

Nordic Research in Music Education

Article | Vol. 3, 2022, pp. 75–91 | ISSN: 2703-8041

Interdisciplinary co-teaching in higher education: Comparing results from music-drama and music- physics partnerships in Sweden and Ireland

Marie-Helene Zimmerman Nilsson

University West, Sweden

Contact corresponding author: mzi@hv.se

Marita Kerin

Trinity College Dublin, Ireland

Abstract

Few studies exist on the impact of interdisciplinary co-teaching in Higher Music Education. The aim of the present study is to compare and analyse the findings from two pioneer interdisciplinary co-teaching studies involving music/drama and music/physics co-teaching partnerships, conducted independently in Sweden and Ireland. Elements of Vygotskian scholarship informed the theoretical framework and a reflexive and thematic analytic methodology was employed. Four themes emerged similar to those from interdisciplinary scholarship in diverse disciplines. These include: a heightened awareness of subject synergies, problem solving as a catalyst for creativity, new/deeper insights into collaboration and expanded professional identity. In conclusion, didactical implications are addressed, related to potential challenges.

Keywords: *interdisciplinarity, music teacher, education higher education, co-teaching*

Introduction

Contemporary societies face complex problems. Therefore, it is essential that interdisciplinary approaches to teaching and learning are adopted in higher education, to promote the integration of knowledge across disciplinary boundaries (Carey et al., 2021). Interdisciplinarity in higher education has the potential to increase collaboration and stimulate creative thinking, skills that are essential for dealing with complexity (Colton et al., 2022). To sustain its impact and influence, higher education needs to evolve by increasing its focus on creating new knowledge and providing increased value for students. Therefore, teachers in higher education must renew their teaching methods to better prepare students for their future professions via interdisciplinary collaboration (Rooks et al., 2022; West, 2013). These issues can be addressed by using a co-teaching approach. Co-teaching in the context of this study refers to two or more teachers with complementary experience or expertise, working together to improve student learning and the teachers' capacity to teach (Kerin & Murphy, 2018; Murphy, 2016; Roth & Tobin, 2005). Research into interdisciplinary co-teaching (relating to more than one discipline of knowledge) in higher education has been conducted in areas such as business, medicine, and design education (Carey et al., 2021; Colton et al., 2022; Daniel et al., 2018; Kliegl & Weaver, 2014; Rooks et al., 2022; West, 2016). In teacher education, scholarship on interdisciplinary co-teaching suggests improved learning for faculty in teaching styles and collegiality, while students appraised co-teachers' different perspectives (Rooks et al., 2022), and enhanced social interaction amongst lecturers (Chian et al., 2021). However, several researchers have identified and acknowledged challenges with interdisciplinary co-teaching. Interdisciplinary co-teaching has been considered difficult given that teachers may apprehend the subject content problem differently (West, 2016). Although committed in theory to the concept of sharing expertise, in reality, teaching can remain siloed (Carey et al., 2021). Specific challenges to interdisciplinary co-teaching are cited as deficits in time, training, commitment, and collaboration skills (Bennett & Fisch, 2013). Despite these constraints, interdisciplinary approaches are encouraged to better prepare students for the future (West, 2016). As research on interdisciplinary co-teaching in higher education has predominantly involved subjects other than music (Carey et al., 2021; Chian et al., 2021; Colton et al., 2022; Daniel et al., 2018; Kliegl & Weaver, 2014; Rooks et al., 2022; West, 2016), there is a need for research that analyzes partnerships where music is concerned. The aim of the present study is to compare and analyse the findings from two pioneer interdisciplinary co-teaching studies involving music/drama (Zimmerman Nilsson & Murphy, 2021) and music/physics co-teaching partnerships (Kerin & Murphy, 2018), conducted independently in Sweden and Ireland.

Coteaching or co-teaching?

As mentioned earlier, co-teaching in the context of this study refers to two or more teachers with complementary experience or expertise, working together to improve student learning and the teachers' capacity to teach (Kerin & Murphy, 2018; Murphy, 2016; Roth & Tobin, 2005). The difference between coteaching and co-teaching (hyphenated) is that the former has been used in a general educational context while the latter stems from a special education context (Murphy & Martin, 2015). However, although this study primarily makes a comparative analysis of two former co-teaching studies located outside of the special education context, coteaching and co-teaching are seen here as synonymous. Hence, interdisciplinary studies involving coteaching and the hyphenated version, co-teaching, in higher education contexts, are regarded here, as comparable. For the purposes of this paper, and in line with international studies on interdisciplinarity, we will now use the hyphenated version throughout. One final point to make at this stage is that over the past two decades, research and practice in co-teaching in Teacher Education has been associated in the main with collaboration within the same discipline. This study is significant in that it expands the scholarship on co-teaching by (i) comparing the findings from two international interdisciplinary co-teaching studies and (ii) including the discipline of Music Education in both studies.

Interdisciplinary co-teaching in higher education

There are three main arguments for interdisciplinary co-teaching in higher education. These include: the complex problems that appear in contemporary societies (Carey et al., 2021; Colton et al., 2022); changes in higher education (Rooks et al., 2022; West, 2016) and the need for relevant teacher and student teacher development (Bennett & Fisch, 2013; Chian et al., 2021; Daniel et al., 2018; Kliegl & Weaver, 2014). Carey et al. (2021), claim that the complex societal problems mentioned above concern economic growth, social injustice, and environmental degradation. The authors contend that leaders of tomorrow need to learn from multidisciplinary approaches if they are to be equipped to deal with such problems. Interdisciplinarity via co-teaching may afford opportunities for the development of collaborative and creative thinking, skills which are acknowledged as essential (Colton et al. 2020). West (2016) argues that higher education needs to change and focus on innovation and creativity, to increase its value for future students. Therefore, efforts need to be made to better prepare teachers and student-teachers for their future professions, extending discipline boundaries by incorporating more interdisciplinary approaches (Rooks et al., 2022). In line with Bennett and Fisch (2013), who argue that interdisciplinary co-teaching is well positioned to prepare student teachers for the future, the extant scholarship in interdisciplinarity in higher education will now be discussed in four contexts,

including: medical education (Daniel et al., 2018; Rooks et al., 2022), business education (Carey et al., 2021; Kliegl & Weaver, 2014), design education (Colton et al., 2022; West, 2016) and teacher education (Bennett & Fisch, 2013, Chian, et al., 2021).

To adopt a more holistic teaching approach, an interdisciplinary co-teaching partnership in medical education was established between lecturers in public health and those in the social sciences in an undergraduate medical program (Rooks et al., 2022). There were many positives reported for co-teachers and for students. Co-teachers reported improvements in their teaching, which they believed were the result of the collaboration with a partner with complementary expertise and experience. Students reported that the interdisciplinary co-teaching model improved the character of the course and was successful in expanding their perspectives on research and problem solving. Possible challenges were identified including power differentials, with the researchers recommending that consideration should be given to establish well-functioning partnerships (Rooks et al., 2022). A study conducted by Daniel et al. (2018) sought to establish a framework for interdisciplinary co-teaching in medical education. Participants, physicians, and social behavioral scientists reported on the factors which impacted the quality of their interdisciplinary co-teaching relationships. The findings revealed the importance of five relational factors that contribute to student learning, including: the need for clear communication, mutual respect, shared goals, shared knowledge, and mutual understanding of respective roles.

In business education, a case-study of an interdisciplinary information literacy and business administration co-teaching partnership was undertaken to support student acquisition of the skills most conducive to optimum teamwork (Kliegl & Weaver, 2014). Participant co-teachers pointed to the significance of shared values, complementarity of knowledge and skills and positive attitudes towards new approaches, as fundamental to successful teacher partnerships. Participants rated the complementarity of knowledge and skills as significantly influential in initiating and supporting the synergy between co-teachers. Such synergy enabled co-teachers to consider experimenting, being creative and adopting new approaches to tasks and problems together with each other and with students, in a way that augmented the quality of the instruction. Positive rating of instruction by undergraduate students also increased. Carey et al. (2021) describe a co-taught course in sustainability and consumerism where teachers of liberal arts, physical science and business disciplines formed an interdisciplinary team to integrate entrepreneurship across these disciplines. Findings reveal both opportunities and challenges. While participant co-teachers explored aspects of subject commonalities and contrasts and accrued new teaching resources and teaching styles, they also reported that despite the desire for discipline fusion, in reality, discrete subject matter tended to remain the preserve of the individual teachers concerned.

An interdisciplinary co-teaching partnership in design education was established involving staff from a School of Art & Architecture and a School of Education (Colton et al., 2022). Participants were tasked with reflecting on the experience of placing students

in interdisciplinary groups comprising Illustration Animation and English Education and via co-teaching, supporting them to create a multimodal narrative text (Colton et al., 2022). Co-teachers reported experiencing key nodes of tension, that lead to boundary expansion where new knowledge was developed. The nodes represented co-teachers' various understandings of design approaches, multimodal narrative texts and collaborative practice. Knowledge co-creation was described as an ongoing process nurtured by the constant flow between the familiar and the unfamiliar. Trust was emphasized as a crucial relational quality. Findings suggest that the most important aspect of interdisciplinarity was the promotion of epistemic flow made possible by trust and an open mind towards the unfamiliar (Colton et al., 2022). Another study, this time focusing on students as participants involving several departments, was created to co-teach creativity and design, focusing on social innovation and instructional design (West, 2016). The course was based on projects rather than lectures. Students reported positively on the innovative approach and confirmed that they learned new ways of working and learning. Co-teaching was considered difficult, given that teachers saw the design problem differently. Nevertheless, the argument in favor of interdisciplinarity was strong, particularly in its potential for preparing students for future challenges.

In teacher education, an interdisciplinary field partnership in English, mathematics and health science was established (Bennett & Fisch, 2013). Student teachers in interdisciplinary groups engaged in discussions about their experience of co-teaching. Strengths identified included opportunities for co-articulating and co-refining aspects of collaboration in co-teaching. Challenges for the co-teachers included time constraints, inadequate training, and uneven levels of commitment (Bennett & Fisch, 2013). Returning again to college lecturers as participants, Chian et al. (2021) report on an interdisciplinary co-teaching module in educational theory and subject knowledge. Co-teachers collaborated in planning a student poster presentation comprising collaborative sessions, where students rehearsed their presentation and received feedback from peers and teachers. Findings reveal that interdisciplinarity supported the integration of theory with practice and promoted quality collective feedback. Loyalty and discipline were reported here as essential aspects for equal partnerships. In conclusion, synergistic co-teaching was dependent on teacher interactions on a social and relational level, as well as their level of commitment and expertise knowledge (Chian et al., 2021).

The recent focus on interdisciplinary co-teaching in Higher Education indicates an interest in expanding this area of scholarship. However, although there are a number of studies on collaborative partnerships in music education (Christophersen & Kenny, 2018; Gaunt & Westerlund, 2016), a thorough literature search failed to reveal any significant scholarship involving music in interdisciplinary co-teaching in either Higher Education or in Teacher Education, apart from the two studies on which this present comparative study is based. The particular intention now is to address this gap in the literature to enlarge on the existing body of research. This will be done by comparing and analysing the two aforementioned independently conducted interdisciplinary co-teaching studies involving music in teacher education in Sweden and Ireland.

Background to the study

This study emanates from two independent studies which took place in two different countries (Kerin & Murphy, 2018; Zimmerman Nilsson & Murphy 2021). Teacher Education implies all of the activities which relate to the professional development of teachers, during initial, induction and in-service phases of their careers (Council, T. 2020). In Sweden, the research context was an aesthetic methods course, comprising music, drama, dance and visual arts in a general preschool teacher education programme in Higher Education (Zimmerman Nilsson & Murphy, 2021). The programme had a duration of 3.5 years and the aesthetic course was held during the fifth term. The segregation of workshops into music and drama sessions respectively was criticized by student-teachers (university students) and questioned by the university lecturers in the course. Therefore, study participants comprising one music teacher and the two drama university lecturers initiated co-teaching in music and drama, seeking to achieve a more holistic approach. The co-teaching design included co-planning, co-teaching and co-reflection. Participants were tasked with co-evaluating their interdisciplinary co-teaching experience via co-reflection.

In Ireland, ten undergraduate student volunteers in Music Education were partnered with ten undergraduate student volunteers in Physics (Kerin & Murphy, 2018). The undergraduate volunteers were challenged to employ the fundamental principles of co-teaching to design and deliver an interdisciplinary Physics-Music (Acoustics) outreach programme for primary school children and their teachers, and to co-reflect specifically on their experience of interdisciplinary co-teaching.

The Swedish study involved as participants teacher education university lecturers from Music and Drama, and the Irish study concerned undergraduate university students of Music education and Physics. The two investigations sought to expand current single disciplinary modular design by exploring participant perspectives on the experience of interdisciplinary co-teaching. The two studies (Kerin & Murphy, 2018; Zimmerman Nilsson & Murphy, 2021) posed similar research questions concerning how participants reflected and reported on their experiences of interdisciplinary co-teaching. They employed comparable means of collecting data including observations, reflection diaries, and semi-structured interviews. Both studies employed co-teaching and incorporated thematic analysis. However, each study involved different subject partnerships and employed participants at different stages of their professional journeys. Swedish participants committed to interdisciplinary co-teaching to improve their own practice. In Ireland, undergraduate students in the disciplines of Physics and Music Education also embraced co-teaching, but in this case to jointly develop and deliver an educational outreach programme, *From Quavers to Quadratics*, for primary school teachers and their pupils. Differences between study disciplinary partnerships and participant profiles provided a control that we believe enriches the results. Table 1 presents an overview of the two studies, Zimmerman Nilsson & Murphy (2021) in Sweden, and Kerin & Murphy (2018) in Ireland.

Table 1: Overview of the studies

Aspects	Music-drama co-teaching partnership	Music-physics co-teaching partnership
Context	Aesthetics course in general preschool teacher education in Sweden	Educational outreach programme for primary teachers and their pupils
Discipline pairs	Music and drama	Music and physics
Focus	How university lecturers in drama and music reflect on interdisciplinary co-teaching	How undergraduates in physics and music education reflect on interdisciplinary co-teaching
Participants	University teachers in drama and music education	Undergraduate students of physics and music education
Data collection	Observations, reflection diaries, and semi-structured interviews	Observations, reflection diaries, and semi-structured interviews
Research design	Qualitative case study	Exploratory practitioner study

Theoretical framework

The theoretical framework for interdisciplinary co-teaching is informed by elements of Vygotskian scholarship, specifically, the concept of the *zone of proximal development* (ZPD). The ZPD is understood as the distance between the developmental level of an individual as determined by independent problem-solving and the level of potential development by problem-solving with guidance or in collaboration with more knowledgeable others (Vygotsky, 1934/1987). The ZPD is where ‘interpersonal and intrapersonal activities blend and fuse and no longer exist as different entities (Yamagata-Lynch, 2010, p. 19). Vygotsky (1978) postulates that a *dramatic collision* must be experienced to initiate development or learning in the ZPD. This *dramatic collision* marks a point of new insight or an *epiphanic moment* where an individual, via the expertise of their partner, may gain new insight, new knowledge, and new understanding (Murphy, 2016). Warford (2011) links the disenchantment with the dominant technicist views of teacher education as discussed by sociocultural theorists including Edwards (1995), Samaras (2000), and Smith (2001), as the impetus for the extrapolation of Vygotsky’s genetic model to teacher development.

Studies in co-teaching conducted by Murphy et al. (2015) and also by Laflamme et al. (2015) explore the affordances of Vygotskian developmental theory in the context of co-teaching partnerships between preservice teachers and experienced classroom teachers in single disciplinary subjects within teacher education programmes. According to these scholars, co-teaching provides an ideal set of conditions for reciprocal professional development. During the co-planning stage, the ongoing exchange of unique and different subject knowledge and skills presents opportunities for partners to experience a circulation of knowledge which in turn provides the conditions for the dramatic collision or moments of new insight. ZPDs created during co-teaching allow partners to experience first-hand the ideal practice or expertise of the other. Vygotskian imitation or professional emulation in the context of co-teaching refers to the mutual appropriation of knowledge and skills. Murphy (2016) suggests that during co-teaching, partners imitate certain practices of the

other, adapting them to their needs and adding them to their repertoire. The co-reflection phase provides partners with the opportunity to consider their attainment relative to ideal practice as they co-evaluate the real (versus the ideal) context of their jointly taught lesson. Co-reflection focuses on the affordances of shared experience, offering partners the opportunity to move towards an ideal identified during co-planning (Laflamme et. al. 2015). The fundamental thinking here is that learners, with the support of a more capable or proficient partner, or indeed a partner with complementary expertise and experience, can progress and develop to a greater degree than if they worked alone.

Methodology

As this paper focuses on analysing and comparing results from two former independently conducted studies (Kerin & Murphy, 2018; Zimmerman Nilsson & Murphy, 2021), both reflexive (Alvesson & Sköldberg, 2009) and thematic analyses (Braun & Clarke, 2006) were used. The reflexive analysis assisted in problematizing our assumptions as researchers (Alvesson & Sköldberg, 2009), as well as our backgrounds as musicians and music teachers, related to the work of co-teachers in the pedagogic practice. In line with Koivisto (2022), we needed to reflect on our implicit assumptions, and by doing so, engage critically with the material analyzed. Additionally, thematic analysis (Braun & Clarke, 2006) was used to review the two individual datasets and to identify initial themes and patterns. Interrogating these datasets, a search for common themes ensued. Subsequently, both authors reviewed these themes at a deeper level and identified four strong themes, common to both studies. Data within each theme was checked across the two datasets for verification. This involved a search for meaningful coherence between each of the themes identified. As a unified storyline began to emerge, authentic comments from participants in each of the studies were included where appropriate. More specifically, we sought to accommodate differences and similarities in participant experiences of interdisciplinary co-teaching, and considered how these findings may suggest the inclusion in Teacher Education of new forms of interdisciplinary professional teaching and learning. This study includes an analysis of published studies, where ethical approval was sought and received in line with ethical regulations. Results from each study were compared and scrutinized in several steps as follows:

Table 2: Analysis phases

Analysis phase	Focus
1	The findings in each study were read several times by both authors
2	The two authors, independently developed initial themes common to both studies
3	Initial themes were identified and refined into four common themes. These themes were discussed between authors until consensus was reached
4	The findings were re-read by both authors to verify the patterns
5	Congruent findings were selected for inclusion in this paper

To situate our study in a broader context, former studies on interdisciplinary co-teaching in Higher Education are referred to in the results (Carey et al., 2021; Chian et al., 2021; Colton et al., 2022; Daniel et al., 2018; Kliegl & Weaver, 2014; Rooks et al., 2022; West, 2016).

Findings

Four strong themes deriving from both studies emerged from the data analysis for this paper. These were labelled as subject synergies, problem solving as catalyst for creativity, insights into collaboration and expanded professional identity.

Theme 1 Subject synergies

Participants in both studies reported gaining a deeper and broader understanding of their own subject area as a consequence of the synergy they experienced via interdisciplinary co-teaching in both the music-drama and music-physics studies. Participants in both studies reported experiencing a merging of music with the partner discipline during co-teaching, such that the conceptualization of their own discipline became more expansive.

Reports from the music-drama partnership suggest that subject synergy or the merging of interdisciplinary understanding began with individual awareness of traditional norms in language and vocabulary usage, unique to each discipline. As individuals experienced differences in the traditional labelling of concepts common to both disciplines, they embraced the opportunity for new understanding. For instance, the musician co-teacher noticed that in drama, the element “dynamics” (sometimes explained to children as simply *loud and soft*) is expressed more comprehensively by the dramatist as “energy” and “power”. Drama co-teachers similarly spoke of their broadened perspectives on an element of some import, “time” when the musician co-teacher introduced “tempo”, “pulse” and “rhythm”. On reflection, co-teachers claimed that such exchanges presented shades of new meaning as well as new perspectives on these core concepts, as each participant entered each other’s dimension and experienced first-hand the “touch points”, the similarities and overlaps between disciplinary conventions. Reports confirmed that such synergy or merging of subject expertise promoted a more comprehensive perspective not only on one’s own discipline, but on that of one’s partner.

In the music-physics partnership, co-teachers similarly reported a deeper understanding and changed perspective regarding the fundamental elements of music after co-planning, co-teaching and co-reflecting with a partner physicist. Participants mentioned gaining an extended vocabulary for concepts common to both disciplines within a macaronic style exchange – with each partner initially drawing on the vocabulary of their discipline, but over time, adopting that of their partner. Musicians reported new dimensions of understanding when the vocabulary for concepts such as pitch was linked with frequency;

tempo with velocity; dynamics with amplitude and timbre with materiality, as musician and physicist taught and learned together. Participants also noticed how language used by musicians tended to be more emotive and less factual than that of the physicist which led one participant to identify the benefits of both. It was claimed that teachers of music focus on effect whereas teachers of physics veered towards cause. All participants concluded that they became more aware of the impact of their choice of vocabulary and language while teaching. Furthermore, reflecting on the experience of the music-physics outreach educational programme, participants described how vocabulary, language and dialogue used by the children throughout the programme migrated easily between the two disciplines, the consequence of which appeared to be greater evidence of engagement and understanding of a range of concepts, including soundwaves and oscillations, patterns and repetitions and of course the ratio of tones. In line with participants from the Swedish study, these participants concluded that the two subjects were merged during co-teaching, the consequence of which was a greater appreciation of one's partner's discipline and a deeper understanding of their own. Interdisciplinarity via the merging of partner disciplines promoted holistic learning, resulting in greater conceptual understanding amongst all participants.

Subject synergy as an outcome of interdisciplinary co-teaching has been mentioned in a number of international studies. For example, Chian et al. (2021) suggest that such synergy is dependent on (i) teacher interactions on a social and relational level, and (ii) on individual levels of expertise in relation to disciplinary knowledge. Kliegl & Weaver (2014) emphasize the importance of complementarity of expertise in producing such synergy. An awareness and acknowledgement by teachers of the subject parallels or indeed of the intersectional spaces shared by the two subjects concerned in interdisciplinary co-teaching, is mentioned as a catalyst for development by scholars, including Carey et al. (2021) and Daniel et al. (2018).

Theme 2 Problem solving as a catalyst for creativity

The second strong theme refers to how co-teaching between subject experts from different disciplines presented opportunities for solving problems via spontaneous bursts of creativity.

Co-teachers in the music and drama partnership reflected on how co-teaching afforded them opportunities to spontaneously react and re-direct an activity during the lesson, when they noticed moments of disengagement amongst their students. When problems arose, co-teachers in deferring to the expertise and experience of their partner had the capacity to re-design an activity "in the moment". As co-teaching became more familiar, these moments of creativity and improvisation ceased to be confined to managing clarifications and making changes to meet student needs, but provided opportunities for extending the context and augmenting the opportunities for learning. Co-teachers observed that interdisciplinary co-teaching presented many occasions for elaborating and embellishing a

lesson plan as it was being taught, offering the students a range of possible perspectives and alternatives at any one moment.

Co-teachers in the music-physics partnership claimed that co-designing an informal educational outreach programme for primary teachers and their pupils was ‘exciting’ ‘energetic’ ‘uplifting’ and ‘mind-blowing’. Commissioned to co-design and co-deliver a new programme, participants claimed that acting and responding spontaneously to ‘a whirlwind of suggestions’, provided both the catalyst for initiation and the energy for completion. Probing deeper into participant experience, several incidences of spontaneous creativity were shared. Music participants recalled suggesting that the programme should always start with a popular, fun song, whereupon physicists suggested that to maximise the learning opportunities, the lyrics of the song should teach elements of science. Interestingly, while musicians suggested modifying a popular song, *Galaxy Song* from Monty Python (Idle & Du Prez, 1983), physicists took the opportunity to create new lyrics so opportunities for learning would be increased. Here, both subjects retained their integrity with neither subject in a position of service to the other. This short extract from the eventual signature tune for the programme exemplifies how problem solving via interdisciplinary co-teaching provided a rich context for creativity.

*Periodic oscillations causing me to have sensations
Most evidently joy or ecstasy
But it's crazy to believe
That all the music we perceive
Depends on amplitude and frequency*

*Amplitude's what makes it loud
It makes you stand out in the crowd
It's dependent on the size of the waves
And to vary frequency to get the pitch you need
Makes music that will get you through your days*

*The way the waves rebound
Is what gives instruments their sound
They make these special things called overtones
And if you change the shape
It affects the sound you make
That's the difference 'tween the flute and saxophone*

*So as you all can see
They're as linked as linked can be
Physics really is contained in every song
So give a tune a try
I see no reason why
That you won't be a mus-physicist ere long*

Colton et al. (2022) offer a possible explanation for the increase in experimentation reported during interdisciplinary co-teaching from the field of Design Education. The authors suggest that nodes of tension lead to subject boundary encounters where knowledge is shared and developed, such that co-teachers possessing different understandings of the subject matter and indeed of collaborative practice are challenged by the complementary expertise and perspectives of their partners. Knowledge co-creation is described as an ongoing process, nurtured by the constant flow between the familiar and the unfamiliar. Similarly, in business education, Kliegl and Weaver (2014) argue that in their study, interdisciplinary co-teachers also demonstrated a willingness to experiment and be creative.

Theme 3 New/deeper insights into collaboration

Contributors to both studies identified several conditions for fruitful collaboration, which they maintained were afforded by interdisciplinary co-teaching.

Music-physics participants recalled that successful interdisciplinary co-teaching included mutual commitment to reciprocal learning. Co-teaching pairs identified the need for each individual to value both subjects, for maintaining a curiosity and wide-awakeness (Greene, 2000), regarding the partner discipline and for retaining an enthusiasm and energy for their one subject coupled with a desire to share this with one's partner. Several participants discovered that relinquishing the urge to control was the first step in building fruitful partnerships. Participants contended that the ego must be surrendered in successful collaboration and replaced with a flexible disposition and an attitude of give and take. Consequently, participants agreed that the most important partner is not the one who initiates but the one who can accommodate, accept and encourage. All in all, participants were unanimous in attributing the outcome, (an informal outreach music-science education programme for primary children and their teachers) to corporate commitment and collaboration via interdisciplinary co-teaching.

This third theme also resonated with West (2016) who discovered that via interdisciplinary co-teaching in Design Education, students reported gaining new ways of working and learning together.

Collaboration based on trust, (which in itself was identified as a significant condition for authentic reciprocity in both studies) was frequently identified by respondents as an essential element in harmonious and productive partnerships. The significance of trust was emphasized as fundamental for fruitful joint ventures, the type that would support and promote individuals to be brave and "risk" new ideas and approaches during the lesson. Music-drama participants experienced mutual trust as strong and liberating, enabling them to be open to changes "in the moment", implying that interdisciplinary co-teaching became a significant mechanism for fruitful collaboration. As such, participants stressed that trusting each other, affirming each other's experience and expertise, promoted collaborative partnerships which subsequently supported innovative teaching manoeuvres and

triggered spontaneous learning. Productive teamwork was, according to these participants, characterised by sustained mutual respect. Findings from Colton et al. (2022) also point to trust as a crucial relational quality in interdisciplinary co-teaching partnerships.

Theme 4 Expanded professional identity

Participants in both studies unanimously reported a significant expansion in insight into their own professional identity. Now, viewing the complementarity of knowledge, skill and competence as a resource, music-physics participants in Ireland spoke of seeing themselves as *educator, collaborator, facilitator, co-learner, coordinator* and *creator of knowledge*. Referencing narrower perspectives in relation to career pathways prior to interdisciplinary co-teaching, these participants reported new professional intentions, linking this change of mind to inspiration received from their co-teacher partner, and also from a greater broader sense of their own capability. Physicists, in particular pointed towards the satisfaction that came from having contributed to a child's engagement with their subject, something that surprised them greatly as teaching was not part of their intended trajectory.

In the music-drama collaboration, University lecturers also reported an expansion in their professional identities. Claiming that previous perceptions of personal and professional limitations may have negatively impacted their tendencies to take risks while teaching, participants reported that opportunities to experience each other's subjects during co-teaching, resulted in a positive reframing of their own personal and professional capabilities.

This expansion in professional identity is also referenced in a number of international interdisciplinary coteaching studies. In the field of Medical Education, Rooks et al. (2022) suggest that participant co-teachers, expanded their repertoires by going beyond the boundaries of their own disciplines. In Business Education, Carey et al. (2021) also cite opportunities for professional development in the context of interdisciplinary co-teaching partnerships. Likewise, Bennett and Fisch (2013) discovered that co-teachers in their interdisciplinary study formed strategies for future teacher collaborations.

Discussion

Findings from the two studies indicate, that regardless of participants, setting or career stage, interdisciplinary co-teaching facilitated the acquisition of integrated content knowledge including music, and inquiry-based pedagogical practice, pointing to broader conceptualizations of teaching and learning in the context of teacher education. Using the Vygotskian theoretical framework to probe the significance of the four strong themes which emerged from the CCA, we suggest that there are implications for the inclusion of interdisciplinary co-teaching comprising music in modular design and delivery in teacher

education. Participants reported that interacting via co-teaching created opportunities for the emergence of learning or zones of proximal development which impacted professional and personal epiphanic moments of transformation. Interdisciplinary co-teaching broadened individual disciplinary frontiers as participants in both studies claimed an expanded understanding of their own subject as a consequence of interdisciplinary fusion.

An in-depth consideration of the findings in the context of teacher education suggests as imperative the re-thinking of module delivery and professional learning in teacher education to support engagement with opportunities for expanded thinking, inquiry-based learning, collaborative approaches and identity development. Interdisciplinarity as experienced via co-teaching provided excellent conditions for deeper understanding, innovative thinking and collaboration. We suggest that in terms of course design and delivery, the traditional emphasis on discipline specific methodologies and solo teaching practice may limit opportunities for dynamic collaboration and for alternative, more expansive, and engaging curricular approaches. Pre-service and in-service teachers request opportunities to innovate and experiment with new ideas. Bearing in mind the findings from the comparative analysis of these two albeit small studies, we suggest that serious consideration be given to the inclusion of informal learning settings and interdisciplinary co-teaching opportunities. Rather than providing a set of definitive instructions, participants were given the freedom to construct the teaching and learning moments as a team. This less-scripted approach saw partners deferring to and learning from each other's expertise and experience where knowledge, both content and pedagogical, emerged from the creativity that was needed to work in new, innovative and integrative ways. To avoid what Carey et al. (2021) describe as the maintenance of traditional subject silos, a commitment to the fidelity of the co-teaching model, which involves co-planning, co-practice and co-reflection/co-evaluation, together with the support needed to execute such a commitment is vital (Guisse et al., 2017). To fully exploit the possibilities for personal and professional growth inherent in interdisciplinary co-teaching in Higher Education, a period of preparation is recommended. Reports of positive experiences based on trusting relationships between co-teacher partners were frequent in both studies. Lee (2014) points to the importance of the facilitation of interdisciplinary learning and calls for an investment in time in preparation and planning. With the investment in time for co-planning and co-reflection and a commitment to reciprocal learning while co-teaching, this mechanism has the potential to support optimum placement conditions for innovation and expansive learning via interdisciplinarity.

To conclude, accepting certain limitations – that both studies are small-scale and both involve volunteers – we suggest that co-teaching, particularly in the context of interdisciplinarity, provides an ideal set of supports for dynamic partnerships which support inspired and inventive curricular and pedagogical approaches. Future studies might consider the impact of interdisciplinary co-teaching on a larger participant cohort, as a mandatory interdisciplinary professional learning and indeed pairing music with a wider variety of

disciplines. To create prosperous conditions for teaching and learning when considering these aspects, there is a need to address potential challenges, such as lack of time, training, commitment, and collaboration skills (Bennett & Fisch, 2013).

Higher education needs to evolve by increasing its focus on creating new knowledge providing increased value for students, to sustain its impact and influence in society (West, 2016). Bearing in mind the fact that teacher education programmes have changed very little over the past 100 years (Guyton & McIntyre, 1990), our findings suggest that it may be time to re-think what we do and how we do it!

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

Author biographies

Marie-Helene Zimmerman Nilsson, PhD in music education, is an associate professor in education at University West, Sweden. She is also deputy operations manager for the research center Child and Youth Studies at University West. Marie-Helene's research interests comprise perspectives as human-materiality combinations, discursive constructions, subject didactics and coteaching in educational settings. She has presented her studies at several general educational and music educational international conferences, as well as in well-known scientific journals.

Marita Kerin, PhD, is an assistant professor in music education at the University of Dublin, Trinity College. With colleagues, Professors Carmel O'Sullivan and Michael Grenfell, Marita established the Arts in Education Research Group at the School of Education, TCD. She is particularly interested in the theory and practice of initial teacher education, specifically within the fields of formal and informal learning in music education. Her published research spans three domains including interdisciplinary learning, (music and physics), teacher-musician partnerships (co-teaching music in primary school; teacher perspectives) and the pedagogy of music performance (artistic biography). Two currently funded projects include *Quavers*

to *Quadratics* (Trinity College Dublin, University College Dublin, and the National Concert Hall) and *Co-teaching Music* (Trinity College Dublin and a number of primary and post-primary schools). An experienced educator and author, Marita is committed to promoting dynamic co-teaching/co-learning interdisciplinary, inter-institutional research partnerships.

References

- Alvesson, M., & Skoldberg, K. (2009). *Reflexive methodology: New vistas for qualitative research*. Sage.
- Bennett, J. B., & Fisch, A. A. (2013). Infusing co-teaching into the general education field experience. *Interdisciplinary Journal of Teaching and Learning*, 3 (1), 18–37.
- Boeije, H. R., Drabble, S. J., & O’Cathain, A. (2015). Methodological challenges of mixed methods intervention evaluations. *Methodology*, 11(4), 119–125.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77–101.
- Campos, M. D., & Estevam, C. V. (2020). Co-teaching praxis as in interdisciplinary experience in natural sciences teaching. *Revista Brasileira de Educacao do Campo*, (5), 1–24.
- Carey, J. C., Beitelspacher, L. S., Tosti-Kharas, J., & Swanson, E. (2021). A resource efficient modular course design for co-teaching integrated sustainability in higher education: Developing the next generation of entrepreneurial leaders. *Entrepreneurship Education and Pedagogy*, 4(2) 169–193.
- Christophersen, C., & Kenny, A. (Eds.). (2018). *Musician-teacher Collaboration*. Routledge.
- Colton, J., Mignone, J., Newport-Peace, D. (2022). Nodes of tension: Negotiating epistemic fluency in interdisciplinary co-teaching. *The Australian Educational Researcher*, 49, 511–527.
- Council, T. (2020). Céim: Standards for initial teacher education. *Maynooth: The Teaching Council*.
- Chian, M. M., Bridges, S. M., & Lee, D. P. L. (2021). Synergistic co-teaching: Surfacing the invisible flows in practice in initial teacher education. *Learning, Culture and Social Interaction*, 31, 1–17.
- Daniel, M. M., Ross, P., Stalmeijer, R. E., & de Grave, W. (2018). Teacher perspectives of interdisciplinary co-teaching relationships in a clinical skills course: A relational coordination theory analysis. *Teaching and Learning in Medicine*, 30(2), 141–151. <https://doi.org/10.1080/10401334.2017.1384381>
- Edwards, A. (1995). Teacher education: Partnerships in pedagogy? *Teaching and Teacher education*, 11(6), 595–610.
- Gaunt, H., & Westerlund, H. (Eds.). (2016). *Collaborative learning in higher music education*. Routledge.

- Greene, M. (2000). *Releasing the imagination: Essays on education, the arts, and social change*. John Wiley & Sons.
- Guisse, M., Habib, M., Thiessen, K., & Robbins, A. (2017). Continuum of co-teaching implementation: Moving from traditional student teaching to co-teaching. *Teaching and Teacher Education*, 66, 370–382.
- Guyton, E., & McIntyre, D. J. (1990). Student teaching and school experiences. *Handbook of research on teacher education*, 1, 514–534.
- Idel, E., & Du Prez, J. (1983). *Galaxy song. On Monty Python's The Meaning of Life*. Andre Pacquemin CBS/MCA.
- Kerin, M., & Murphy, C. (2018). Equal temperament: Coteaching as a mechanism for musician-teacher collaboration. In C. Christophersen & A. Kenny (Eds.), *Musician-Teacher Collaborations* (pp. 217–230). Routledge.
- Kliegl, A. J., & Weaver, K. D. (2014). Teaching teamwork through co-teaching in the business classroom. *Business and Professional Communication Quarterly*, 77(2) 204–216.
- Koivisto, T.-A. (2022). Making our way through the deep waters of life. Music practitioners' professional work in neonatal intensive care units. In H. Westerlund & H. Gaunt (Eds.), *Expanding professionalism in music and higher music education. A changing game*. Routledge.
- Murphy, C. (2016). *Co-teaching in teacher education. Innovative pedagogy for excellence*. Critical Publishing.
- Murphy, C., & Martin, S. (2015). Coteaching in teacher education: Research and practice (Editorial). *Asia-Pacific journal of teacher education*, 43(4), 277–280.
- Murphy, C., Scantlebury, K., & Milne, C. (2015). Using Vygotsky's zone of proximal development to propose and test an explanatory model for conceptualising coteaching in pre-service science teacher education. *Asia-Pacific Journal of Teacher Education*, 43(4), 281–295.
- Rooks, R. N., Scandlyn, J., Pelowich, K., & Lor, S. (2022). Co-teaching two interdisciplinary courses in higher education. *International journal for the scholarship of teaching and learning*, 16(2), 1–12.
- Samaras, A. P. (2000). When is a practicum productive? A study of learning to plan. *Action in Teacher Education*, 22(2), 100–115.
- Smith, J. (2001). Modeling the social construction of knowledge in ELT teacher education. *ELT Journal*, 55(3), 221–227.
- Warford, M. K. (2011). The zone of proximal teacher development. *Teaching and Teacher Education*, 27(2), 252–258.
- West, R. E. (2016). Breaking down walls to creativity through interdisciplinary design. *Educational Technology*, 56(6), 47–52.
- Zimmerman Nilsson, M.-H. & Murphy, C. (2021). Synergies in subject parallels: Coteaching in music-drama. *Hungarian Educational Research Journal*, 11(1), 1–13.