

HARMONIZING EDUCATION: THE ROLE OF MUSIC IN SAUDI GRADE 2 SCIENCE AND LITERACY"

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Abstract: Over recent decades, a severe decline in the honeybee population, coupled with alarming colony collapse rates, has raised significant concerns among beekeepers (Sweeney, 2019). This decline affects both domestic and wild bee populations, presenting a dual-level crisis with both local and global ramifications (Cameron & Sadd, 2020; Lerata & Lubuma, 2018). Bees play a vital role as nature's premier pollinators, indispensable for various food production and ecosystem stability. While wind pollination primarily supports grains, bees, both wild and domestic, contribute to the pollination of fruits, vegetables, and nuts—sources of nearly 70% of global nutrition. Honeybees alone facilitate up to one-third of the world's food production (Sweeney, 2019).

Multiple factors contribute to the bee population decline, including the widespread use of pesticides, notably neonicotinoids, invasive parasites such as the Asian Varroa mite, and a general decline in bee dietary quality (Lerata & Lubuma, 2018). These challenges underscore the significance of studying pollinators, making it a pertinent real-world subject for investigation, even for young students as early as seven years old.

Contemporary educational literature emphasizes the integration of curriculum disciplines to address societal issues. Curriculum integration, involving the examination of a topic from multiple disciplinary perspectives, is recognized for promoting deeper learning compared to traditional subject-based approaches (Drake, 2012). The ongoing debate between integrated and specialized studies, dating back centuries (e.g., Whitehead, 1929), holds particular relevance, especially in the context of environmental and social issues, such as the global pollinator crisis.

Keywords: Bee population decline, Pollinator crisis, Curriculum integration, Environmental education
Interdisciplinary learning

Literature Review

For the past several decades, beekeepers have noticed a dramatic decline in the honeybee population as well as high rates of collapse within colonies (Sweeney, 2019). The declining population of both domestic and wild bees is both a local and a global concern (Cameron & Sadd, 2020; Lerata & Lubuma, 2018). Pollinators are essential for many types of food production and the balance of ecosystems, and bees of all kinds are nature's finest pollinators. Although grains are predominantly pollinated by the wind, wild and domestic bees are responsible for pollinating fruits, vegetables, and nuts, which provide close to 70% of the world's nutrition; honeybees alone pollinate up to one-third of the world's food (Sweeney, 2019). Several reasons have been advanced to explain the

decline of bee populations, including the use of pesticides (most notably neonicotinoids), invasive parasites (e.g., the Asian Varroa mite), and the general decline in the quality of bees' diets (Lerata & Lubuma, 2018). These are serious problems and learning more about pollinators is arguably a worthy real-world topic of inquiry for study—even, or perhaps especially—for students as young as seven years of age.

The notion of integrating curriculum disciplines to explore societal problems is widespread in contemporary educational literature and pedagogical approaches. Curriculum integration, which in its simplest form involves the study of a topic or theme from more than one disciplinary perspective, is heralded as a way of ensuring deeper learning on the part of students than through a subject-by-subject approach, where what is being studied in, say, mathematics, is completely unrelated to what is being studied in art (Drake, 2012). The debate on whether, and when, integrated versus specialized studies are best for learning has carried on for centuries (e.g., Whitehead, 1929), and especially when it comes to the arts (Upitis, 2011). That said, there are many arguments to be made for subject integration, especially to explore questions of environmental and social significance, such as the plight of pollinators worldwide.

Subject integration can be described in terms of a continuum of approaches. The disciplinary or specialized subject approach involves learning both concepts and skills separately in each discipline (Kaufman, Moss, & Osborn, 2003). Multidisciplinary approaches involve learning concepts and skills separately according to disciplines, but in reference to a shared or common theme.

Interdisciplinary studies link two or more disciplines around a given theme in ways that deepen general skills (e.g., literacy and research skills) while also learning about the concepts and skills of the disciplines involved (e.g., geography and science). Finally, a transdisciplinary model involves exploration of real-world problems requiring students to apply knowledge and skills from two or more disciplines to shape the learning experience and outcomes (Drake, 2012; Kaufman, Moss, & Osborn, 2003). The International Baccalaureate Primary Years Programme (PYP) is a transdisciplinary model (Savage & Drake, 2016), and the present study took place in a setting where the PYP was used as an organizing framework for three of the Units of Inquiry during the academic year.

Transdisciplinary teaching and learning has been identified as one of the few approaches that can address the complex problems that exist in contemporary society (Hadorn et al., 2008). Further, transdisciplinary approaches are more than an intellectual exercise: properly executed, transdisciplinary work involves the mind, the body, and one's emotions (Nicolescu, 2008). The International Baccalaureate (IB) is centered on a series of transdisciplinary themes that serve as frameworks for learning and teaching, often involving collaboratively designed Units of Inquiry by groups of teaching colleagues working at the same grade level. Some of these transdisciplinary themes include, for example: (a) who we are, (b) how we express ourselves, (c) how we organize ourselves, and (d) sharing the planet. Each of these themes is then transformed into a Unit of Inquiry, which is comprised of a number of central ideas, key concepts (e.g., form, function, causation, change), related concepts (e.g., patterns, sequences, structure), and lines of inquiry that correspond to the central idea (IBO, 2012).

Research provides evidence that this transdisciplinary model results in academic outcomes that are at least as strong as traditional disciplinary approaches and often better (e.g., Guyette, Sochaka, & Costantino, 2015; La Porte, 2016). Arguably even more important, a meta-analysis of over 200 transdisciplinary programs indicates

that these approaches increase student motivation and empathy, as well as contributing to self-regulation and problemsolving skills (Durlak et al., 2011).

The strengths of curriculum integration as a pedagogical approach have been recently embraced in the Kingdom of Saudi Arabia (KSA), at least when it comes to the STEM disciplines using an interdisciplinary approach (Aldahmas, Naem, & Aljallal, 2019). In a study involving 48 middle school science and math teachers in Riyadh, Saudi Arabia, Aldahmas, Naem, and Aljallal researched a 6-day professional development (PD) program to determine if teachers' attitudes towards and knowledge about teaching STEM improved with the professional development offerings. The researchers argued that it was critical for the economic advancement for teachers to be skilled in designing curricula that integrate science, technology, engineering, and mathematics within a single interdisciplinary STEM perspective. While their results indicated some positive shifts in attitudes as a result of the PD program, the researchers concluded that in order for the teachers to fully understand the relevance of STEM and to develop the necessary pedagogical skills, much longer PD programs were required. They concluded that PD programs should be continuous and take place throughout the academic year. They also observed that most PD in KSA was a week or less in length. Arguably, one of the important elements of the present study was that the Canadian teacher-researcher who supported music teaching and learning, as well as STEAM inquiries, was actively involved in the PD sessions before the school year began as well as throughout the 2018-2019 academic year.

The Role of Music

Where does music fit in curriculum integration? In many cases, when music and other arts subjects are hailed as being integrated into a curriculum unit, they are, in fact, not much more than window dressing for the so-called core curriculum subjects, such as mathematics and language. In that process, music, visual art, and drama can suffer, as they are not accorded the same disciplinary value or attention as their sister disciplines. In a review of arts integration throughout 20th century classrooms, Brewer (2002) was critical of many attempts to integrate the arts with other subject areas, suggesting that it would be better to teach these subjects as standalone specialized disciplines. He claimed that:

Although integrated ... curricula can provide positive learning circumstances, the problem is that, in practicality these approaches often result in classes that deny [the arts their] value as distinct discipline[s]. Often the operational definitions for these curricular concepts may in fact be code words for devaluation. —Integrated curriculum often becomes more and more —instrumental, serving as a means to bring about greater knowledge in history or social studies. Art produced under this rubric tends to be merely illustrative of a form of untutored child art devoid of instruction in aesthetic issues. When integrated art is used in this fashion, student learning in the arts does not fulfill requirements set forth by national or state standards ... An overemphasis on integration used instrumentally may in fact subvert those standards unless art is studied as a distinct discipline. (Brewer, 2002, p. 31)

In the music context, the type of integration Brewer eschews most often consists of singing songs about the unit under consideration, which would be a low-level integration representing a multidisciplinary approach at best. That is, if the students are learning about harvesting apples, for example, the classroom teacher, diligently and with all good intentions, seeks out songs about apples—songs about types of apples, colours of apples, or about

counting apples. While the students are likely to enjoy these musical interludes, this is not what would be considered interdisciplinary or transdisciplinary integration, where the fundamental features and forms of music are taught and used to deepen the topic under study (Upitis, 2019). A deeper form of integration might involve the students creating their own lyrics or melodies about apples, using the power of melody to reinforce their learning and new vocabulary. Or they might create a musical soundtrack, using non-pitched rhythm instruments, to bring life to a book about apple picking—perhaps identifying a recurring idea and developing a musical motif to represent that idea, with the teacher explicitly introducing the musical elements of repetition, pattern, and motif. Other integrated approaches might involve explorations of how music has been traditionally used to lighten menial tasks—including apple picking and other forms of labour—or to communicate amongst labourers through music, in subtle but effective forms of social protest (Smith, 1966). For example, a centuries-old practice continuing into the early years of the 20th century required labourers in England to give up a tenth of their earnings and wealth—the tithe—to the landowners. A traditional song includes the words, —We’ve cheated the Parson, we’ll cheat him again / Why should the Vicar have his one in ten?‖ (Smith, 1966, p. 252).

Along with the song are stories of tithe evasion, such as the Quaker beekeeper who delivered his bees to the parson and then removed the skep, a container housing the bees, claiming it was not part of the tithe. Or the Quaker apple picker who only handed over one apple, claiming he had picked ten, and would pick more the following day (Smith, 1966). In these cases, music was at the heart of the tithe evasion. Students studying apples might do well to ask, Why music? What songs? How were they effective? These ways of integrating music into a unit on apples go much further than naming the colours of the apples in a basket to the tune of *Did You Ever See a Lassie*.

Research Aims

The overarching aim for the present study was to provide a rich description of how music was used in the context of a transdisciplinary PYP-based Unit of Inquiry on bees. Particular attention was paid to the types of music activities and nature of music created and performed, the extent to which they were teacher-initiated and/or student-initiated, and other ways that students expressed their growing understanding and empathy for declining bee populations.

Method

This qualitative case study took place in a private elementary school in Saudi Arabia. The single case was bounded by three intact classrooms made up of students (approximately 10 students per class), three homeroom teachers, three associate (Saudi) teachers, the Academic Coordinator, as well as the Arabic and Islamic Studies teachers, the Science, Technology, Engineering, Arts, and Mathematics (STEAM) coordinator, and the Curriculum Integration Specialist, who was tasked with introducing music to the school in the 2018-2019 academic year along with the responsibility of deepening trans disciplinary approaches at the school. The Curriculum Integration Specialist was a visiting teacher-researcher from Canada; she spent most of the 2018-2019 academic year in Riyadh. Prior to the commencement of the study, ethical clearance was obtained from the Queen’s University Research Ethics Board. The Director General and the School Principal (2018-2019) both endorsed the study. All of the teachers associated with the three classrooms agreed to take part. Due to the privacy constraints in place at the school, students could not be identified by name nor could their photographs be published.

Data Collection and Analysis

In keeping with a case study methodology, data were collected with the aim of developing an in-depth understanding of the teaching context through multiple data collection methods and allowing for thick and detailed description (Creswell & Poth, 2018). Data were gathered throughout the 12-week unit and included artifacts, interview data, and field notes collected by the Canadian teacher-researcher. Artifacts were comprised of the melodies and lyrics co-created by students and teachers, photographs of children's work, lesson plans, writing samples, and audio recordings of the music that was created. Formal interviews were conducted by the Canadian teacher-researcher with one classroom teacher and one associate teacher, and notes were kept regarding informal conversations that took place with the nine teachers that had a role to play in the Bee Unit of Inquiry. Field notes were comprised of classroom observations and reflections on the part of the Canadian teacher-researcher.

Data were analyzed using well-established qualitative protocols (Creswell & Poth, 2018; Yin, 2017). The 12 weeks of the unit were used to both organize the data as it was collected, as well as to describe the development of the unit as it unfolded. Documents, such as the writing produced by the students, were coded using a combination of *a priori* and emergent coding. *A priori* codes were created from the lines of inquiry and emergent codes arose from observations, interviews, and weekly lesson plans. The use of music in the Bee Unit of Inquiry was coded in terms of the level of integration, language (English and/or Arabic), and whether music engagements were teacher-initiated or student-initiated. Collectively, these data were used to describe the results in narrative form as they appear in the following section.

Results

The results are presented in two segments. First, the arc of the 12-week unit is detailed, including places where music featured in the unit and well as the nature of the music undertaken. Next, the evolution of music teaching and learning is described in deeper detail in terms of types of musical activities and the impact of the musical explorations.

The Unit

Three classes of students and their teachers took part in the Bee Unit of Inquiry (both domestic and wild species). Each of the classes had a number of teachers involved, including the homeroom teacher, the Saudi associate teacher, the Arabic and Islamic Studies teachers, the STEAM Coordinator, the Academic Coordinator, and the Curriculum Integration Specialist.

Before the unit began, homeroom and associate teachers from each of the three Grade 2 classrooms met to plan the unit by discussing the transdisciplinary themes and ideas for structuring the teaching content for the unit. Assessment data on student achievement was used to help identify the types of skills and experiences needed to move their learning to the next level. This team then met with the Curriculum Integration Specialist to deepen the initial ideas and to develop a timeframe for the entire unit, ensuring adequate time and opportunities for curriculum coverage. Under the transdisciplinary theme of —Sharing the Planet, the central idea and lines of inquiry were formulated as follows:

Central Idea:

Every choice we make affects the environment and other people.

Lines of Inquiry:

Where does honey come from?

Why are bees important to us?

How can we make informed choices about what we buy?

The unit opened with the beguilingly simple question: Why should we care where honey comes from? Throughout this transdisciplinary unit, the central idea and lines of inquiry were then explored through a full range of curriculum subjects. For example, language activities included reading, speaking and listening, and writing, and were all related to the Unit of Inquiry. Non-fiction texts were the most accessed reading materials. As students learned about domestic and wild bees and other pollinators, they explored features of non-fiction texts, such as glossaries and dictionaries. They used a wide range of print and digital media to glean information about the questions that intrigued them most. For example, by using information derived from their reading, they were able to connect the processes of seed dispersal and pollination. Students also analyzed how images and diagrams supported various authors' ideas and claims.

Speaking and listening involved a number of paired activities. Students were asked to describe the main ideas or details from the non-fiction sources they had read, summarizing information and presenting their findings to their partners. They then took turns asking and answering questions to clarify comprehension, to find additional information, and to deepen understanding. Their discussions about issues surrounding bees and pollination were used as a basis for formulating research questions for further study.

Writing projects were comprised of joint and individual research and writing tasks. Joint writing involved working with a partner to produce information texts about bees. By using facts and definitions learned through their non-fiction during reading and research, students created strong statements about how they and others could modify their behaviours to help save bees and other pollinators. These statements were later formalized in opinion letters, in which students wrote individual letters introducing the topic of fair trade, stating their opinions, supplying reasons to support their opinions, using linking words to connect opinions and reasons, and providing concluding statements. With guidance and support from teachers and peers, students focused on strengthening writing through revision and editing.

Mathematics activities were equally rich and fully integrated with the Bee Unit of Inquiry. In addition to the work that was part of the school-wide market, (e.g., creating products, setting prices, selling goods), students studied regular geometric shapes, examining how bees make hives using hexagons. This examination was extended by having students create shapes to investigate tessellations, in order to determine what other shapes could be used to create hives.

Of course, there were many natural links to the science curriculum. Students explored the process of pollination, dissected flowers and identified the parts, as well as learning about seed dispersal. Students participated in a virtual dissection of a bee, and also interviewed a beekeeper and an entomologist about some of the questions they had about bees that their reading had not uncovered. They had opportunities to use lab tools, such as microscopes and black lights, to see cells and phosphorescence of chlorophyll to understand photosynthesis. A visual survey of seed types was carried out and students engineered their own seed designs to maximize air time for efficient dispersal. Following on from the seed study, students learned about bees and their role in multiple

ecosystems, how honey is made, and the importance of bees to the environment and to people. Reasons behind the decline of bee populations were explored and conservation efforts of scientists searching for solutions to this global problem were discussed.

Students also learned about the anti-bacterial properties of honey by observing how bacteria multiplied in a petri dish that was segmented into three parts: one with Manuka honey, one with a penicillin disc, and one with a local honey. Students were astonished to see that the honey had effective medicinal properties, and that the famed Manuka honey was almost as effective as penicillin. Finally, students took part in the engineering and design process to construct —bee hotels to house solitary bees on the school campus, with guidance from the STEAM Coordinator, the Curriculum Integration Specialist, and the homeroom and associate teachers. Working in pairs, students created a design on paper and then tested a variety of materials to determine which materials would be most appropriate for the desert climate and weather. Students were able to test materials to see if they were windproof, waterproof, or breakable, and experience the pros and cons of these materials first-hand. After selecting their materials, students constructed their hotels from wood, and in so doing, learned how to handle a large variety of tools and construction materials as they enacted the design process. These bee hotels were displayed at the year-end celebration and then placed in the gardens around the school, which were known to have several species of wild bees.

Social studies topics began with an inquiry into the basics of economics and business through the study of goods and services, producers and consumers, as well as aspects of budgeting, finance, and accounting associated with small businesses. Students explored fair trade within supply chains and how the cost of a product within a supply chain affects the price consumers and end users pay. Part of this exploration involved a field trip in Week 4 of the unit, when the three classes travelled to **وعافية عسل | Asal and Afia** (literally meaning —honey and —away from all problems) in Riyadh and met with the beekeeper and owner. Through the study of honey manufacturing, students were able to look into the life of a small producer and understand the concept of living wage within fair trade practices and how to make informed decisions about the products they buy. Lively discussions ensued, with expressions of strong conceptual understanding of the intricacies of the marketplace, as demonstrated when students attempted to sell the wax-based products they created, negotiating with their buyers in the process.

Islamic Studies teachers also became deeply involved with the Bee Unit of Inquiry. There are important references to honey bees in the Quran: the sixteenth chapter of the Holy Quran, called Surah An-Nahl (The Bees), details the medicinal benefits of bees, and emphasizes that the bee is an important creature to consider and ponder. Students read Surah An-Nahl from the Holy Quran and discussed different types of honey and their various benefits. A reading from the Quran about bees also featured in the year-end presentation.

The range of music activities varied in the three classes. In one of the classes, where the homeroom teacher had prior experience integrating music into the daily life of her classroom prior to teaching in the KSA, music was introduced from the very outset as the children sang and moved to YouTube songs about bees created for primary-aged audiences. In all three classes, students wrote original lyrics to Western melodies to convey their knowledge about bees and their growing concern about the plight of the pollinators. Two of the three classes were also involved in writing a song in English and Arabic that was performed at year-end. These music activities and others are discussed in more detail in the following section.

In keeping with the central idea and lines of inquiry, the unit culminated with activities focusing on activism and social justice. Students wrote letters to local municipalities and to their fellow Saudi Arabian citizens to ask for pesticide bans, to encourage bee-friendly plantings and fair trade practices, and to inform them, generally, about the vital role that bees play regionally and globally. Excerpts from the letters appear below, beginning with a writing sample that emphasized the importance of bees to human health and as a keystone species:

Did you know that bees are so important to us? They pollinate flowers and plants and trees to give us food and oxygen. If bees weren't here, people with asthma would suffer a lot more and people who are fine would have more trouble breathing. Bees are a keystone species. Keystone species means they are very important because if they die, a lot of other animals suffer and die. (HN, 04-2019)

Some of the letters focused on food and human health:

Bees give us a lot of our food. If bees weren't here, one third of our food would be gone. We would lose almonds, oranges, pumpkins, and a lot more. Our health would be going down really quickly. Bees pollinate by getting the nectar and pollen from the highest flower and spreading pollen to the other flowers. If they didn't pollinate, our world would be very dusty and less beautiful. (HN, 04-2019)

Still others described the importance of purchasing fair trade and organic products of all kinds:

I am writing to you to ask you to think about the honey you buy. I believe that we should buy fair trade and organic honey because fair trade helps people to have a fair price and make sure the bees are treated fairly.

You can buy fair trade products in many different countries. If we buy fair trade honey, the people who made it will have the money they need to keep making it. (AQ, 04-2019)

And finally, many of the students described the interaction between pesticides and the bee population, focusing on the declining bee populations:

Did you know that bees are disappearing? It is because farmers are using pesticides to kill any insects that are harmful to the plants and they actually mistakenly harm bees. We should give bees a safe home by not using harmful pesticides and planting more flowers and plants. (NB, 04-2019)

And:

Did you know bees are dying? Next time you see a bee, don't be scared and swat at it because now you know how good bees can be. (AB, 04-2019)

Students became fully engrossed in the plight of bees. At the year-end school performance, the students produced a skit about a world without bees, beginning with references to the Holy Quran, and ending with a song, half in English and half in Arabic, pleading with the audience to —help us, don't use any more pesticides... [because] bees are dying off, all around the world we're losing them.¶

Music in the Unit of Study on Bees

Music was present throughout the unit in all three classes. To begin with, children sang and moved to a version of *The Ants Are Marching One by One* adapted for bees called *The Bees Go Buzzing* (https://www.youtube.com/watch?v=bWUgZm_AE64), found by one of the teachers as an online resource. Once the other teachers heard the song, they too began playing it in their classrooms. Students from all classes requested the song throughout the day, especially during transitions or when they were in need of an active, physical break. *Our Bee Song*, (https://www.youtube.com/watch?v=oST_t2XaBaY) was also frequently used as a go-to online

resource. The students' enjoyment of both of these songs was palpable, despite the fact that the songs were aimed at much younger children. According to the framework outlined in the literature review, these ways of enlivening the Bee Unit of Inquiry through music and movement were more instrumental than integrated, but nevertheless served as an important introduction to the notion that music and other art forms would play a key role in the inquiry as it unfolded. More important, moving and singing were motivating activities for the students and infused much joy into the classroom environment. All three classrooms also regularly took part in standalone music skill-building activities, such as exploration of head voice, beat-keeping, accompanying music using non-pitched rhythm instruments (both Arabic and Western), and singing. Most of these activities were led by the teacher-researcher.

As the unit progressed, at the request of both the teachers and the students, the classes began to write their own lyrics to known melodies in co-taught lessons involving the homeroom teachers, associate teachers, and the teacher-researcher. The lyrics showed their detailed understanding of bees, including references to pollination, nectar, combs, poison, royal jelly, and propolis. In addition to the enjoyment they displayed in singing their bee songs, all three homeroom teachers reported that the students' vocabulary deepened through their singing.

Six weeks into the unit, some students began to spontaneously produce lyrics and original melody phrases to describe what they were learning about bees. This was especially true in the classroom where the most music took place, beginning with the YouTube songs and movement activities.

The culminating integrated musical activity involved students in two of the three classes, resulting in a year-end presentation to close to 1,000 parents and friends of the school, staged at an opulent off-site theatre in Riyadh.

The two classes involved were those with boys; girls performed separately in keeping with Saudi customs.

Through the course of the unit, as evidenced by the children's writing cited earlier, the students became concerned about the plight of the bees, but at the same time, were sensitized to the complexities of changing production patterns, such as moving away from the use of pesticides and embracing earth-friendly fair trade practices. They wished to convey their concerns to the audience, and chose to do so through drama and song. The backdrop for the presentation was a bi-fold set, with brightly coloured flowers and fields on one side, and the same set presented in drab greys on the other. The students portrayed two scenarios: one where the use of pesticides was limited, where bees thrived, and where people worked together to produce food for their needs. The other showed what would result if present patterns of consumption and production continued. The presentation ended with one young boy imploring, —Can you help us?!, followed by a poignant song that the children themselves had created. The melody for the song was a popular Arabic tune, modified by the students to accommodate the sentiments they wished to express. It was sung partly in Arabic, partly in English.

The song opened with, —Bees are dying off/all around the world we're losing them/it's a problem, what will we do?/[so we can bring hope again]?! The lyrics of the chorus were, —Help us, don't use any more pesticides/[Let us plant flowers, to create gardens from them that give us life]. The second verse, entirely in Arabic, was as follows:

ه دواء أزر في .../[Blossom that could cure us] /ف /[That could heal us]

This powerful description of the plight of bees and gardens of hope is a far cry from the first song lyrics created by the same children, when they sang, to the tune of *London Bridge*, —Bees are insects with five eyes/with five eyes... they make honey... in my tummy.¶ The evolving musical maturity demonstrated over the 12-week unit exemplified the growth in both their musical skills as well as understanding of bees and our increasingly fragile relationship to nature’s extraordinary pollinators.

Discussion

Perhaps one of the most striking things about the learning outcomes—the powerful artistic presentation at year-end, the poignant writing samples, the level of scientific experimentation, the construction of bee hotels, and the modeling of a fair trade market—was that these impressive activities were accomplished by children in Grade 2 classrooms. There was much learning on the part of the teachers as well: many teachers commented on how grateful they were for the rich learning opportunities that presented themselves as they, themselves, learned more about bees in response to the students’ interest and questions. As the unit unfolded, it became evident how the investigation of this topic had cut across demographic and curricular lines, uniting teachers, students, and parents as they sought solutions to enhance bee populations. One teacher commented that she was surprised by the level of parental interest in the unit because of the enthusiasm that students shared for their learning at home. A parent reported that her shopping trips had become much longer as her son wanted to check the labels of the products they were buying to look at where and how they were made. Students were keen to make changes wherever they could; one group of students asked to meet with the school’s honey supplier to find out about the source of the school’s honey.

The seamless way in which music was integrated in the unit is also important to note, as music as a subject of study has been strictly prohibited in the KSA, and it was only with special permission from the Crown Prince that music could be taught at the elementary school under study (Upitis, Donaldson, & Osman, 2022). To those involved in the study, the musical elements were critical to the success of the inquiry, and all the more so because music was much more than an add-on: it became one of the key vehicles to convey the plight of pollinators that was enlisted by students and teachers alike as they made their views known within and beyond their school community.

This leads us to make two further, but related, observations. The first is that one of the greatest disservices we do to children is to underestimate their abilities to tackle difficult topics, concepts, and creative projects at an early age.

These young students were completely capable of learning about bees in depth, as well as the economies of fair trade, tessellating shapes, and learning from non-fiction sources, even though many of these explorations might be more typically seen in later grades. The second is that bees, as a topic of interest, proved to be engaging not only to the Grade 2 students, teachers, parents, and other students in the school, but also, beyond the immediate school community. When the school year ended, the teacher-researcher returned to her Canadian home where she runs an off-grid wilderness retreat centre called Wintergreen Studios (wintergreenstudios.com). Just before leaving, one of the Grade 2 boys asked her if she had bees at Wintergreen. When she replied that she didn’t, the child asked, —Why not?¶ Why not, indeed? In fact, she was so inspired by the Grade 2 unit on bees, and the student’s pointed question, that she started an apiary upon returning to Canada. The apiary has become a central

part of the educational offerings of Wintergreen Studios. In the 2019-2020 school year, three Canadian schools partnered with Wintergreen to learn how to increase their native plantings and to learn about domestic bees. Along with Wintergreen, these three schools have become Bee City Canada members and students and teachers have become ambassadors for bee habitats. These developments were communicated with the children and teachers in Saudi Arabia: it is a powerful example of how students can have an impact far beyond a unit of study to inspire change beyond the walls of the school.

There is more. One of the Grade 2 teachers from the school, who is an author on the present paper, also left Saudi Arabia. She taught in Bahrain for the subsequent two academic years (2019-2021). Because of the powerful nature of the topic, she continued to teach students about bees and adapted the work to her new setting, using music to enliven the unit once again and stretching the musical explorations even further. She incorporated much of what took place in the 2018-2019 year at the KSA school. But it has not been the same: the collaborative environment at the school in Riyadh resulted in much better pedagogy, as well as a level of enthusiasm and energy that comes from working with one's teaching peers, than was the case in the Bahrain school. Although an integrative curriculum design was used to enable students to develop conceptual links across disciplines, the unit was delivered in discrete teaching blocks with teachers working separately on developing learning experiences. Because the collaboration, excitement and common language were not modelled by teachers, it is our view that the students did not have the same enthusiasm or dedication to learning across curriculum areas. Even so, half of the students set a personal science goal related to bees either to learn more about bees, pollination or pesticides, demonstrating again how appealing the topic is across ages and cultures—regardless of how it is taught.

Ultimately, then, this study demonstrates how an extensive integrated and collaborative inquiry has the potential to engage students and teachers far beyond the walls of the classroom, leading to international ripple effects and enduring learning on the part of the members of the learning community. It also demonstrates that music has both an instrumental and integrated role to play in adding life to the learning process.

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