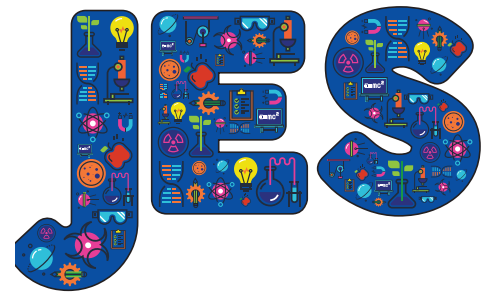


Forest nursery as an ideal backdrop for engaging girls in STEM education



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Abstract

This paper explores issues relating to gender equality that are present in early years education and reviews current literature relating to gendered education spaces. In this review, we found that classrooms can be viewed as gendered spaces and that social pressures on children may mean that girls do not have equal access to Science, Technology, Engineering and Mathematics (STEM) resources and toys. Children attending forest nurseries, however, could have more freedom from stereotypical gender norms than those attending classroom-based nurseries. We suggest that moving STEM education outside can reduce the social pressure on young children to conform to gender stereotypes, leading to a higher engagement with STEM.

Keywords

Gender equality, pre-school, STEM education, forest nursery

Introduction

As a society, we are reliant on people working in Science, Technology, Engineering and Mathematics (STEM) (House of Lords Science and Technology Committee, 2022), but diversity in these areas is lacking. One UK-based report found that women make up only 27% of the people working in STEM, with technology and engineering roles being particularly skewed in men's favour (APPG on Diversity and Inclusion in STEM, 2020). Gender Equality is one of the UN's sustainable development goals, and increasing the number of women working in

STEM will help to bring us closer to reaching that goal (United Nations, 2015).

However, despite multiple efforts over the past decades, the challenge of achieving gender equality in the STEM workforce still requires a lot of work. Career development theory (Gottfredson, 1981) highlights how career choices become limited early, with children ruling out careers and having gendered career aspirations at a young age (Chambers *et al*, 2018). Recent studies have started to explore the benefits of bringing STEM education to early years settings, considering the role of the environment, pedagogy and the attitudes and interests of the children as factors that are key to broadening perspectives (Padwick *et al*, 2022). These studies emphasise that an important approach to improving diversity in STEM is to start young (Campbell *et al*, 2018; Rippon, 2021).

Pre-school is often a child's first taste of formal education, but children as young as 2 years are influenced by the gender stereotypes found in classrooms (Campbell *et al*, 2020; Halim *et al*, 2014; Régner *et al*, 2014). During early years education, children are learning the social cues that help them develop into productive members of our society, and at this age they are particularly sensitive to what is 'for boys' and 'for girls' (Halim *et al*, 2014; Rippon, 2021). Removing barriers to, and increasing participation in, STEM before children see it as 'not for them' could help to tackle diversity issues further down the line.

With the Scottish government calling for improvements in early years STEM learning (Learning in STEM in early years, 2020), increased provision for outdoor learning opportunities (Out to Play, 2020), and gender-free play environments for pre-school children (Care Inspectorate & Zero Tolerance, 2018), the rise in popularity of forest nurseries in Scotland (Brooks, 2018) provides a unique opportunity to draw attention to the limited research linking these key areas. This paper builds on work by Speldewinde (2022)

and Maynard *et al* (2013) by suggesting that taking STEM education outdoors may provide a way of reducing the gender conformation pressures found in early years education, and could increase girls' attainment in STEM by lowering gendered barriers to participation.

Theoretical frameworks

The direction of this work has been informed by place-based learning and feminist pedagogies. Place-based learning is where a connection between learners and their environment allows for learning to happen through hands-on experiences (Yemini *et al*, 2023), while, in feminist pedagogies, more inclusive learning environments are created, empowering children (particularly girls) to challenge traditional gender roles (Shrewsbury, 1997).

In this paper, we argue that outdoor learning environments offer children spaces that are less constrained by traditional gender roles, instead offering children a more inclusive environment aligned more with feminist principles than a traditional classroom. As well as challenging social norms, outdoor learning also provides opportunities for children to explore and engage with their surroundings through hands-on experiences, providing experiential, place-based learning. By encouraging children's inherent curiosity, outdoor learning allows children to discover and make sense of the world around them without any predetermined social pressures.

Classrooms as gendered spaces

Pre-school forms a big part of young children's lives, with 92% of 3 and 4 year-olds in the UK being registered as attending a pre-school (Department for Education, 2022). Children start forming their perceptions of gender and social roles around the age of 2 years (Rippon, 2021), and so pre-school environments provide a key role in a child's lifelong perceptions of gender and its place in society.

Pre-school classrooms are often highly gendered spaces in the way that they are set up, which impacts how children play in them and how acceptable adults deem their play (Børve & Børve, 2017). When accessing STEM spaces set out by pre-school teachers, girls have been shown to be equally interested in the activities as boys (Campbell *et al*, 2020); however, as sessions go on, girls become progressively excluded from the activities by boys (Fleer, 2019). Boys have also been shown to sometimes block girls' access to construction-based play areas (Lyttleton-Smith, 2015). Even when children have equal opportunity to use play items, they prefer to occupy spaces with more activities relating to their own gender identity. This could be because the way that toys are played with differs between genders, with girls using building materials to build for a purpose (such as building a zoo), whilst boys build as they play (Hallström *et al*, 2014). The physical set-up of a pre-school can impact the way in which children interact in the classroom; for example, having a dolls' corner can confine girls to the peripheries of a classroom, whilst the nature of 'boys' toys' such as cars and weapons require more space, and thus are often found being played with in the centre of rooms. This division of space then limits children, with girls, for example, becoming unwilling to enter spaces occupied by boys (Børve & Børve, 2017).

Gendered access to STEM toys

Toys can further exacerbate the gender imbalance found in classrooms, with boys accessing play items such as building blocks more frequently than girls (Prioletta, 2018). Blocks are known to promote STEM and engineering thinking through allowing children to practise spatial thinking (Bairaktarova *et al*, 2011; Gold *et al*, 2021). Children in classrooms, however, don't have equal access to blocks and construction-based toys, with boys pushing girls out of shared building spaces (Bagiati & Evangelou, 2016) and girls trying to join in by taking on secondary roles through passing blocks to boys rather than building themselves (Hallström *et al*, 2014).



This lack of access to play equipment that supports STEM learning has a lifelong impact, as toy choice as a young child has been linked to undergraduate degree choice, with women who preferred to play with spatial toys such as blocks as children being more likely to study STEM subjects as undergraduates (Moè *et al*, 2018). Some toy manufacturers have attempted to address this gender imbalance with a 'pinkification' of STEM toys. It has been found, however, that not only is this not beneficial to girls, but that it is actively harmful to boys, with young boys performing worse on spatial building tasks when told to use pink, purple and white construction materials rather than primary-coloured materials (Mulvey *et al*, 2017).

Gender in natural spaces

The way in which children express themselves in outdoor environments is different from that in the classroom. Observations of children in nature show that they engross themselves in the exploration and manipulation of the environment, challenging themselves physically and creatively. As natural environments and the items within them were not created with a predetermined social purpose in mind, they support ungendered play and discovery (Chawla, 2021).

However, the impact of being outdoors on children's gender identity does appear to depend on the proximity to the child's school. Studies by Decker and Morrison (2023) and Hine (2023) looked at primary-aged children engaged in forest school or nature-based interest groups and found gender conformation to be more salient in outdoor settings with, for example, boys choosing to use sticks as weapons and girls using sticks as pretend animals in need of care. However, both studies did also find that outdoor spaces provide a space where the exploration of gender non-conforming play is more acceptable than in a classroom (Decker & Morrison, 2023; Hine, 2023).

On the other hand, studies observing nursery-aged children attending outdoor sessions away from their usual school or nursery site found natural outdoor spaces to be significantly less gendered than classrooms (Änggård, 2011; Waller, 2010).

Early years education is no stranger to outdoor learning, with the very first recorded nursery school in New Lanark, Scotland being designed to allow children to experience the outdoors (Martin, 2017). Nature pre-schools are a way of life for many Scandinavian children, with time outdoors and away from the classroom being typical in all but the worst of weather conditions (Beate & Sandseter, 2014), and countries that embrace their indigenous roots such as New Zealand often have early years curricula that focus on place-based learning, such as *Te Whakariki*, which naturally lends itself to outside learning (New Zealand Ministry of Education, 2017).

These outdoor spaces afford children freedoms that are not attainable in classroom environments, enough space to be themselves, and to be *by* themselves. The reduced pressure from the physical environment, no longer being in close proximity to others, and the freedom from manufactured and consumerist play items allow children the space to explore their gender identities and result in a much less gender-focused environment (Änggård, 2011; Decker & Morrison, 2021; Frödén, 2019).

The clothing that children wear at nursery impacts the way that they express their gender identity, which in turn impacts the way that others interact with them, often resulting in gendered exchanges (Halim *et al*, 2014; Meland & Kaltvedt, 2017). At forest nursery, this pressure is reduced when everyone is wearing waterproof clothing, particularly when the nursery has given every child identical-looking items. This outerwear can have the effect of creating a barrier between a child and the dirt, allowing children to engage more freely with nature and removing the worry for girls of maintaining their status as '*careful, clean girls*' (Mycok, 2019).

In outdoor environments, there are few differences between the activity levels of girls and boys and, whilst there is sometimes a gender difference in the types of play in which children engage, overall, outdoor environments provide a much less gendered play space and provide children with more opportunities to engage in counter-stereotypical play (Änggård, 2011; Waller, 2010).



Implications for practice: STEM learning in natural spaces

Giving children a space in which to learn and grow with a reduced pressure on gender conformity allows both girls and boys to realise their full potential (Speldewinde & Campbell, 2021). Activities exploring place-based learning, such as learning about native plants and animals, help to foster a sense of responsibility in children and afford them a sense of wonder and appreciation of the natural world (Hughes & Maaita, 2023). This wonder can stimulate children to start questioning their environment and allows them to discover STEM topics in a child-led and natural way (Campbell *et al*, 2018). This freedom to explore what is interesting to the child is key for fostering a love of learning and a lifelong interest in STEM, with positive childhood experiences with STEM being cited as a reason for pursuing a STEM career (Dorsen *et al*, 2006).

The outdoors provides children with opportunities for real-world contexts for STEM learning, challenging educators to act reactively to children's discoveries rather than planning STEM learning ahead of time (Speldewinde, 2022). The lack of toys with a prescribed purpose forces children to be more creative; for example, a simple stick can become a tool or a building material. With a simple bit of imagination, sticks can provide multiple opportunities for children to engage with engineering and technology (Speldewinde & Campbell, 2022). Spatial reasoning, a precursor skill for complex mathematics, is a skill that both girls and boys can practise without judgement in outdoor spaces by climbing trees (Gull *et al*, 2017; McCluskey *et al*, 2023). Throwing stones into puddles gives rise to opportunities to explore momentum, forces and even the chemical properties of mud. And, with seedlings, bugs, stones, eggshells and countless other natural wonders, the opportunities for exploring natural sciences are limitless.

Conclusion

Diversity in STEM is an area with room for improvement, and exploring ways of increasing engagement with STEM during early years education can only be beneficial. Pre-school classrooms often struggle to provide the equal access to the STEM resources that our children deserve. By increasing the forest nursery provision available to our young children, we can increase their opportunities to learn in a less gendered environment.

With outdoor education, children who otherwise would struggle to engage with STEM are given the opportunity to explore their world, free from the usual artefacts that could constrain them in a classroom environment. Additionally, fostering the natural sense of wonder with which all children are born empowers them to grow their own interests and build their critical thinking skills.

The outdoors also provides a real-life context for many scientific phenomena that are difficult to engage with in the classroom – water cycles, Moon phases, and projectile trajectories are all topics within reach of discussion whilst on a walk in the woods. There is however, work to be done. Overstretched early years staff need the time and training to become comfortable with bringing their work outside, and parents used to the rigours of the classroom may need convincing of the benefits. However, by bringing STEM outdoors, we can make it accessible to everyone.

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