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Including the Literary Arts as the A in STEAM

Abstract

This article examines the integration of literature into secondary STEM (science, technology, engineering, mathematics) classes in British Columbia, Canada. Data were collected through interviews with nine secondary STEM subject teachers and focus on teachers' perceptions of the effects of including literature, what/how literature has been included, as well as the barriers, both real and perceived, to doing so.

A review of the literature demonstrates that integrating literature into STEM can be appealing to a broad range of students and teachers and can help to engage students with a variety of interests, perspectives, and backgrounds. The arts, including the literary arts, are a part of STEAM (science, technology, engineering, arts, mathematics) education, which focuses on interdisciplinary or transdisciplinary approaches to education. Furthermore, due to its multiple disciplinary nature, literature can present opportunities for students to learn holistically and help them to better understand the context of the content they are studying. Interview data suggest that literature can also help to make lessons memorable, build community within the classroom, and create opportunities for students and teachers to authentically represent themselves and the subject matter.

Participants in this study described several barriers they have faced in choosing to integrate literature in STEM classes, including time constraints, locating appropriate literary material, and managing the expectations of students, colleagues, administrators, and parents. However, the participants in this study all stated that they would continue to include literature in their classes in the future, despite the barriers.

Keywords

Interdisciplinary education, literary arts, STEAM, secondary education

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Including the Literary Arts as the A in STEAM

Lindsay Cunningham (University of British Columbia)

Introduction

One afternoon, shortly before I started graduate school, I was driving while listening to CBC radio (Canada's public broadcaster) and happened upon a discussion about calculus. The show's guest, Steven Strogatz (McDonald, 2019), was an author who is passionate about mathematics and had written a book about seeing calculus in the world around us (*Infinite Powers: How Calculus Reveals the Secrets of the Universe*). Given that I am a language arts teacher and avid reader, my curiosity was sparked in a way that had never occurred during high school math classes. It sounded like a great foundation for a project: students could examine how "mathematics interweaves with the fabric of the Earth," as David Jardine would suggest (1990, p. 112). Perhaps students could use the skills acquired in their language arts classes to interpret their findings in calculus. Students could possibly understand math in a different way, potentially increasing their perception of the relevance in their studies, and perhaps drawing a different type of student into the concepts. It is also possible that a fresh, integrative perspective could escalate student engagement for those who might not normally consider math class a favourite.

I was a language arts teacher at the secondary level for thirteen years, and as such, I have used a wide variety of literature in my own lessons. I have first-hand experience with holistic approaches using literature as a connector through literature circles and science fiction. I understand the power of literature and its ability to transcend subject boundaries. For example, I taught environmental sustainability in English 12 using a multi-modal approach; my classes examined the topic through documentaries and scientific writing, as well as through poetry, fiction, and art. I have been able to introduce literature from a variety of perspectives in an effort to help students from differing cultural backgrounds see themselves represented.

I know that for many students, literature is engaging and offers a way to connect to the world around them. Even for myself, reading introduces me to new ideas that spark my interest and compel me to seek further information and perspectives on a topic that may not have seemed interesting in previous contexts. I've started to see this effect in my young daughter through the questions she asks while we are reading together: For instance, "why do fireflies light up?" during *James and the Giant Peach* (Dahl, 1996) and "why is there no gravity in space?" during *Charlie and the Great Glass Elevator* (Dahl, 2001). Her inquiry offers an opportunity to explore new topics and she is more engaged because she is the one who initially asked the question. Integrating literature provides readers with a chance to understand the complexities of situations that they would never otherwise have the opportunity to experience. I was interested in exploring whether the experiences I have had in language arts classes, particularly with the use of literature, are transferable and equally beneficial in STEM (science, technology, engineering, and math) classes as well.

In order to learn more about the potential benefits of incorporating literature into secondary STEM classes, as well as what types of barriers teachers may face in doing so, I interviewed nine STEM teachers (subjects include mathematics, as well as various science and technology courses) in British Columbia, Canada, who have included literature in their secondary school classes. For this study, I kept the definition of literature deliberately broad: any type of short or long fiction or non-fiction, or poetry, excluding textbooks. The benefits that the interviewees described include promoting inclusivity,

providing opportunities for holistic learning and authenticity, and helping to make lessons memorable. Although the teachers described barriers they faced when deciding to integrate literature, such as time constraints, difficulty in finding appropriate resources, and feeling pressure to conform to previously held expectations, all of the interviewees expressed that they would continue to include literature in their classes in the future. They also explained that, in general, students reacted positively to the inclusion of literature in their secondary STEM classes.

Opportunities for Holistic Education and Contextualization

The teachers I spoke with appreciated how literature can connect topics and provide context for the content they were trying to teach. When learning is fragmented through the division of “knowledge into subjects, units, and lessons,” students may lose the ability to find the connection between their school work and the realities outside of their classrooms; consequently, students might not be able to “see the relationship between... subjects, the relationship between facts within a subject, or the relevance of the subject to life,” and the real purpose of education is lost (Miller, 2019, p.6). Thus, the incorporation of literature could be a starting point for a more holistic approach to STEM education. Literature can include fiction and non-fiction novels and stories, as well as poetry, and “books do not have to be taught or read in their entirety” to be a meaningful addition; in any class, “books can offer stories, tidbits to make lectures more captivating, [and] poetry [can] add beauty and wonder to the topics in a curriculum” (Kane, 2020, pp. 3, 86). Literature is not limited to a single subject and can therefore be easily used to help students understand the real-world implications of what they are learning in class. Stories can be a bridge between students and the concepts and theories they are trying to learn (Flynn & Hardman, 2019; Klassen & Klassen, 2014). Furthermore, “real world problems are not solved with discrete and decontextualized facts”, so a holistic, literature-based approach to education allows students to see the bigger picture in learning (Henriksen et al., 2015, p. 458). Stanley J. Farlow (2017) describes a connection between reading and math skills, as well as an increased engagement in math when they were combined; furthermore, there is evidence that “students who are taught mathematics with connections to storytelling become better problem solvers for problems related to the real world” (p. 581).

Several of the teachers incorporated literature in an effort to bridge the art/STEM divide; this combination is commonly referred to as STEAM (the A represents the arts, including the literary arts). Literature can offer another way of looking at STEM subjects and can help those students who gravitate towards the arts engage with STEM. In literature, poetry can often be overlooked; however, it can serve as a powerful resource for STEM education (Farlow, 2017; Helfferich et al., 2014; Kane, 2020; Vardell, 2019; Vardell & Wong, 2015). Although STEM and poetry may be viewed as “antithetical” to many, ultimately, these fields have a common goal: they attempt to develop our “understanding [of] how human beings fit into the world” (Major, 2011, p. xv). Mathematics, in particular, is often “presented as a wholly abstract discipline, devoid... of human emotions... and artistic expression”; however, this approach does not allow students to experience the “abstract beauty of mathematical ways of knowing” which can be explored through the arts (Gerofsky, 2019, p. 58). Sylvia Vardell (2019) argues that “we can connect thematic poetry collections with those same topics” in STEM classes in an effort to create deep, meaningful connections for the students (p. 100). Poetry can be particularly impactful for “students, who are used to texting, tweeting, and engaging in short-form communication” as they “can find the same powerful conciseness and focus in poetry” (Vardell, 2019, p. 101).

It is through joining both subject areas, STEM and language arts, that each can be fully explored, experienced, and appreciated. STEAM education can help to highlight the mutually beneficial relationship between the arts, including the literary arts, and STEM. This unification can also allow all

types of students to find a place within STEAM where they feel engaged. Thus, incorporating a variety of approaches can help learners find a way into STEM and internalize the concepts in a way that feels compelling and meaningful (Braund & Reiss, 2019).

Fostering Inclusivity and Empathy

Literature can be used as a means to include more diversity in classrooms. Specifically, some teachers included literature with Indigenous perspectives and representations of women in STEM fields in order to highlight and include groups that are underrepresented in STEM fields. Paula A. Magee, Aimee Lee Govett, and Jane H. Leeth (2019) suggest that using non-fiction literature helps “students develop a sense of social consciousness and empathy” (p. 126). Literature can promote the development of empathy through “bring[ing] students in contact with issues of gender, race, ethnicity, and cross-cultural experience and understanding” (Nussbaum, 2010, p. 108). Students who do not normally see themselves or their cultures represented in the STEM curriculum can feel that classmates respect their culture and take an interest in it through the integration of culture-specific literature (Kane, 2020; Nussbaum, 2010). Peter MacMillan, Catherine McGregor, and Barbara Old (2005) describe an overarching belief among students that math is “culturally neutral” although this is not the reality (as cited in Stavrou & Miller, 2017, p. 105). Integrating mathematics-related literature involving a variety of cultures could help to create a more inclusive environment for students who do not normally see themselves represented in the curriculum. It is important for a teacher not only to accept diversity, but to affirm and normalize it in the classroom; therefore, a teacher who includes a variety of reading selections (i.e., representing various cultures, backgrounds, and experiences) helps to make “the classroom into a safe haven where differences are recognized as resources and assets that can add richness and vibrancy” (Lieber, 2009, p. 95). Thus, the integration of literature can be a tool for promoting inclusivity and respect for diversity in the classroom. Moreover, narratives can also “[humanize] science through the use of history” and “make it clear that scientists do not work in isolation”, hence supporting the concept of collaboration which is integral in STEM (Flynn & Hardman, 2019, pp. 133-134).

The arts, and literature specifically, can create scenarios where students must see the world through another point of view (Kane, 2020; Magee et al., 2019; Mishra et al., 2011; Nussbaum, 2010). It allows readers to see others as more than “just a body”, which is particularly important for scientists and people working in STEM fields (Nussbaum, 2010, p. 102). Jennifer Boger (as cited in Galloway, 2021) suggests that employing a cross-curricular approach to ethical discussions is important because often the groups that are “building tech”, for example, are not the same groups who are “asking questions about impacts and ramifications of tech”, and there is a perception that “it’s not one’s job to consider the other”; however, if STEM can be “unsilo[ed]”, there would be “more crossover so that the people building [tech] can talk to the people who are passionate about the implications of it and vice versa” (para. 46). Literature, especially science fiction, could offer all STEM students opportunities to contemplate ethical questions and extrapolate potential outcomes.

The Possibilities of Science Fiction

Although there are many forms of literature, and there can be a place for all of them in STEAM education, an easy starting point for teachers could be science fiction. STEAM learning promotes experiential activities, but they may not always be possible; time and resource constraints can limit what teachers are able to manage in class. However, science fiction can allow students to experience science concepts in a new way as well as inspire discussion and reflection on complex, real-world problems (Cavanaugh, 2002). Therefore, the use of science fiction in STEM classes can increase student engagement and build interest (Cavanaugh, 2002; Kane, 2020; Knippels et al., 2009). Moreover, science

fiction can help to “bridge the gap between real science and school science” by allowing students to see the concepts they are learning used practically (Nunan & Homer, 1981, p. 317). Students are able to use their imaginations to go beyond what is possible, escaping the constraints of the real world, while opening the door for some truly creative and innovative thinking (Bucher & Manning, 2001; Kane, 2020). Furthermore, science fiction reminds readers that science is neither devoid of politics nor context. Its analysis can provide a starting point for students to reflect on “how science affects individuals as social beings” as well as how science is “shaped by social factors and responds to social change” (Nunan & Homer, 1981, pp. 317, 327). Students would have the opportunity to look at science in a human, interconnected way as opposed to striving for neutrality and being disconnected from the real-world applications of the knowledge they are learning. This shift may be useful in captivating a broader spectrum of student, drawn into seeing science from a different perspective. As this genre looks at STEM through a more social, human lens, it can provide opportunities for the inclusion of a variety of voices and cultures. Although STEM teachers should not be limited to science fiction, this genre can be a good fit for those who wish to introduce literature into STEAM curricula.

Conclusion

By listening to their experiences, I have gained a more thorough understanding of the benefits as well as some of the challenges that STEM teachers face when considering or attempting the use of literature in their classes. A lack of time, as well as challenges in locating appropriate resources, can discourage teachers from trying new lesson ideas or teaching methods; these barriers can affect any teacher, and are not limited to teachers in STEM subjects. Additionally, a STEM teacher may have a negative view of integrating literature or may not see its relevance to their class or subject, which could affect how their students perceive more holistic approaches in future classes (Emerson, 2019; Norris & Phillips, 2003). Straying from preconceived notions and expectations around STEM education, from educators, administrators, students, and parents, could potentially lead to stressful situations and difficult conversations. However, the teachers that I interviewed all expressed that striving to overcome these barriers is worthwhile, and that the perceived benefits of including literature outweigh the challenges.

Interviewees noted that when teachers incorporate literature into STEM classes, it can help to make lessons more memorable by prompting students to make connections to themselves and highlighting the contextual relevance of class content. Other potential benefits of integrating literature in STEM classes mentioned during interviews include helping to foster a sense of community within a classroom and improving critical thinking skills. The use of literature can also offer teachers another way to express themselves and integrate their own authentic interests and passions into the classes they teach. Whereas curricular fragmentation can lead to disengagement, holistic approaches in STEM classes can help to highlight content relevance and contextualize learning (Banack, 2018; Flynn & Hardman, 2019; Gray, 2013; Hatch, 2018; Klassen & Klassen, 2014; Schreiner & Sjoberg, 2005). Literature is rarely limited to one subject matter, and thus, can be a useful tool for exploring context and helping students to see connections. STEAM may also help teachers feel that they are representing their subject matter authentically, in a way that more closely resembles their perception of the content in real life. Furthermore, blending the arts and STEM can help to engage a broader range of student, while offering learners a chance to understand the commonalities between these areas and develop skills that can be beneficial for any subject (Braund & Reiss, 2019; Mishra et al., 2011). Although further research is needed to address how to effectively overcome barriers, it is evident that there are many reasons to consider incorporating literature into any secondary STEM class.

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