Head, Hearts and Hands for the environment

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Abstract

As a teacher of science in a middle school serving children with diverse needs, I was keen to explore whether an embodied approach might be fruitful in supporting learners to engage with environment education. Embodied cognition (an example of which is the practice of Making) is an emerging idea that has foundations in established pedagogies such as those of Dewey, and involves placing tangible materials at the centre of the learning experience to promote deeper cognitive understanding. I therefore turned to the theory of embodied cognition and designed a lunchtime club that encouraged learning with hearts (learning through passion and values promoting a change in behaviour), heads (becoming cognitively involved in the learning and showing engagement), and hands (engaging with and manipulating tangible objects to engage with real-world issues). By engaging in embodied approaches to test the optimal growing conditions for different vegetables, pupils also developed STEM skills (science, technology, engineering, and mathematics), for example, critical thinking and teamwork. Embodied cognition can, therefore, be seen as a way to embed STEM skills and develop affective interest in the environment.

That is, when pupils are shown how to care for their environment, then embodied acts such as upcycling or planting seeds could be become an act of self-expression and potentially shared with the wider community.

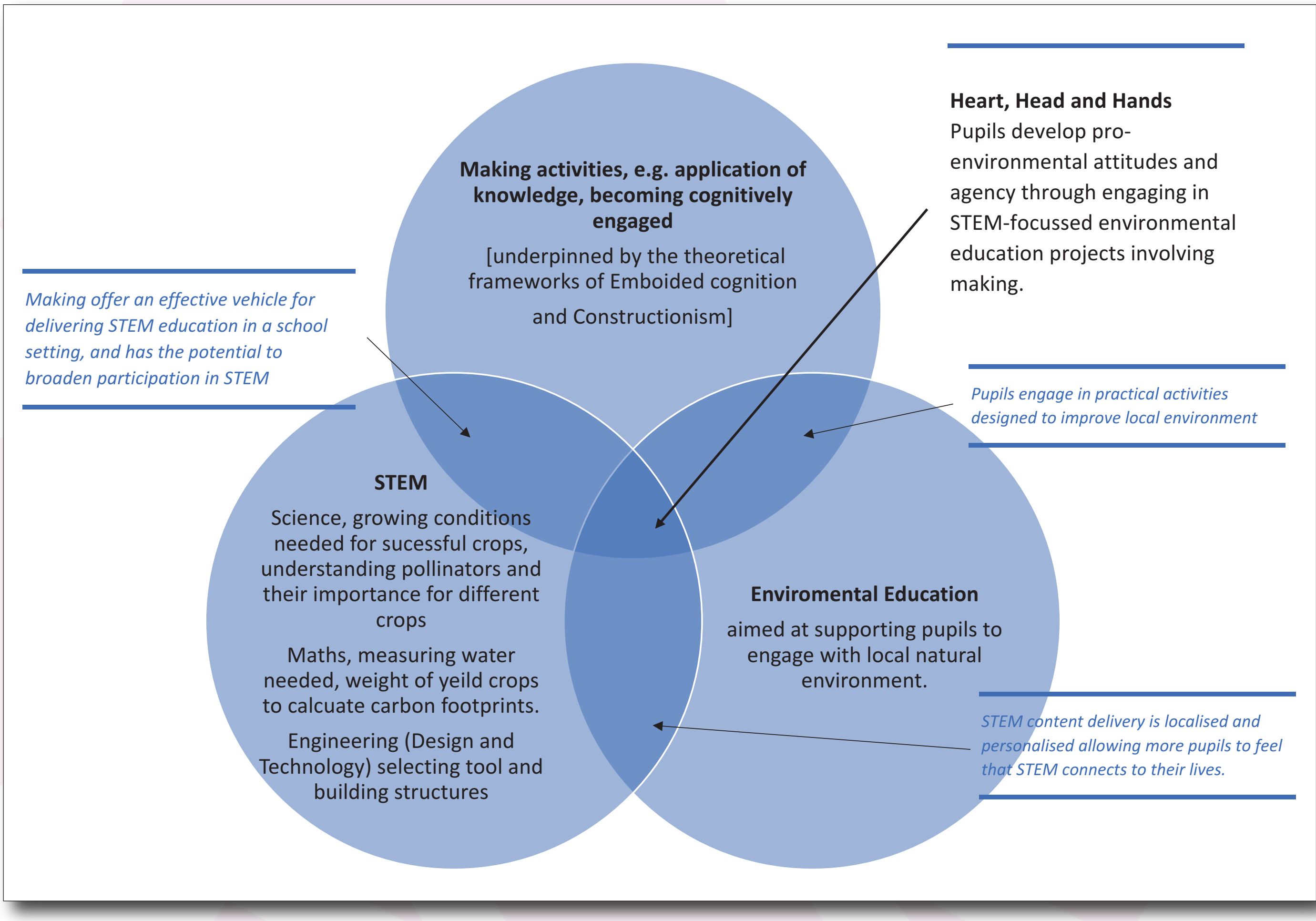
Introduction

Environmental Education (EE) was included in the formal education system in England in 1989 when the National Curriculum was launched. Glackin and King's (2020) analysis of how EE is delivered in secondary schools in England found that pupils are exposed to issues relating to the environment in science, and geography. However, their findings suggest that pupils are mostly taught *about* the environment rather than learning *for* the environment. That is, pupils learn facts about the environment such as deforestation and climate change, but rarely engage in critical analysis of these issues. Glackin and King go on to discuss that learning *for* the environment could be achieved by the pupils being *in* the environment. For example, to help a pupil to really make a connection with the environment and act to protect it, they should have the opportunity to physically interact with their natural surroundings.

Academics have viewed STEM education as having connections with EE. For example, Bybee (2020) addresses the need for pupils to understand and develop the skills that they will need to overcome challenges, such as over-population and climate change, as active and concerned citizens. He suggests that grounding these global challenges into a context that pupils can understand could enable them to see the role that they can play; and how, through innovation, STEM can help to resolve these issues.

Furthermore, it has been widely viewed in the literature that there is a need to challenge the dominant forms of STEM education as being masculine, about robotics, or excluding some social demographic groups (Archer *et al*, 2020; DeWitt *et al*, 2011; Halverson & Peppler, 2018). Projects such as ASPIRES (Archer *et al*, 2020) suggest that widening participation in STEM is necessary and calls for a systemic shift to change the perceptions of who can do STEM.

Figure 1. VENN diagram representing the connections between STEM, EE and Making.



The learning theories that are associated with the embodied approach of Making, where pupils are constructing new knowledge using their hands, is accredited to Papert's theory of Constructionism (Bevan, 2017; Kafai, 2005). His theory marked a new era in understanding how pupils learn; providing practical learning environments allowed pupils to construct their own knowledge and grasp abstract concepts through purposeful manipulation and interactions.

Above is a VENN diagram (Figure 1) drawing together my findings from academic literature. I noticed that the research suggested that there was an opportunity to deliver a STEM-focused environmental education programme using the embodied approach of Making.

Wilson's (2002) review of embodied cognition emphasises that we must understand the role of the mind and body when interacting with tools in learning situations. Her work includes two tentative views of embodied cognition that are relevant to this study, stating that cognition is situated, and that cognition is for action. The first view highlights the importance of learning in the environment and that we can learn best when we are actively placed in the situation – a claim that Wilson feels is well researched. The second claim underlines the importance of the mind to guide action. For example, our minds can develop episodic and implicit memory through our experiences and interactions and that, over time, difficult tasks become familiar and easier to comprehend. That is, our bodies can store information to help them to carry out actions, thus reducing the cognitive load for actions such as walking and using tools.

However, there is, as yet, little research examining the use of embodied approaches in the context of EE. I thus sought to explore the impact of using an embodied approach for engagement with the environment, emphasising head, hands and heart, through the implementation of a STEM-focused lunchtime environmental education club.

Research study

To explore the impact of an embodied approach to learning about the environment, I applied the work of Bevan *et al* (2020), in which they propose a framework of learning dimensions that can be observed during embodied activities.

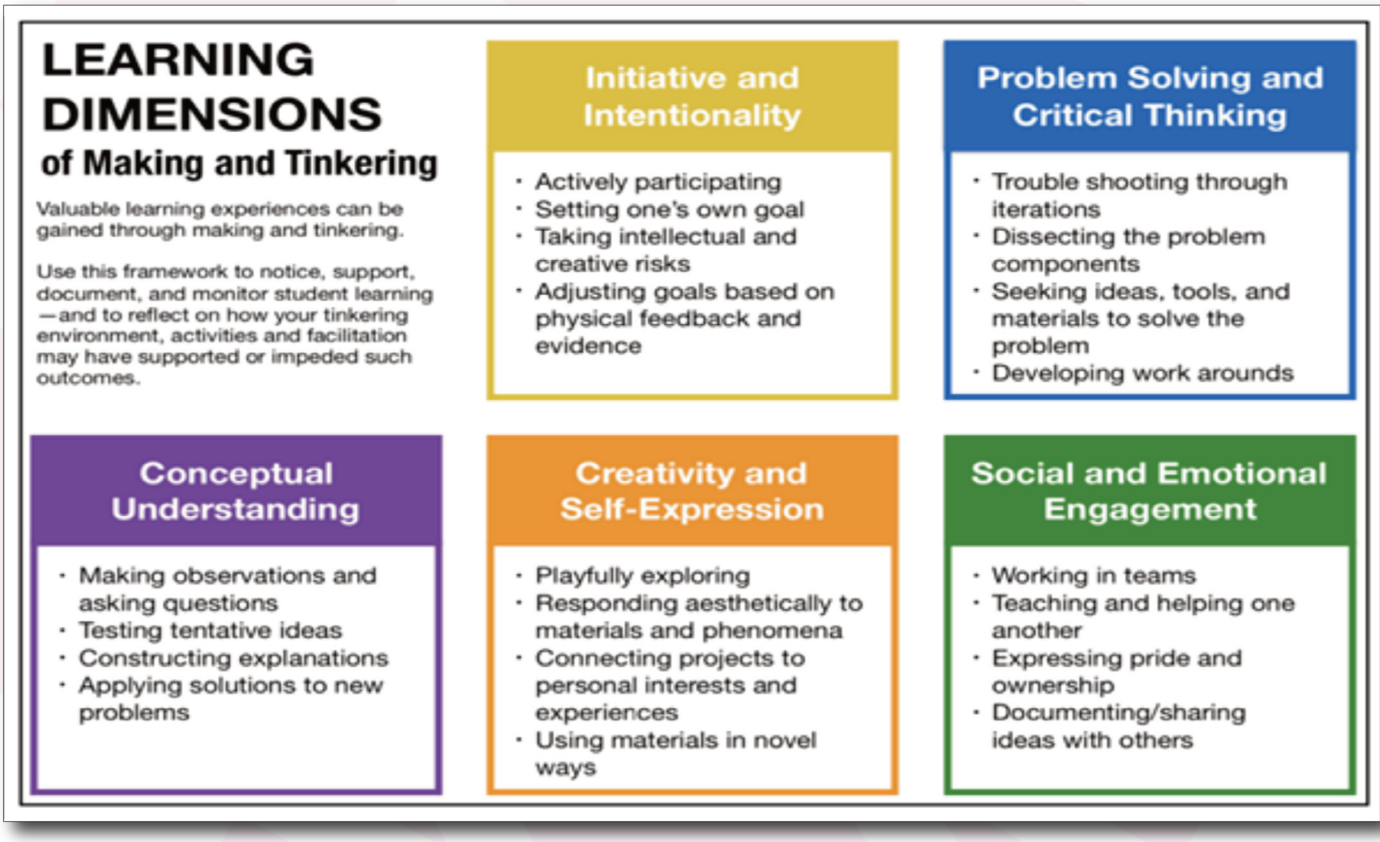


Figure 2. Learning dimensions of an embodied approach to STEM education.
Learning dimensions of an embodied approach to STEM education, © 2020 Bevan, Ryoo, Vanderwerff, Wilkinson & Petrich, reproduced under Creative Commons Attribution License (CC BY) (Bevan *et al*, 2020, p.4).

Method and data collection

To ensure that this study was conducted in an ethical manner, I made sure that all stakeholders were aware of the research objective and given opportunities to ask questions. I sought ethical approval from King's College University; this study was the dissertation module for my Master's degree.

Fifteen pupils aged 11-12 years returned the permission forms; hence, this was the size of the sample group. I recorded my data from April to June, spanning a school term. The pupils planted seeds from an organic seed library, which included runner beans, peas, tomatoes and other root vegetables. The pupils also made structures to support their plants and investigated factors that affect the yield of their crops. More specifically, plants were placed under different conditions and the yield recorded. For example, some were in raised beds, some were placed under a cloche (polytunnel) or in plant pots, with some being planted in direct sunlight and others in more sheltered spots. These data were shared with an external STEM partner who used the figures to calculate the carbon footprint of the pupils' produce; pupils were then able to make comparisons with fruit and vegetables that they buy from the supermarket.

For this project, I gathered empirical data using a reflective ethnographic journal along with a focus group meeting at the end of the project. This triangulation of qualitative data allowed for a deeper understanding of the impact that the intervention had on the pupils; I was able to cross-reference my perspectives with those of the pupils and make new discoveries from the focus group.

Notes were recorded each week and set out chronologically; they contained photos and brief descriptions of my observations in each session. The notes began as general observations and became more focused over time. For example, I would set up an activity with the learning dimensions (Figure 2) in mind and document evidence of pupils displaying those skills. This helped to keep the sessions focused and allowed me to collect data that could suggest pupils engaging in a STEM-focused EE.

Findings

The data gathered showed that pupils were developing an appreciation for the school environment. Additionally, the learning dimensions (Figure 2), such as displaying social and emotional engagement, were shown in this intervention. It was apparent during the seven weeks that the pupils could use the STEM disciplines to make structures to support their plants to grow. Once they could see how the pea plants were supported, they applied this to all other plants that looked as if they would fall, such as tomatoes and runner beans. Through iteration, they could select tools that were needed to carry out tasks without seeking guidance from me.

This intervention found that an embodied approach is a complementary way of learning that could be used in conjunction with formal education activities. For example, during the focus group discussion, pupils reported that learning whilst in the garden helped them gain a better understanding about what they were asked to do than merely writing notes in their books. The concept of cognition being situated is well researched (Wilson, 2002). Dewey (Bodzin *et al,* 2010) advocates that embodied learning should be with purpose, and the purpose here, as the pupils describe it, was to allow them to act in line with their environmental concerns. For example, during the focus group, pupils explained that they had chosen to attend the club because they wanted to learn how to grow their own food and be self-sufficient. Pupils growing their own vegetables, saving the seeds, and returning them to the library can be viewed as acts in line with global issue solutions: food shortages for a growing population. Further, by pitching global issues at a local level – that of being self-sufficient in vegetables – allowed pupils to take ownership of their actions and contribute to addressing environmental issues in ways that were feasible for them. For example, the pupils enjoyed sharing their crops with the Design and Technology department, as well as taking some of their produce home. This allowed pupils to see that what they were doing was having a direct impact: they enjoyed being part of a positive drive to reduce the carbon footprint of the food that they consume.

The focus group responses as to why they continued to attend the club were that they had developed an affective interest in environmental issues, and that the activities were motivating and helping them to learn. For example, they expressed their desire to learn new skills to *'save the planet'* and, more prosaically, they liked getting muddy. The focus groups also stated that they were applying the skills they had learned in the club to their communities, for example, in their parents' gardens. This was encouraging, as these acts can be viewed as promoting pro-environmental behaviour such as an awareness of their local environment and acting to preserve it. They were also promoting the club and generating interest amongst their peers, and had encouraged others to join in.

From my perspective, I found that an embodied approach to EE was impactful and especially effective for pupils aged 11-12 years. The pupils were also developing their STEM skills and their agency. For example, it was evident that, to begin with, they were apprehensive and sought guidance from me each time that they were assigned a task. Over the course of the term, pupils began to ask me if they could lead on a job and took ownership of their learning: they wanted to test their ideas, they sought specific tools, and they used their initiative in nurturing their plants. They enjoyed working as a team and assigned jobs to each other, with a shared goal of providing suitable conditions for their crops. They were also observed mentoring new recruits, thus demonstrating to me that they had gained new knowledge and skills and were able to convey them to others.

Figure 3. Pupils growing plants from organic seeds.

Figure 4. Pupils putting their plants into raised beds.

Figure 5. Peas growing around the structures that pupils made.

What was apparent through this intervention was the building of pupils' mindsets to engage in activities that had a purpose and meaning; they came along to the club as they wanted to '*do their bit*' to help the environment. They displayed cognitive, social and emotional engagement in environmental issues and conceptual understanding, hence reinforcing the ideas of hands-on and heads-on learning that is guided by the heart.

Pupils arrived with great enthusiasm, and I was able to nurture this to expand their environmental competencies. To help me see the relevance of my findings, I turned to Birmingham and Calabrese's (2014) study, in which pupils put on a carnival to help them understand green energies.

These authors reported that pupils who are traditionally excluded from science learning were given a voice and felt that they could participate. Further, the authors argued that connecting the mind and the body, by contextualising the science content that pupils could then physically use, helped provide meaning to the scientific knowledge. The data from my intervention suggest a similar conclusion. By providing an opportunity to develop skills, environmental awareness and agency, pupils were beginning to see that their voices were having a positive impact on the school. The club situated the global, abstract idea of reducing one's carbon footprint into a context that pupils could not only understand, but also one in which they felt that they could actively participate. Finally, the pupils reported better epistemic returns (building knowledge) when the learning was contextualised into something that was meaningful to them. That is, enabling pupils to pursue their interests in the environment helped them to see how STEM can be part of their lives, thus encouraging them to develop their skills.

Conclusion

My objective was to understand the impact of an embodied approach implemented within a STEM-focused environmental lunchtime club. The findings indicate that an embodied approach was impactful and that pupils exhibited pro-environmental attitudes and behaviours as a result of their participation in the club. Data collected at the end of the term indicated that participating pupils demonstrated many of the competencies outlined by Bevan *et al* (2020), such as teamwork and application of knowledge (Figure 2). The results from this study found that allowing pupils to see a broader view of what STEM is helped them to engage with STEM and foster environmental attitudes and agency. The adoption of a head, hands and heart pedagogy, where pupils were encouraged to develop their skills and not just focus on abstract knowledge, helped pupils to have a better understanding of tasks in which they were engaging.

The literature highlighted the limited research on the development of pupils' pro-environmental behaviours and a need to understand the pedagogies that teachers deploy to encourage engagement in EE. Here, I have offered my perspective and have suggested a way forward to help shape pupils' environmental attitudes. This small-scale study reports the perspectives of both the researcher and the pupils involved. As I work at the school where the data were collected, I am aware that the findings are situated within this school's context and may not be transferable to other settings. However, I hope that these findings demonstrate how an embodied cognition approach can be a useful vehicle for delivering a STEM-focused environmental education that could, potentially, help pupils to see how STEM connects to their lives. That is, schools could encourage pupils to identify local environmental concerns that they feel connect to their lives and with which they could engage with hands, head and heart. From this, schools could support pupils to find small-scale solutions that could have an impact, thus promoting a local and contextualised approach to global environmental issues. The framework from Bevan *et al* (2020) (Figure 2) would provide the academic justification for this project, as pupils will be observed developing their skills specifically related to STEM.

Lastly, the literature acknowledges the need to challenge dominant views of what STEM is and widen participation from some demographic groups that feel excluded from STEM. I believe that a STEM-focused environmental club, which employs the pedagogical approach of embodied cognition, can be seen as one way to channel pupils' affective interests in the environment, successfully motivating them to learn. The greater hope here is that pupils can leave school with the skills to contribute to and participate in society as environmentally aware and pro-active citizens.

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