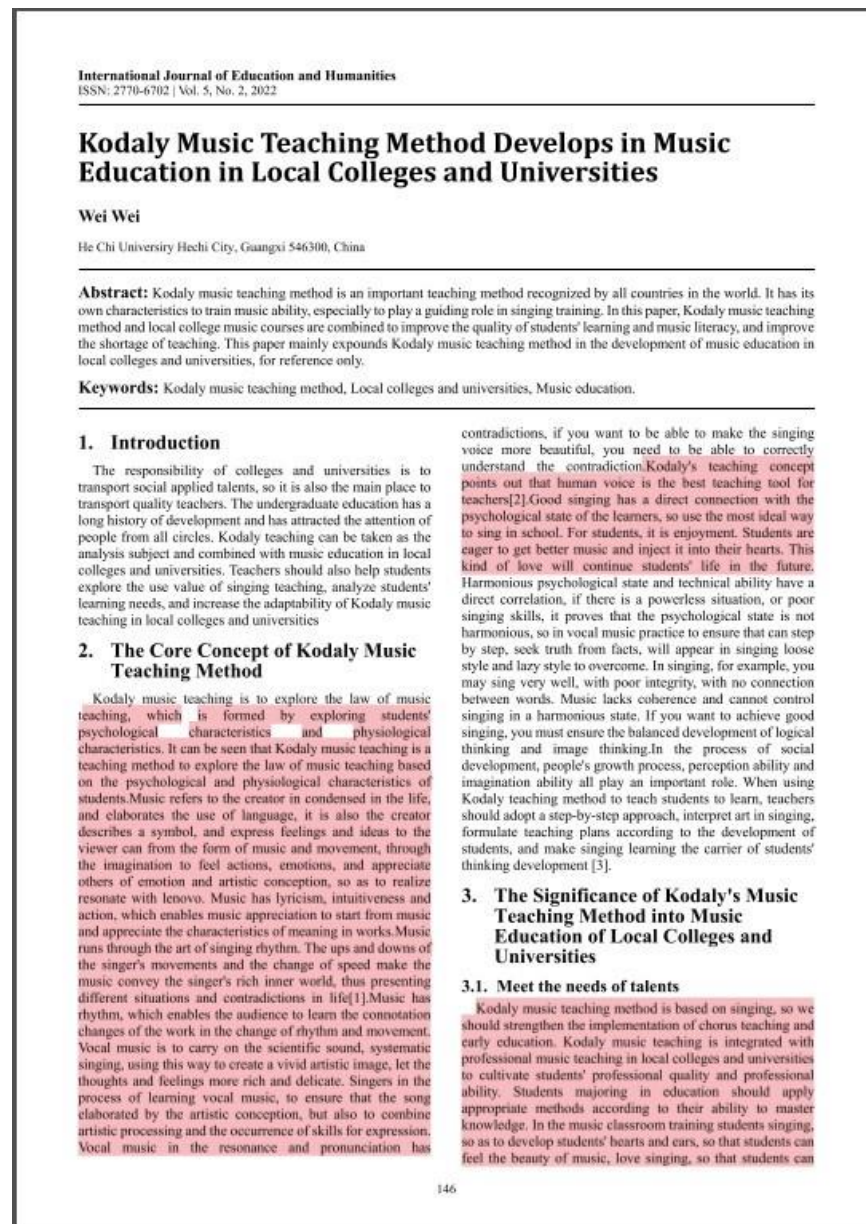
CONCLUSION

The four methods of teaching strategies in Music education specified in this study varied in four indicators such as in the proponent, foundation, philosophy, and methodology, yet similarly focused on using the senses for holistic growth and development and providing the opportunity for all students to be successful as everyone is capable and has the right to musical literacy (Landis, 1972). The quality of education depends mostly on the part of the teacher. The different Music teaching strategies serve as a guide to fulfill the purpose that a teacher and student needs. The methods, approaches, and strategies of the teachers in the utilization of learning, learning difficulties. Learning styles include developmentally appropriate strategies, differentiated activities, and instructional materials, schematic processing, modeling, creative teaching strategies, and socialized classroom art of questioning (A. Tabuena, 2020a) by the Music teaching strategies by recognizing and assessing their students and applying the appropriate teaching strategies to learn and equip them for the 21st-century skills. Although this research study is limited to four Music teaching strategies, it will help future music directives and perspectives on evaluating appropriate teaching methods, approaches, or music education strategies. In this light, the researcher recommended analyzing its implications towards different modes of learning, that is, blended, distance, modular, self-directed, and online learning, as global education facing numerous challenges in terms of economic crisis, pandemic, educational incapability, and inequalities, and other related matters that could affect the educational system.

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Figure 20. Wei (2022)



achieve comprehensive development. Teachers in local colleges should apply moral knowledge in music teaching. When teaching students to sing, they should ask them to use gestures to build ladders to sing, which is the multiple pitches of Colvin's gesture singing. Gesture pitch is the rise and fall in pitch that allows students to practice singing. Teachers of local colleges and universities can arouse the enthusiasm of students and strengthen their vocational ability when commenting on the students they teach. At the same time, it is necessary to improve the shortcomings in education and apply Kodaly music teaching model in music teaching of local colleges and universities, so as to cultivate professional talents and meet the needs of talents. For example, professional students from local colleges and universities go to kindergartens or primary schools and apply the knowledge they have learned in practical teaching. When the teacher leads the students to learn "My Hometown Shigatse", it is necessary to explain how to use gestures to build ladders. The ups and downs of gestures should be combined with the ups and downs of music melody, so that the students can master the melody trend of music. In chorus activities, teachers should also play videos for students when explaining folk songs, so as to ensure that national culture can be inherited and students can feel the charm of songs in the scene. In chorus performance, students should use staff to check the interval distance, to ensure that the voice is more stable and better cooperate with other students' voice parts. After students carry out independent practice, they can also improve the efficiency of chorus [4].

3.2. Stimulate students' interest and initiative in music learning

For the students of local colleges and universities, the learning foundation is poor, so they should start from the beginning to learn music knowledge. In particular, the students of local colleges and universities should develop the ability of music perception, rhythm control and score recognition. School arrangement and local colleges and universities music, piano music in professional course, content, which plays an instrument and sings songs for children students learning problems in the learning efficiency is low, interest is low, so the kodaly's music teaching method can be applied to use in music teaching, to join the action goes antiphonal singing teaching and points the way innovation teaching, arouse students' interest in learning music knowledge. So that students can learn the rhythm in music. Learning music has more fun, teachers explain the rhythm of music, can make students grasp the rhythm of music through auditory vision in information teaching. Teachers should also create situations, carry out improvisation, consolidate the learned knowledge, so as to improve students' ability to control music [5].

3.3. Enhance the efficiency and quality of music teaching

In Kodaly music teaching content, learning and training rhythm is the difficulty. If the traditional teaching is used, the teacher will show the music singing and practice singing instructions when carrying out the rhythm teaching, so that the students can master the rhythm change, which can not arouse the enthusiasm of students to learn, and can not improve the efficiency of students' learning. In music teaching, Kodaly teaching method is applied to train the rhythm and use gestures, so that students can feel the change

of music rhythm. This kind of complex rhythm teaching can be more specific and strengthen the quality and efficiency of music teaching. Students learn music from strong and weak beats, step by step, until independent completion. Kodaly music teaching method attaches importance to the rhythm of oral reading and gestures, which is easy for students to understand and accept. For example, students learn music from strong and weak beats, step by step until they can independently complete Kodaly music teaching. Pay attention to the rhythm of gesture and oral reading, easy for students to understand. When students touch the single beat, the relationship between the strength and weakness of the two beats is strong and weak. The strong and weak beats have a happy and concise rhythm. Teachers should let students clap their hands to feel the strength of the leg, the right hand clap the right leg is strong, the left hand clap the left leg is weak, the speed from slow to fast, from fast to slow changes, students under the guidance of the classroom for continuous training, so as to show the detailed rhythm of the movement. Teachers should according to the situation of the students to master knowledge to join the single teaching, three of the pat this time with a sense of rhythm, teachers can let students try to make both physical activities, to facilitate students to master the rhythm relations, this kind of teaching pay more attention to students' participation, teachers use different expression, lets the student from imitation to alone, better knowledge, deepen students rhythm awareness, Let students develop interest in learning music [6].

3.4. Effective integration of various teaching methods

In order to achieve different teaching objectives, generally will use different teaching methods. Teachers do not connect these contents in their teaching, and Kodaly can improve this problem. Before teaching, teachers let students participate in the practice of singing and writing, qualitative creation, game competition, etc., to provide a guarantee for students to build an efficient teaching classroom, but also innovative teaching methods, improve students' enthusiasm for learning, for students to accumulate knowledge. Teachers add auxiliary teaching methods to traditional teaching mainly participate in games and competitions. When students are learning the song "Xiaoyu Shasha", teachers will divide students into several groups, with about five people in each group, and guide students to participate in hand gestures to beat according to the music beat. If there are students who make mistakes, they can learn from each other in a group so that they can grasp the rhythm of the music. After the students learn the knowledge, the teacher also wants to create the situation in the music class, such as the art performance, simulation competition, etc., let the students create the movement according to the song. Both teachers and students act as judges to encourage outstanding teams and mobilize students' innovative ability. The application of Kodaly teaching method in teaching can help students better master skills [7].

4. Conclusion

To sum up, Kodaly music teaching method used in music classes of local colleges and universities can make students devote themselves to music learning and cultivate students' sense of music rhythm and perception ability. It is feasible and practical to use Kodaly teaching method in music classroom of colleges and universities, and it can also make students

Table 2. Relationship Between Moderator Variables and Ear Training Achievement.

Variable	Effect Size	Test Statistic	p Value
Age	$r = .03$	$t(391) = 0.63$	.52
Gender	$d = 0.23$	$t(279.7) = -2.27$	.02
Absolute pitch	$d = 0.30$	$t(20.8) = -1.24$	.23
Solmization	$d = 0.11$	$t(204.6) = 1.00$	.32
Music studies	$d = 0.07$	$t(368.2) = -0.68$	.50
Language	$\eta_p^2 = 0.004$	$F(2, 390) = 0.77$	.46
Main instrument	$d = 0.10$	$t(335.7) = 1.01$	.31
Genre	$d = 0.20$	$t(365.7) = -1.94$	.05

Effects of Various Moderator Variables on the Ear Training Skill

Switching the perspective away from the item parameters and their goodness of fit to the participants, we were able to calculate a simple percentage score for the correctly solved items of each participant. Here, this percentage—unlike in classical test theory—is made up of homogenous and unidimensional items, is interval-scaled, and represents the participant's latent skill by probabilistic association.

Since this is, to the best of our knowledge, the first time that influencing factors on ear training (as measured by a standardized instrument) have been examined, we mainly focused on the effect size of each moderator variable. This was done for two reasons: First, an effect size gives information on the magnitude of a correlation or difference, enabling us to estimate its importance. Second, as only 20 participants reported possessing absolute pitch, it was close to certain that this difference would not reach any significance level.

No effects were found for some of the often debated topics, such as the main instrument and occurrence of solmization classes. The three moderator variables reaching the baseline for a small effect (Ellis, 2010) were gender, genre, and absolute pitch. Male subjects solved more items than female (mean response probability in percent, $M_m = 42.5\%$, $M_f = 35.3\%$), and musicians playing mostly jazz, rock, and pop (jrp) solved more items correctly than those playing classical (c) music ($M_{jrp} = 43.5\%$, $M_c = 37.4\%$). Not surprisingly, the 20 participants with self-reported absolute pitch (AP) solved more items than did participants with relative pitch (RP; $M_{AP} = 48.9\%$, $M_{RP} = 39.6\%$; see also Table 2).

Short Test Versions: META-25 and META-10

On the basis of the fitting items, two shorter test versions were compiled to provide instruments with high test efficiency. Test version Musical Ear Training Assessment 25 (META-25) consists of 25 items with a mean difficulty of $M = 38.9\%$ ($SD = 19.0\%$, see Table S8 in the online version of the article). Test version META-10 consists of 10 items with a mean difficulty of $M = 41.5\%$ ($SD = 21.1\%$; see Table S9

in the online version of the article). Their properties are comparable to the full number of 53 items (META-25/all items: $r = .84$; META-10/all items: $r = .68$). To facilitate future research, these short test versions are available at <http://thinkinginmusic.com>.

Longitudinal and External Validation Study

Due to time restrictions, the 1-year intervention study was partly conducted before the validation study. For this reason, 21 pretested but at the time unvalidated items were tested. Of these 21 items, 12 were later confirmed by the Rasch analysis. All following calculations are based on the subset of these 12 items.

In this study, the full cohort of $n = 33$ participants (13 women) from a first-year undergraduate music study program took part. In this first year of studies, participants received 1 hour of ear training instruction per week during a lecture period for a total of about 25 weeks, here regarded as an educational intervention. At two points in time (November 2013 and June 2014), the same items were tested as part of a regular class meeting. In addition to their test scores, entrance exam and study grades were made available from the university administration. In both parts of the entrance exam (written and oral), music theory and ear training were tested and graded together. For the study grades, one grade resulting from written exams for each subject was available.

First, participants improved their skill by $d = 0.27$ (95% CIs [0.02, 0.53]). This change corresponds to an improvement of 8 percentage points ($M_1 = .47$, $M_2 = .55$) or to one more correctly solved item. This result is an indication for a theory-consistent intervention effect, subsumed under construct validity (Gregory, 2015). Participants' scores correlated highly at both points in time, $r = .73$, $t(31) = 5.96$, $p < .001$, providing evidence for notable consistency of this skill over time.

Since university grades are not interval-scaled, the nonparametric correlation coefficient Kendall's τ was calculated for correlations involving entrance exam and study grades. To address questions of criterion-related validity (i.e., retrospective, concurrent, and predictive), META scores from pre- and postintervention were correlated with entrance exam grades prior to the beginning of studies and study grades from an exam shortly after the posttest. As expected, the META score correlated highest with grades for the participants' ear training skill, such as the entrance exam grades and ear training study grade. The lowest correlation was achieved between the META score and the music theory grade, providing additional support for convergent and discriminant validity (see Table S10 in the online version of the article).

To recapitulate the found gender difference, we performed t -tests to compare scores for men and women on the following: preintervention META score ($d = 0.63$), postintervention META score ($d = 0.45$), written entrance exam ($d = 0.48$), oral entrance exam ($d = 0.60$), and ear training study grade ($d = 0.63$; always men outperforming women). No effect was found only for the music theory study grade ($d = 0.02$). While none of the results was significant, the sheer frequency of this gender disparity provides every indication that more research on this entirely unexpected finding is indispensable.

Discussion

First, we were able to assess the musical skill of ear training with a standardized test procedure using objectively scorable items. This was achieved with the theoretical foundation of a one-dimensional Rasch model (or 1PL model), which allows the conclusion that only a person's ear training skill influences his or her test behavior. Second, the final items best fit a one-dimensional model, suggesting that despite any didactical divisions, ear training is a skill best described by a model with one latent dimension. Third, the developmental study over one academic year showed the ability of this test to measure improvement and provided evidence for its substantial construct and criterion-related validity. For instance, entrance exams at universities of music often show a low prognostic validity when predicting the study grades of admitted students (Wolf & Kopiez, 2014), and this prognostic validity, in addition, seems to differ between different instrument groups (Lehmann, 2014): High correlations were found for pianists and singers ($r > .5$) and low correlations for string players ($r < .1$). Fourth, as shown in the online study, the ear training skill differed depending on the genres in which the musicians most often practiced and their level (or lack) of absolute pitch. The musicians' ages, college majors, and whether they had had learning experiences with solmization did not correlate with a difference in their ear training skill. The lack of a relevant correlation between the ear training skill and the participant's age leads, for now, to the cautious supposition that the data from the paper-and-pencil-tested pilot study are comparable with the online sample with participants of a broader age range. Undoubtedly, only a new investigation into this question can provide further insights. Future investigations on the influence of absolute pitch could best start with a matched-subjects experiment with, above all, a standardized assessment detecting absolute pitch possessors. Unexpectedly, no difference was found for musicians with harmonic versus melodic/rhythmic instruments. And very much to our surprise, we found considerable gender differences in the ear training skill, with males outperforming females throughout (d between 0.23 and 0.63).

This provides much substance for speculation. Looking at the staff who generally teach music theory and ear training in German music schools, one often sees a larger number of men than women teaching these subjects. However, no gender difference was found for the music theory study grade. There is some evidence that women's performance can decrease in tests when they either have to state their gender or are in the minority in an exam situation (Fine, 2010)—both of these circumstances were true in the test situation of the developmental study.

A second explanation for the gender disparity originates at the neurophysiological level. Zaltz, Roth, Gover, Liran, and Kishon-Rabin (2014) found significant differences in pitch perception in children (better performances from boys). Investigating both pitch and loudness discrimination, Rammsayer and Troche (2012) also found that men outperformed women, a fact that still held true after controlling for musical training. However, in their literature review, the accumulated results were more ambiguous and led in several directions. Furthermore, research on otoacoustic emissions shows that women's spontaneous otoacoustic emissions are louder than those of men, providing evidence for,

in general, better hearing in women than men (McFadden, 2008). The author concludes "that the auditory system apparently is highly sensitive to certain (as yet unknown, but possibly hormonal) influences operating early in development and some aftereffects of that apparent sensitivity persist into adulthood" (McFadden, 2008, p. 320).

Third, one could argue that the ear training skill as an *auditory-spatial* skill is somewhat similar to the visual-spatial skill as scales and chords are often imagined in a two-dimensional space like a musical score. In such a mental image, the temporal progression is depicted on the *x*-axis and the music's pitch on the *y*-axis. Whether musicians use such a mental image to solve ear training items needs to be a subject of future studies. As men generally show higher performance in visual-spatial tests, especially tests of mental rotation (Lippa, 2005; Voyer, Voyer, & Bryden, 1995), this might provide some explanation for this previously unknown musical gender effect.

Aside from further research on this skill difference between men and women, more general questions regarding musical skill structure and acquisition can be investigated. The primary purpose of the development of this test was to objectively measure the ear training skill so that researchers can study this skill on its own (e.g., in longitudinal studies comparing different learning methods). As a control variable in studies, it can help us to better understand the presumed but empirically unconfirmed relevance of the analytical hearing skill in musicians. On the other hand, this test is less suitable for often repeated assessments in non-research-focused settings as the items are always the same. This could especially impact the results of the shorter test versions due to habituation effects. Moreover, we recommend the application of the 25-item version META-25 if its longer duration is feasible due to the lower correlation ($r = .68$) between the 10-item version META-10 and the respective item set tested in the validation study.

Regarding its test theoretical background and the general makeup of the item set, this test offers the possibility of screening entrance exam candidates at universities of music and advanced students at music schools to quantitatively determine how much they can improve ear training skill over the course of their studies. In addition, we hope that this methodological approach has shown that subject areas, which at first sight do not seem to be objectively measurable, might still be suitable for a performance test (e.g., music theory and analysis). The results of such a test can offer a standardized score that can be easily compared within and between students.

Conclusion

We have developed an extensively proven assessment instrument to measure the ear training skill of advanced amateur and professional musicians. Fifty-three items have been made available to the scientific community and can quantify the one-dimensional manifestation of a person's ear training skill. Two short test versions with 10 (META-10) and 25 (META-25) items were derived to enable efficient testing.

These results suggest that future research should focus on differences in ear training skill between musicians of different genres, with and without absolute pitch, and, surprisingly, gender. Moreover, by means of this and other standardized assessments, we

listen to it. This kind of teaching has the problem that students lack the ability to perceive music physically.

3.3. Deficiencies and Challenges

Firstly, low student participation is one challenge. Solfege and ear training as a basic subject of music, the learning content is relatively boring. This leads to lower interest in the subject, less motivation in the classroom and thus lower student engagement in the classroom. Besides, large individual differences are also a challenge. Due to the differences in students' music learning background, talent for music learning and ear training ability, and the large class system of solfege ear training courses, it is difficult for teachers to customize the teaching plan suitable for students while maintaining the teaching progress and teaching effect. Moreover, outdated teaching methods is one of the main deficiencies. The teaching methods of "reading along" and "singing along" adopted by teachers make solfege and ear training a single and rigid discipline, which can no longer meet the learning needs of cultivating music literacy. Outdated teaching methods not only make learning lag behind, but also affect students' interest in the subject. Furthermore, less combination with modern elements is the fourth challenge. Traditional solfege ear-training teaching mostly relies on subject-specific textbooks for teaching, which take a long time to change and cannot meet the needs of the class in time.

With the development of The Times, modern teaching technology is progressing rapidly, but it is seldom used in solfege class. Solfege ear-training is a basic music subject. The traditional teaching method of solfege ear-training is relatively simple, the course content and teaching class are boring, and the students lack interest in this subject, so the students' participation in the class is low. Sight-singing practice ear and colleges and universities how to many big class teaching, students' music learning background, the inherent quality and practice ability is uneven, music [6] it gives teachers how to develop the teaching plan has brought the huge challenge.

3.4. Advantages of Orff Method

The first is that it can improve student participation. Orff method emphasizes students' subjectivity. In the classroom, teachers take students as the main body, change the traditional mode of "teachers say, students listen", cultivate students' subjective initiative, stimulate students' interest in solfege and ear training, and improve students' class participation. Besides, it can also improve teaching efficiency. Give full play to the "improvisation" of Orff teaching method in teaching, let students synthesize their own interests and hobbies, improvise some rhythms or melodies according to the learned knowledge, cultivate students' personality and improve students' learning initiative. In addition, due to the level of students' musical ability, the complexity of the creative content is also different, which is convenient for teachers to timely understand the knowledge of students. Moreover, it can also enhance the ability of art appreciation. Orff's teaching method focuses on "comprehensiveness". The use of comprehensive subject knowledge in the classroom is no longer limited to cultivating a single solfege and ear training ability, but in the process of learning to stimulate students' creativity and imagination, divergent musical thinking, so as to promote the growth of comprehensive ability.

4. Application of Orff Teaching Method in Solfege Class

4.1. Strengthen Rhythm Teaching, Improve Perceptual Ability

In solfege class, teachers adopt Orff teaching method to optimize traditional teaching methods and train students' judgment and response to music rhythm. The teacher designed different body movements for different rhythm patterns, allowing students to learn and master new rhythm patterns through body movements, such as expressing the beat by swaying from side to side or stepping, strengthening the impression of knowledge points through body movements, feeling the rhythm of rhythm patterns, and strengthening the ability to perceive rhythm. Teachers can also use familiar phrases in life to match the rhythm of learning, no longer limit the learning of rhythm to the learning of music, so that students can feel the rhythm from life. Teachers can also provide basic rhythm patterns for students to adapt and show their own creations on this basis. Such rhythm games not only consolidate students' own knowledge and cultivate students' creativity, but also facilitate teachers to understand students' knowledge.

4.2. Use Movement Teaching to Train Coordination Ability

The bluff teaching in Orff's movement teaching method refers to the teaching that uses simple and primitive body movements to make various rhythmic sounds. The teacher can divide the students into different groups, give the specified rhythm pattern, and each group designs a set of body movements to represent the rhythm pattern. Each group completes the rhythm pattern. After confirming that the students have mastered how to make a bluff, the teacher will formulate a body movement and rhythm pattern for each group, and perform the superimposed performance one by one, so as to investigate the students' flexible response ability and understanding ability of the beat, so as to improve the students' good training and practice ability of music rhythm. In the process of playing, students can not only train their teamwork ability and physical coordination ability, but also improve their learning interest and maintain their subjectivity in the classroom.

4.3. Multi-part Rhythm Training

In Orff's multi-part rhythm training, rhythm and body movements are combined to improve students' memory ability and effect. In the multi-part rhythm training, teachers can ask students to make relatively simple rhythm patterns with body movements, and then sing more complex rhythm patterns, so as to cultivate students' ability to play multi-part melodies. Reasonable work related to multi-part rhythm training should be carried out to give students more time and energy to memorize more complex voice parts, which can also reduce students' learning difficulties in multi-part rhythm training and enhance students' enthusiasm and initiative to participate in classroom learning. Multi-part rhythm training can also provide guarantee for students' music solfege learning, further strengthen students' musical ability and cultural literacy, and enhance students' physical coordination and innovation. In the process of cultivating students' coordination ability, teachers should strengthen the interaction and communication with students, use teachers to

demonstrate and explain various forms, mobilize students' initiative to participate in classroom learning, activate the classroom learning atmosphere, make up for the drawbacks of traditional classroom teaching, and bring students different learning experience and feelings.

5. Case Analysis

5.1. Training with Songs to Make Loud Movements

The first step is learned to sing the song "Qumandi", the teaching goal is to feel the melody style and rhythm style of Xinjiang folk songs. The second step refers that the teacher shows the rhythm of the song with national characteristics, and designs the music according to the rhythm. Students learn new rhythm patterns and experience the rhythm of the rhythm by imitating and associating with the movement. The it comes to consolidation and practice of bluff movements. Through the way of unison, Canon and rotation, experience the strong rhythm brought by syncopated rhythm. The Outward Bound training of bravado movements is the next step. After the students are familiar with the rhythm pattern, the difference of different timbre of different body parts such as hands, feet and legs is gradually added to guide the students to make a gesture with syncopated stress characteristics. The last step is to combine movement with singing. First, the students are divided into two groups, one group singing, the other group doing bluff action, cooperate with each other to complete the song, and experience the coordination process of accompaniment and singing.

Through the rhythm and bluffing training of the above steps, students can not only master the key points of bluffing rhythm, but also produce the difference in volume and timbre due to the rhythm combination of different parts and methods. Not only enrich the methods and forms of rhythm training, but also greatly increase the interest of rhythm training, so that students feel a strong sense of participation, effectively improve their learning enthusiasm and initiative.

5.2. Design Games with Bluster Activities and Play Rhythm Games

The teacher gives a basic rhythm pattern and momentum

spectrum, the first student makes the momentum spectrum given by the teacher and ADAPTS it, the second student repeats the momentum spectrum adapted by the first student and re-adapts it, and so on to complete the succession. Rhythm games not only enrich the fun of rhythm training, but also improve students' interest and attention in class, and cultivate students' ability of improvisation.

6. Conclusion

The application of Orff teaching method in actual solfeggio ear training classes is ever-changing. In teaching, teachers should give full play to the native nature of Orff teaching method, combine it with actual teaching content, and highly combine it with classroom content through body movements, language and other forms, so as to provide students with more interesting and efficient learning experience, train students' sense of rhythm, and cultivate students' musical perception ability. Improve comprehensive literacy.

References

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Appendix 3. Grey literature guidelines

Table 2. Guidelines for incorporating grey literature into research (Adams, Smart and Huff, 2017).

Guideline 1	Including grey literature Consider all tiers of grey literature to define and contextualize phenomena of research interest when potentially relevant knowledge is not reported adequately in academic articles, clearly stating the rationale for and source of material included in review.
Guideline 2	Including grey literature Consider all tiers of grey literature when attempting to (a) validate/corroborate scientific outcomes with practical experience, or (b) challenge assumptions/falsify results from practice using academic research.
Guideline 3	Question formulation Consult grey literature in formulating questions for research where practitioner or user impact is a significant purpose.
Guideline 4	Locating studies Record and report all search decisions to support credibility of study process and findings and to build shared procedures for working with grey literature.
Guideline 5	Locating studies Explore electronic repositories (ideally with editorial independence and professional or institutional affiliations) to identify grey literature, creating site-specific search strings as necessary.
Guideline 6	Locating studies Deploy a semi-structured approach to identifying grey literature from generalist and specialist sites. Augment results with sources identified by experts from policy and practice.
Guideline 7	Selection and evaluation Use fit-for-purpose quality criteria when selecting and evaluating grey literature. Develop proxy measures of quality to sort large collections of literature if necessary, but justify them in a pilot exercise that considers the relevance and potential contribution of each artefact.

Guideline 8	Selection and evaluation Be guided by field experts in identifying sources for and evaluating grey literature, but retain decision-making independence and rationalize systematic review actions.
Guideline 9	Analysis and synthesis Include the grey literature not as a competing form of evidence, but as supplementary and complementary evidence. Select a mode of analysis and synthesis consistent with the review question, nature of included evidence, and the intended purpose of the review.
Guideline 10	Using and reporting results To increase report credibility for multiple audiences, consider comparative analyses, descriptive statistics, and inclusion of evidence that do not fit primary conclusions, with explanations of how decisions were made in analysis and synthesis.
Guideline 11	Using and reporting results Unless academic and grey literatures are of similar status (as they may be in the case of reviews that include only Tier 1 grey literature), findings and confidence levels of systematic reviews of white and grey literature should be reported separately.
Guideline 12	Excluding grey literature Exclude grey literature from reviews supporting relatively mature and/or bounded academic conversations with the possible exception of some Tier 1 literatures that are relatively easy to defend on the basis of widely acknowledged decision rules about quality.

Appendix 4. Grey literature colour coded document

(Qinfeng, 2019)

Brief Analysis on Multiple Effects of Solfeggio Teaching and Ear Training on Music and Art Education

Jiang Qinfeng

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Keywords: Solfeggio and ear training; Teaching, music and art education; Practice; Effectiveness

Abstract: The great value of music exists in human's spiritual expression and explicit aesthetic perception in the course of musical composition and appreciation. In musical composition and appreciation activities, solfeggio and ear training are of great importance. This paper makes a brief discussion on the multiple effects of solfeggio teaching and ear training on the practice of music and art education.

Art education is an aesthetic education that cultivates the ability to perceive, appreciate and create beauty. Music education refers to all organized, well-planned and purposeful academic teaching of music under certain social requirements, which influences students' emotions, thoughts and thinking quality as well as promotes their knowledge and skills. In music education and teaching, solfeggio and ear training is a basic course with strong requirements of techniques, which can be divided into two parts, namely solfeggio, and ear training. "Ear training" is a skill training course on the purpose of cultivating musical auditory ability. The quality of "ear training" directly affects the teaching results of solfeggio training and guides its further development. Similarly, solfeggio also constantly accelerates the formation and improvement of human's inner hearing, continuously enhancing "ear training" skills in the practice of "singing". Therefore, the two parts should not be separated in a rigid way, in that they are an organic unity. Ear is the organ of perceiving music, and hearing is the sensation of sound produced by auditory organ (ear) under the action of sound waves, which is also the main way for the beauty of music to be internalized into the ripples of the soul. The aim of solfeggio teaching and ear training is to cultivate comprehensive musical auditory ability that is pervading in all music practices, including music composition, performance and appreciation, and to produce profound influences on the achievements of music and art education.

The teaching of solfeggio and ear training is based on skill training. Through the practices of solfeggio and ear training, students can form a complete system of musical knowledge and acquire practicable skills as well as rich musical cultures, so as to contribute into the research and practice of various majors and categories in music and art education. This paper discusses on the multiple effects of solfeggio teaching and ear training on the practice of music and art education in the following aspects.

1. Promotion of Innovation on Students of Music Composition Major

The contents of solfeggio teaching and ear training is to analyze and deconstruct the text symbols in musical works by using auditory ability, in order to clearly understand and restore the composer's writing ideas. Through the training of recognizing musical elements, the actual teaching of solfeggio and ear training in music composition major helps students understand and analyze the relationship and the way of combination between the elements in musical works, finally enabling them to understand the logical relationship in application of these elements.

The teaching task of music composition major is to cultivate students to use musical elements in different combinations to form various sound structures, finally to produce complete musical works. The essence of composition is that the composer designs and forms his works with musical text symbols using the auditory images generated in his inner world. Skill training on musical elements in the traditional teaching mode of solfeggio and ear training presents a good result on the development of students' musical auditory ability, and also produces obvious influences on the practice of music creation. However, "how to encourage the composition major students to consciously apply their auditory ability onto music practices" is a teaching problem that worth considering by all the solfeggio and ear training teachers. At the 2009 National Teaching Seminar for Undergraduate and Postgraduate of Solfeggio and Ear Training Major in Art Colleges, Zuo Jia, a solfeggio and ear training teacher of China Conservatory of Music, said "Strengthening students' adaptation and creation skills of solfeggio works can not only improve their solfeggio proficiency and the level of auditory ability, but also develop their innovative minds". In solfeggio teaching and ear training, teachers can achieve a better teaching result by combining solfeggio with the actual situation of composition major. For instance, teachers can ask students to compose a solfeggio according to a specific training element in solfeggio course as the original material, or try to adapt a classical solfeggio instead. In this way, students can deeply understand the effectiveness of solfeggio teaching when reconstructing the classical works, and naturally abandon the incomplete recognition of solfeggio and ear training course. During the above process, teachers can not only guide the way of organizing works to students, but also improve the development of students' analysis ability by using musical hearing, which is undoubtedly a win-win result. Firstly, the above-mentioned creation and adaptation should focus on solfeggio and ear training with limited contents. The degree of difficulty of music works should meet the requirements of training curriculum, favorably integrating technology with music. Secondly, the most important elemental structure adopted in the works must conform to the requirements of certain section of element training in solfeggio and ear training course, and should hold the value of targeted training. This kind of teaching idea and method that closely related to the major requires teachers to seriously consider about material selection and teaching objectives, and regularly organize students to self-evaluate on teaching results. Thus, while improving the effect of solfeggio teaching and ear training, it also promotes the innovation of students in music composition major.

2. Improvement on Comprehensive Ability of Students in Performance Major

Although solfeggio and ear training is a basic subject of music, it has a profound influence that unconsciously laid on the whole art career of its learners. In the professional course of performance major, the level of solfeggio and ear training directly affects the performer's overall ability and his recognition of music interpretation. Facing students of music performance major, solfeggio teachers should fully apply their mind to the research of "the methods of making solfeggio teaching effectively guide students to perform music works and improves their comprehensive performance ability". At the same time, in teaching practices, teachers can also carry out targeted training with combination of aesthetic characteristics of different directions in performance major, stimulating

students' enthusiasm at innovation and thinking in music performance.

In actual teaching, solfeggio and ear training teachers should train on students' comprehensive musical performance ability adapting to their different professional directions. On the one hand, students can be encouraged to produce a much deeper understanding of the works by the analysis of solfeggio teaching and melody structure. On the other hand, they can further understand the close tie of creation and performance (recreation) in the solfeggio skills training.

In the early music life, performance and creation were originally integrated together. In the era when music text symbols have not yet appeared or were imperfect, creation is embodied as performance activities. Impromptu creation or performance has been seen as means of the expression of folk music and the creation of professional music. "If music creation builds up the body of a musical work, then the music performance endows this body with a soul. The combination generates the vivid life of music." From this point of view, any musical work is only about visual symbols which can be transformed into auditory symbols only by performance or singing. However, any music notation can not record various kinds of complex expressions in music without omission, which makes every performance of the works reflect subtle shades of differences. Therefore, the performer's interpretation of the music tends to be of great importance. The interpretation with subjective initiative is a recreational activity of performers. Any song we heard is actually the result of the co-creation between the creator and the performer. Therefore, on one hand, the solfeggio teaching and ear training for students of performance major should be proceeded in an orderly way; on the other hand, solfeggio teachers should guide students to form their ability of sight-singing and inner hearing which is necessary to be a performer. As a good music performer, as soon as he gets the works to be performed, the first thing to do is to read the music score. When reading music score, the performer can not only stay at the level of recognition, but at the same time of "reading", his inner auditory system should transform the music into music lines flowing out from his heart, with which his heart can feel the beauty of the melody. That is undoubtedly the organic unity of the ability of "solfeggio" and "ear training"—the ultimate goal of solfeggio teaching—which can be achieved by strictly following the teaching law as well as its scientific nature. Facing the students of performance major, the teacher should, first of all, guide students to comprehensively realize their role as performers in the process of artistic activities in the solfeggio class. To flawlessly perform a work, students should experience the emotion expressed by the composer through "sight singing" and subtly perceive the true sound beauty of the work by their auditory feedback in instrumental playing or singing performance. As a performer, using the ability acquired from Solfeggio teaching and ear training course, he can organically combine the music score (sight-playing) reading with auditory perception, apply the two links together on the recreation of works and creatively explore the soul behind the notes, finally to achieve a indefectible performance.

3. Improvement on Music Appreciation Ability

Music is originally an art about sound hearing, in that music delights human senses and moods as well as sublimates spirits. "Listening" can be divided into two categories: admiration and appreciation. Generally speaking, the common casual way of music listening in daily life is the behavior of music admiration, while music appreciation conducts the behavior that people rationally analyze and distinguish the advantages and disadvantages of a certain music work through auditory perception after accumulating rich experience of music appreciation. In other words, music appreciation is a relatively professional auditory ability. Therefore, in order to achieve the real purpose of appreciating, the music appreciation should not stay on the surface or on human senses, but explore deep into the sound structure and various forms and factors of music. Only in this way

can people accurately grasp the "connotation" of musical works, truly understanding music. To achieve the above point, the first thing to do is to repeatedly listen to the same piece of music. Listening over and over again is the key to cultivate music appreciation. Human's ears can not only play a role in the practice of recognizing and transforming the world, but also enjoy a strong inherent aesthetic perception. The music hearing of human is developed accordingly to the opportunity of linking with music given by music appreciation. The more times we listen, the more impressed we are. And the more impressed we are, the deeper our emotional experience of musical works will be. Therefore, if the memory of music is accumulated, the admiration and appreciation of music will be greatly improved.

Solfeggio and ear training is a basic course for music majors. Its task is to train students in aspects such as sense of pitch, rhythm, tonality and music score reading, cultivate students' musical perception, comprehension, appreciation and creativity, enable them to have a good command of correct pitch, rhythm and basic emotional expression, so as to fulfil the requirements of sight singing, recording the fragments of songs and instrumental music, and analyzing the mode, tonality, rhythm, termination and phrase of the music works. The aim of this course is to cultivate excellent music appreciation, laying a solid foundation for the further study of music major in the future.

The basic requirement of professional music appreciation is to form good musical hearing. However, students' ability of music appreciation is varied greatly as a result of their different emotions and thoughts, living habits, education backgrounds, artistic accomplishment and perception ability. Fortunately, students can still enjoy the same or at least similar level of perception and evaluation ability in music appreciation if the solfeggio teaching and ear training course can help them enhance auditory ability. In solfeggio teaching, the composition of solfeggio etudes and the expression of musical tone and color will deeply affect students' understanding of works and their feelings of singing. In this way, students will further experience and understand the music composition through the "sight singing" learning with continuous accumulation, forming the ability of rational analysis on music works. Meanwhile, through the practice of "sight-singing", students can in reverse recognize the auditory effect in the works produced by musical hearing. This is a series of teaching activities. It plays a positive and effective role in students' understanding, creation and performance of music. It will directly influences the improvement of students' music appreciation, and then promote their comprehensive ability. Students can constantly improve themselves in understanding and interpreting music works.

4. Conclusion

Solfeggio and ear training is the basic course of all kinds of music majors, the foundation of social art education in the future, and a required skill that frequently used in teaching practice in music and art education, which produces great driving force in cultivating musical and artistic talents. The Solfeggio teaching and ear training should be introduced in a thorough research of the effective teaching approaches suitable for the subject itself as well as the music and art education, and a constant study on more effective teaching methods combined with creative teaching practice. While improving the quality of teaching activities in music majors, solfeggio and ear training course constantly reacts on itself, integrating and developing itself with other directions of music majors altogether.

References

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Table 3. Results from the open coding process / initial codes

	<i>Title and author</i>	<i>Open coding results</i>
1	Aural training in the Dalcroze practice (Greenhead, 2016)	• Literature review • Mentions fixed and moveable do solfège • Hand signs • Pitch • Pedagogy • No participants
2	Carabo-Cone, Dalcroze, Kodály, and Orff Schulwerk Methods (Tabuena, 2021)	• Literature review • Pedagogy • No participants • Hand signs • Pitch
3	Dalcroze's approach to solfège and ear training for the undergraduate aural skills curriculum (Ristow, Thomsen and Urista, 2014)	• Pedagogy • Mention of fixed do and moveable do solfège • Pitch • Hand signs • Teaching method review • No participants
4	Determining the impact of the use of Kodály pedagogical approach (KPA) on teacher trainees' performance (TTP) in basic music skills (Okeyo, Shithandi and Kanake, 2022)	• Literature review • Pedagogy • Hand signs • Pitch • Participant study • Quasi-experimental design (not randomised) • Questionnaire • Interviews • 344 participants • Teacher trainees

5	Development and Validation of the Musical Ear Training Assessment (Wolf)	• Pitch • 393 participants • Male and female • Mean age 41.9 years • English, Spanish and German versions used • Questionnaire • Pedagogy • Gender impacts
6	Effect of training and level of external auditory feedback on the singing voice: Pitch inaccuracy (Botallico, Graetzer and Hunter, 2017)	• Physiology • Pedagogy • Participant study • 10 male and 10 female participants • Mean age 22.9 / ages 19 - 32 • Professional and non-professional singers • Singing experiment
7	Guido of Arezzo and His Influence on Music Learning (2012)	• Pedagogy • Hand signs • Pitch • Nonparticipant • Teaching method review
8	Imagine, sing, play- combined mental, vocal and physical practice improves musical performance (Steenstrup et al., 2021)	• Pedagogy • Pitch • Hand signs • Gender reference • Level of training impacts • Participant study • 50 male and female participants • Professional • Mean age 23 • Questionnaire

		• Experiment
9	International Journal of Education and Humanities Internal Listening and Musical Creativity: A Study of Brain Function (Sha, 2024)	• Teaching method review • Pedagogy • Pitch • No-participants
10	Movement, gesture, and singing: A review of literature (Kilpatrick, 2020)	• Nonparticipant • Pedagogy • Physiology • Pitch • Hand signs • Cognition • Literature review
11	Pitch systems and Curwen hand Signs: A review of literature (Freya-Clark, 2017)	• Scholarly paper • Literature review • Curwen hand signs • Pitch • Moveable / fixed do systems • Cognition • Pedagogy • 18 years and above • Level of training unknown but mentions higher education
12	Relationship between the use of Kodaly approach of teaching music to primary school teacher trainee' performance in music examination in Nandi County, Kenya (Okeyo, Shithandi and Kanake, 2020)	• Kenya • Participant • Quasi-experimental design • Teacher trainees • 170 participants • Male and female • No mean age • Questionnaires and interviews

13	Research on Application of Orff Teaching Method in Solfeggio Ear Training Class (Zhao, 2024)	• Teaching method review • Pedagogy • Solfege • No participants
14	Singing ability is rooted in vocal-motor control of pitch (Hutchins, Larrouy-Maestri and Peretz, 2014)	• Participant • Singing experiment and recording • 22 non-professionals • Male and female • 18-30 years old • One year or less of any training • No diagnoses hearing difficulties
15	Solfège teaching in higher music education in Turkey: instructors' perspectives (Eroglu, 2021)	• 37 Participants • Instructors • Male and Female • Questionnaire • Turkey • Pedagogy • Pitch • Physiology
16	Teaching Pitch Notation–Reading Skills (Reifinger, 2020)	• Pedagogy • Pitch • Hand signs • Cognition • Teaching method review • No participants
17	The Challenges Encountered in the Application of Kodaly Method in Turkey (Wei, 2022)	• Pedagogy • Pitch • Hand signs • Nonparticipant • Teaching method review

18	The effect of Kodaly method on the musical knowledge and skills of preservice teachers (Mete and Dundar, 2020)	• Quasi experiment design • 97 participants • Participants are all teachers • 54 are put in the experimental group • 43 are out in the control group • Used the music hearing and the basic music knowledge tests • Based on Kodaly method • Carried out for 8 weeks • Pedagogy • Hand signs
19	The Effect of solfège syllable Indications on sight-reading skills of undergraduate music majors (Agbenyo, 2021)	• Pedagogy • Pitch • Hand signs • 32 Participants • Experiment • Undergraduate students • Male and female
20	The Key to singing off-key: The trained singer and pitch perception distortion (Kervin, 2023)	• Participant • Took place during COVID pandemic • Pitch • Level of training • Only English-speaking participants were included • Survey • 115 participants • Male and female • 18 years or older • Professionals • Provided anonymity

21	The use of Kodaly method in teaching music (Kutlimuratovich,2024)	• Pedagogy • Hand signs • Pitch • Review of teaching method • Non-participant study
22	When the fixed do tends to move: The ambiguity of the solfège syllabary (Kis Zuvela, 2018)	• Participant • Undergraduate students • Male and female • Questionnaire • 18 years and above • Fixed and moveable do • Pitch • 196 participants • Croatia • 120 females • 79 males • Mean age 21.3 years • All had an average ear training grade of 3.8 • Average years of training is 12.2 • Pedagogy • pitch

Appendix 6. Ethics form

APPLICATION FOR ETHICAL APPROVAL

RESEARCH STUDENTS

This form is to be completed by the student within **SIX** months for full-time students and **TWELVE** months for part time students, after the commencement of the research degree or following progression to Part Two of your course.

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

This document is also available in Welsh.

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: “creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications”. As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the “principal researcher”.

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity.

Please see Checklist for details of process for different categories of application.

SECTION A: About You (Principal Researcher)

1	Full Name:		Nichola Pask			
2	Tick all boxes that apply:		Member of staff:	☐	Honorary research fellow:	☐
	Undergraduate Student	☐	Taught Postgraduate Student	☒	Postgraduate Research Student	☐

3	Institute/Academic Discipline/Centre:	WAPPAR
4	Campus:	Carmarthen
5	E-mail address:	2132700@student.uwtsd.ac.uk
6	Contact Telephone Number:	07711946909
For students:		
7	Student Number:	2132700
8	Programme of Study:	MA Professional Practice (Voice Pedagogy)
9	Director of Studies/Supervisor:	Louise Emanuel/Julie Crossman/Debbie Winter

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)	YES	☒	NO	☐
				Date	
2	If Yes, please indicate source of approval (and date where known): Approval in	Research Degrees Committee	☐		
Institute Research Committee		☐			

	<i>principle must be obtained from the relevant source prior to seeking ethical approval</i>	Other (write in) WAPPAR Ethics Board Representative	☒	
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SECTION C: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.		
1	<u>UWTSD Research Ethics & Integrity Code of Practice</u>		☒
2	UWTSD Research Data Management Policy		☒
3	<i>[List any other relevant documents here]</i>		☐

SECTION D: External Collaborative Research Activity

If there are external collaborators then you should gain consent from the contact persons to share their personal data with the university. If there are no external collaborators then leave this section blank and continue to section E.

1	Institution					
2	Contact person name					
3	Contact person e-mail address					
4	Is your research externally funded?	YES	☐	NO	☐	
5	Are you in receipt of a KESS scholarship?	YES	☐	NO	☐	
6	Are you specifically employed	Voluntary	YES	☐	NO	☐
7	to undertake this research in either a paid or voluntary capacity?	Employed	YES	☐	NO	☐
8	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)?	If YES then the permission question below does not need to be answered.	YES	☐	NO	☐
9	Has permission to undertake the research has been provided by the partner organisation?	(If YES attach copy) If NO the application cannot continue	YES	☐	NO	☐

Where research activity is carried out in collaboration with an external organisation

10	Does this organisation have its own ethics approval system?	YES	☐	NO	☐
	If Yes, please attach a copy of any final approval (or interim approval) from the organisation (this may be a copy of an email if appropriate).				

SECTION E: Details of Research Activity

1	Indicative title:	An investigation into the impacts of using solfège hand signals when teaching ear-training to singers.			
2	Proposed start date:	03/07/24	Proposed end date:	21/02/25	
	Introduction to the Research (maximum 300 words) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the three points below: • <i>Purpose of Research Activity</i> • <i>Proposed Research Question</i> • <i>Aims of Research Activity</i> • <i>Objectives of Research Activity</i> Demonstrate, briefly, how <u>Existing Research</u> has informed the proposed activity and Explain • <i>What the research activity will add to the body of knowledge</i> • <i>How it addresses an area of importance</i> •				
3	Purpose of Research Activity The purpose of this document analysis study is to investigate the impacts of using solfege hand signals when teaching ear training to singers. Solfege hand signs are physical gestures along with syllables which are assigned to individual notes of the major scale which assist the learning of pitch and melody.				

	(this box should expand as you type)
4	Research Question What are the benefits or drawbacks to using solfege hand signs when teaching ear training techniques to adult singing students? (this box should expand as you type)
5	Aims of Research Activity The aim of this research is to better understand the impacts and prevalence of Solfege hand signs when ear training adult singers. Through examining the available literature, I hope to gain a better understanding of solfège (this box should expand as you type)
6	Objectives of Research Activity • To conduct a document analysis • To explore and analyse previous studies and literature of Solfege hand signs and ear training • To recognise any gaps in the research and provide other researchers further information of the impacts of using Solfege hand signs • To develop greater understanding of solfege which may lead to becoming a specialist teacher (this box should expand as you type)
	Proposed methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	I will conduct a document analysis which will include thematic analysis and will incorporate a grounded theory approach. Methods will include: • Reflective practice I will select a reflective model and framework to assist my research journey and conduct a reflective diary to document my findings during the course of the study. • Literature review and data collection I will select documents to analyse which will be sourced during a literature review of relevant research. • Coding

	Once the documents for analysis have been selected, I will continue to code them to develop themes within the information. I will follow a coding framework to assist the process. (this box should expand as you type)
	Location of research activity Identify all locations where research activity will take place.
8	The research will be carried out online. (this box should expand as you type)
	Research activity outside of the UK If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants. If you live in the country where you will do the research then please state this.
9	NA (this box should expand as you type)

10	Use of documentation not in the public domain: Are any documents NOT publicly available?	NO	☒
		YES	☐
11	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with the current data protection law of the country in question and that of England and Wales. (this box should expand as you type)		

	Does your research relate to one or more of the seven aims of the Well-being of Future Generations (Wales) Act 2015?	YES	NO
12	A prosperous Wales	☐	☒
13	A resilient Wales	☐	☒
14	A healthier Wales	☐	☒
15	A more equal Wales	☐	☒

16	A Wales of cohesive communities	☐	☒
17	A Wales of vibrant culture and thriving Welsh language	☐	☒
18	A globally responsible Wales	☐	☒
19	If YES to any of the above, please give details:		
	(this box should expand as you type)		

SECTION F: Scope of Research Activity

	Will the research activity include:	YES	NO
1	Use of a questionnaire or similar research instrument?	☐	☒
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☐	☒
5	Use of video or audio recording?	☐	☒
6	Use of computer-generated log files?	☐	☒
7	Participant observation with their knowledge?	☐	☒
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☐	☒
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.	☒	☐
	Details of any other primary data collection method: Analysis of content from peer reviewed written documents, studies such as journals, articles and books. Furthermore, consideration may be given to some grey literature such as conference proceedings and thesis's. (this box should expand as you type)		

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

If there are no participants then do not complete this section, but go directly to section H.

Who are the intended participants:		YES	NO
1	Students or staff at the University?	☐	☐
2	Adults (over the age of 18 and competent to give consent)?	☐	☐
3	Vulnerable adults?	☐	☐
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☐
5	Prisoners?	☐	☐
6	Young offenders?	☐	☐
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☐
8	People engaged in illegal activities?	☐	☐
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.	☐	☐
Details of any other participant groups: (this box should expand as you type)			

Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?		
10	How many participants are expected?	(this box should expand as you type)
11	Who will the participants be?	(this box should expand as you type)
12	How will you identify the participants?	(this box should expand as you type)

Information for participants:	YES	NO	N/A
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13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☐	☐	☐
14	Will you tell participants that their participation is voluntary?	☐	☐	☐
15	Will you obtain written consent for participation?	☐	☐	☐
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☐	☐	☐
17	If the research is observational, will you ask participants for their consent to being observed?	☐	☐	☐
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☐	☐	☐
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☐	☐	☐
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☐	☐	☐
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☐	☐	☐
22	If NO to any of above questions, please give an explanation			
	(this box should expand as you type)			

	Information for participants:	YES	NO	N/A
24	Will participants be paid?	☐	☐	☐
25	Is specialist electrical or other equipment to be used with participants?	☐	☐	☐
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☐	☐
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☐	☐
28	If YES to any question, please provide full details			
	(this box should expand as you type)			

SECTION H: Anticipated Risks

	Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them. If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.		
1	Full risk assessment completed and appended?	Yes No	☐ ☐
2	Risks to participants For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information		
	Risk to participants: NA <i>(this box should expand as you type)</i>	<i>How you will mitigate the risk to participants:</i> <i>(this box should expand as you type)</i>	
3	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities		
	<i>(this box should expand as you type)</i>		
4	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest		
	Risk to the investigator: Risk of emotional stress due to the overload of information from documents collected or adversely emotional stress from the inability to source enough data for the research <i>(this box should expand as you type)</i>	<i>How you will mitigate the risk to the investigator:</i> I understand the potential risks associated with emotional stress and will seek help if required. Furthermore, I will take breaks from the research to mitigate the potential for information overload. <i>(this box should expand as you type)</i>	
5	University/institutional risks For example: adverse publicity, financial loss, data protection		
	Risk to the University:	<i>How you will mitigate the risk to the University:</i>	

	Reputable risk <i>(this box should expand as you type)</i>	Ensure the data collected is reliable and per reviewed to ensure the findings of my research are accurate and trustworthy. <i>(this box should expand as you type)</i>
6	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems	
	Risk to the environment: NA <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: <i>(this box should expand as you type)</i>

Disclosure and Barring Service				
	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	YES	NO	N/A
7	Does your research require you to hold a current DBS Certificate?	☐	☒	☐
8	If YES, please give the certificate number. If the certificate number is not available please write "Pending"; in this case any ethical approval will be subject to providing the appropriate certificate number.			

SECTION I: Feedback, Consent and Confidentiality

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when? NA <i>(this box should expand as you type)</i>
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation. NA <i>(this box should expand as you type)</i>

3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.
	(this box should expand as you type)

SECTION J: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 “GDPR” and the Data Protection Act 2018 “DPA”)?	YES	NO
1	“Personal data” means any information relating to an identified or identifiable natural person (‘data subject’). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.		
	If YES, provide a description of the data and explain why this data needs to be collected:		
2	(this box should expand as you type)		
	Does it involve special category data (as defined by the GDPR)?	YES	NO
3	“Special category data” means sensitive personal data consisting of information as to the data subjects’ – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes),	☐	☐
	If YES, provide a description of the special category data and explain why this data needs to be collected:		
4	(this box should expand as you type)		

		YES	NO
	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?		
5	Manual files (i.e. in paper form)?	☐	☒
6	University computers?	☐	☒
7	Private company computers?	☐	☒
8	Home or other personal computers?	☐	☒
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	"Cloud" storage or websites?	☒	☐
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation:		
	All data will be kept in password protected cloud storage on the company's Office 365 system which will not be shared. Audio/visual data will be transcribed and would be shown to participants to check accuracy of reporting. Any USB sticks used to store or transfer data will be password protected. All participants will be given a unique identifier to ensure confidentiality and this list will be kept securely in the password protected folder. <i>(this box should expand as you type)</i>		

Data Protection			
		YES	NO
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☐	☒
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☐	☒
19	Use of data management system?	☐	☒
20	Data archiving?	☐	☒
21	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and any international equivalents, where appropriate):		
	All data will be encrypted and kept in password protected cloud storage on the Company's Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected. All data transfers will be encrypted, and password protected. All participants will be given a unique identifier to ensure		

	confidentiality and this list will be kept securely in the password protected folder. The data will be stored until the completion of the project and then deleted. In accordance with the DPA2018. <i>(this box should expand as you type)</i>		
22	List all who will have access to the data generated by the research activity: The principal researcher only <i>(this box should expand as you type)</i>		
23	List who will have control of, and act as custodian(s) for, data generated by the research activity: The principal researcher only <i>(this box should expand as you type)</i>		
24	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not. All data will be encrypted and kept in password protected cloud storage on the Company's Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected and will be reformatted at the end of the project in order to destroy the data. The data will be stored until the completion of the project and then deleted. <i>(this box should expand as you type)</i>		
25	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtsd.ac.uk/). If so please explain. <i>(Most relevant to academic staff)</i> <i>(this box should expand as you type)</i>		
26	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtsd.ac.uk/library/research-data-management/)	YES	☒
27	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	YES	☒

SECTION K: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/	
1	Signature of applicant: Nichola Pask	Date: 12/10/24

For STUDENT Submissions:

2	Director of Studies/Supervisor:		Date:
3	Signature:		

For STAFF Submissions:

4	Academic Director/ Assistant Dean:		Date:
5	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

☒	I have read the guidance notes supplied before completing the form.
☒	I have completed ALL RELEVANT sections of the form in full.
☒	I confirm that the research activity has received approval in principle
☐	I have attached a copy of final/interim approval from external organisation (where appropriate)
☐	I have attached a full risk assessment (where appropriate) ONLY TICK IF YOU HAVE ATTACHED A FULL RISK ASSESSMENT
☒	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.
☒	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.

RESEARCH STUDENTS ONLY

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

Appendix 7. Permission Letter

I Nichola Pask,

Hereby give permission for the following research 'The Role of Solfège Hand Signals for Developing Singers Pitch Matching Skills: A Document Analysis Approach'.

The research will be carried out with Wales Trinity Saint David University for my master's degree in voice pedagogy.

Yours Faithfully

Nichola Pask