

Regaining Paradise? Sustainability in the Early Years

My name is Lindsay Turner, Student Number 2216886, and today I would like to discuss with you sustainability in the Early Years and the complexities around how our young learners are introduced to protecting the natural world.

The first part of this discussion will reflect on the process taken to create a scrapbook on a natural environment to be considered for the John Muir Award. This process required choosing an environment that variously demonstrated natural life and provided opportunities to explore sustainability and conservation. I chose to concentrate on an area that is very special to me, that is rich in plant and animal life but that also provided an emotional context, this being the garden of my family home. The area is situated in Pontarddulais and over the years I have watched it grow and evolve as depicted in the images in my scrapbook. The garden is divided into sections, has natural wild areas, two large ponds, and rockeries, and is home to many different plants, trees, and animals.

Being very familiar with this garden I was sure that there were many areas of interest to be explored and documented, however, I was unsure if I would learn any new information or be able to make positive changes. This opinion changed over time as I researched ways in which small introductions and adaptations could improve the ecosystems within the environment. For example, the garden's existing natural hedgerows already provided habitat for animals but creating 'hedgehog highways' ensured that hedgehogs and other small garden animals could pass freely from garden to garden in safety. In addition, the garden's rich plant life could be improved to encourage more pollinators which would in turn improve the already rich tapestry. The natural areas could provide safe havens for the wildlife within the garden and nesting boxes could be added to the bird feeding stations already dotted about.

Spending time in the garden brought back memories from childhood, time spent playing on the lawns with friends but also time spent watching my parents as they toiled in their labour of love. The garden was once home to a large vegetable patch which has sadly become too much work now, and I realised that this was an excellent example of sustainability that sadly I didn't appreciate in my younger years. These days you are more likely to see squirrels rather than children playing on the

lawns and my mother enjoying a cup of tea while listening to the bird song and the sound of the waterfall.

Connecting with nature has always been an important part of my upbringing and something I have passed on to not only my child but to the children that I care for in my setting. In our setting our outdoor space is limited and we are currently raising funds to create a garden where the children will be able to get involved in nature, just as I was when growing up. Up until now, we have come up with creative ways of involving children in outdoor learning, we undertake nature walks, encourage children to collect items for nature displays, and plant flowers and seeds for the children to take home. As demonstrated in my scrapbook I have tried to inspire the children in the setting to think about nature and the natural world, the children have contributed to making garden displays prompting discussions about the environment and the need to care for it. When exploring the environment and researching ways to conserve and preserve it I have been provided with further ideas to bring into the classroom such as creating wildflower bombs with the children so that they can be involved in observing the life cycle of plants and animals from beginning to end and encouraging the children to take care of birds and wildlife and treat the outdoors with healthy respect.

This garden has been many things to many people over the years, for me it is a place that I can return to when everyday life becomes too much, a home away from home where I can sit a while and reset, but I know that it evokes different memories and emotions for every member of my family. It is a place of remembrance, joy, solitude, a place for reflection, peace, and laughter, yet, it provides us all with the same feeling of warmth, of belonging, of home.

I will now move on to the second part of this discussion where I will investigate the theme of sustainability in more detail and explore how this links with the Early Years.

What is Sustainability?

Sustainability is the term applied to the “process of meeting the needs of the present without compromising the abilities of future generations to meet their needs” as defined by the United Nations Brundtland Report, 1987, commissioned by The World Commission on Environment and Development (cited in Boyd, 2018; Earth, 2023). Sustainability is entrenched with the desire to strive for an environmentally stable

and sustainable world and embedded in that a longing to establish equality socially, economically, and politically (Ärlemalm-Hagsèr, 2013). These three pillars of sustainability are interconnected (Davis and Elliott, 2014; Boyd, 2018). Sustainability is the responsibility of all; working towards a more sustainable planet gives an appreciation of relationships with the environment and fosters respect for the planet and nature (Barrable, 2018).

To obtain a sustainable world, it is recognised that there will need to be a shift away from the practices that have resulted in overproduction and consumption and a global awareness of the need for these changes (Engdahl, 2015). Education for Sustainable Development is UNESCO's global reaction to the environmental issues faced by the planet (UNESCO, no date; UNESCO, 2020). The ESD was constructed with the view to strengthen the processes used for learning about sustainability. The ESD's purpose is to redirect education towards contributing to a more sustainable future for both present and future generations (Parry and Metzger, 2023). ESD recognises the environmental, economic, socio-cultural, and political dimensions of these processes and aims to create lasting change (Engdahl, 2015; Parry and Metzger, 2023). Working towards the 2030 Agenda for Sustainable Collaboration and Global Partnership, there are 17 Sustainable Development Goals (UNESCO, no date). Key to the Sustainable Development Goals is the recognition that they are all holistic and interconnected, which in turn, reflects an early years pedagogical approach (Elliott, Ärlemalm-Hagsèr, and Davis, 2020). In line with this, is the Education for Sustainable Development and Global Citizenship (ESDGC) which is a statutory component in Wales and features heavily as a cross-cutting theme within the new curriculum to support participation and understanding of sustainable development (Welsh Government, 2008; Tinney and Merriman, 2018; Welsh Government, 2022c). Traditionally, environmental and sustainability education has been treated as an add-on and oftentimes even ignored in national curriculum reforms but the new curriculum for Wales and the Welsh government takes a strong standpoint (Engdahl, 2015; Tinney and Merriman, 2018). The Curriculum for Wales requires that learners identify as local and global citizens who can be responsible for sustaining and improving their environments (Haas and Ashman, 2014). Progress is being made towards a globally responsible Wales and the Well-being for Future Generations (Wales) Act 2015 provides a framework for Wales's contribution to the

achievement of the United Nations Sustainable Development Goals (Welsh Government, 2022b).

Early Years education has proved itself to be an important player in sustainable development, early years play-based philosophies are rooted in nature with activities about and within the outdoor environment. As depicted in Bronfenbrenner's ecological theory (1979, cited in Jarvis, George and Holland, 2013, p.42), 'childhood is a social construction and children are daily affected by the view of adults and society and also intertwined with cultural, economic, and political structures', so it is imperative that as a society education is delivered responsibly and that adults do not underestimate the child's potential for knowledge (Feriver, 2022). Our children will one day inherit the environmental issues that we create and ultimately the responsibility of looking after the Earth (Ärlemalm-Hagsèr, 2013).

Education has proven to be an efficient method for increasing the potential for a society that is more sustainable. It is vital to embed education on sustainability into all aspects of early childhood (Edwards and Cutter-Mackenzie, 2013). Children should be acknowledged as being crucial environmental stakeholders who should be given the right to meaningful participation in environmental issues (Ärlemalm-Hagsèr, 2013; Mintoff *et al.*, 2024). Teaching children about sustainability has benefits beyond the obvious environmental aspects, it helps children to make sense of the world around them and to explore the more abstract concepts like 'what if?' and 'how?'. Experiences and interactions with nature are a proficient way to ignite children's interest in and therefore concern for the environment (Ärlemalm-Hagsèr, 2013; Mintoff *et al.*, 2024), therefore promoting a lifelong inclination to care for the planet. Children who connect with and develop a passion for the environment also gain an understanding of the criticality of sustainability (Mintoff *et al.*, 2024).

Furthermore, engaging children in experiential environmental learning opportunities promotes critical thinking and questioning and ensures that they are already actively participating in the practice of sustainability (Edwards and Cutter-Mackenzie, 2013). This together with the positive impacts of spending time immersed in nature enables children to better envisage the environment that everyone is working together to protect (Ginsburg and Audley, 2020).

Providing children with the opportunity to participate in authentic ecological experiences that promote a love of nature also provides them with agency. The United Nations Convention on the Rights of the Child (UNCRC) Articles, 3, 6, and 12 (UNICEF, 2010), highlight the importance of giving children agency and listening to their views about issues including sustainability and climate change, to help them better understand how they can grow and develop while supporting the planet. Young children are agents of change for sustainability although they are often viewed as simply recipients of the decisions of adults, and respecting their rights and allowing them to engage with complex sustainability problems demonstrates how they can be part of the solution for sustainability challenges (Boyd, 2018; Ginsburg and Audley, 2020). Children need opportunities to practice and develop the skills of responsible citizenship and with guidance can be taught to relate to sustainability issues in ethical and rational ways and therefore to care for and safeguard the planet (Engdahl and Rabušicová, 2011; Haas and Ashman, 2014). Furthermore, Article 29 of the UNCRC highlights that education should encourage children to respect themselves and others and to consider human rights and different cultures. Children should be afforded the right to live in peace and to be able to protect their environments (UNICEF, 2010; Tinney and Hurst, 2017; Tinney and Merriman, 2018).

In 1973, German-born American psychoanalyst, Erich Fromm, described humans as having a genetic need to connect with nature and life, which he termed biophilia. When this genetic need is not nurtured in the early years of life, children may become fearful of nature and this is termed biophobia. Nurturing experiences in Early Years settings help children to develop a biophilic disposition. Children are most likely to become biophilic when they are afforded chances to encounter nature by touching, smelling, drawing, creating, playing, and pretending. These opportunities can then be scaffolded with information and activities about their experiences (Cutter-Mackenzie *et al.*, 2014, p.29).

Early Years practitioners are responsible for creating enabling environments in which children can make their own choices (Van Poeck and Östman, 2020). By arranging learning that supports these choices, both indoors and outdoors, children are scaffolded and able to deepen their knowledge which will stimulate their desire for learning (Arelmalm-Hagser, 2013; Van Poeck and Östman, 2020). This links with Vygotsky's teachings around the zone of proximal development, (1978, cited in

Jarvis, George and Holland, 2013, p48). Educators can link learning with the outdoors to practical indoor learning around events such as National Outdoor Week, National Insect Week, and National Tree Week, to name but a few (Tree Council, 2024; Insect Week, 2024; National Resources Wales, 2024). This holistic approach entrenches sustainability into the Early Years Education and ensures a long-term impact (Boyd, 2018; Parry and Metzger, 2023).

Furthermore, linking Science, Technology, Engineering, and Maths learning (STEM) to Early Years outdoor experiences compounds this impact. STEM provides opportunities for children to experiment, question, challenge, and understand their environments and these experiences can only serve to further their development (Zoller, 2015; Ampartzaki, Kalogiannakis, and Papadakis, 2021).

However, Cutter-Mackenzie *et al.*, (2014) suggest that the focus has been placed more on educating about why sustainability is important rather than concentrating on understanding how learning through play can connect with environmental education in a broader context. Outdoor play-based activities can often be lacking in chances for children to really engage with nature and the environment and possibly to explore and discover more about natural habitats and biodiversity, which in turn would help them to develop positive environmental dispositions (Bushby, 2003; Cutter-Mackenzie *et al.*, 2014). In contrast, Blanchard and Buchanan (2011) suggest that outdoor play alone is sufficient for helping children develop later pro-environmental inclinations and reflects the teachings of Froebel (cited in, Cutter-Mackenzie *et al.*, 2014, p.13) who believed strongly that children learn through play and therefore would also naturally learn to live in accord with nature.

Although action should be taken on a broader sector-wide scale, great importance should also be placed on leading from the front concerning sustainability and settings should endeavour to practice sustainability whenever possible (Prince, 2010; Edwards and Cutter-Mackenzie, 2013). The Early Years sector is in an ideal position to influence future generations on sustainability because of its proximity to young children and families (Boyd, 2018). Given that climate change in particular is more paramount than ever the need to raise awareness of issues such as damage to the environment from disposable nappies is vital. Statistics estimate that 8 million nappies are sent to landfills each year which accounts for 3% of all household waste.

Educating families on alternative options such as reusable cloth or biodegradable nappies is a positive step towards change (Welsh Government, 2022a).

Encouraging children to interact with nature provides rich opportunities for them to begin to understand complex processes (Mintoff *et al.*, 2024). Simple activities such as gathering fallen twigs and petals to make pictures, nature walks and mini beast hunts provide opportunities for bigger discussions around habitats, and life cycles, and foster caring and empathetic attitudes towards the environment (Haas and Ashman, 2014). Providing children with access to nature, rich and meaningful environmental experiences, and a safe and caring environment begins to support the aspirations of the ESDGC and other sustainability policies (Tinney and Hurst, 2017; Boyd, 2018). Ensuring children are ethically taught about the world in addition to protecting and respecting their rights now and for the future while also providing an environment of care and respect for all creates a strong foundation to build upon (Edwards and Cutter-Mackenzie, 2013; NCFE, 2022).

This being said Early Years educators have faced challenges teaching the principles of ESDGC and other sustainability practices due to lack of time or sufficient facilities (Lasen, Skamp, and Simoncini, 2017; Ginsburg and Audley, 2020), and some facilitators did not fully understand the principles of ESDGC could be incorporated into existing play experiences and delivered more holistically (Tinney and Merriman, 2018; Ginsburg and Audley, 2020). A focus on more thorough professional development (Dyment *et al.*, 2013; Lasen, Skamp, and Simoncini, 2017; Ginsburg and Audley, 2020), and involvement in environmental certifications such as the John Muir Award can provide practical insights into how practitioners can engage with ESDGC themes and incorporate them into current teaching methods (Bushby, 2003; Tinney, 2013).

The benefits of sustainability education are numerous but likewise so are the barriers (Ginsburg and Audley, 2020). As discussed previously educators can sometimes feel that there is not enough time to devote to sustainability and environmental education especially as the children grow (Ginsburg and Audley, 2020; Parry and Metzger, 2023). Practitioners can sometimes feel that curriculum demands more formal classroom education and sometimes lack the foresight to adapt teaching practices to accommodate all subjects in an outdoor setting. Continuous professional

development is key to ensuring that educators can adapt the practice to fit the constraints of the new curriculum (Bushby, 2003; Ginsburg and Audley, 2020; Parry and Metzger, 2023).

Settings do not always have adequate outdoor spaces that can provide links and connections with the natural world, some just have yard space and therefore have to look for links to nature in more inventive ways (Parry and Metzger, 2023). Health and safety can therefore be viewed as a potential barrier. Parents can sometimes be concerned about risk and injury in outdoor settings, especially in wilder more natural areas (Haas and Ashman, 2014; Ginsburg and Audley, 2020). There is a higher child-to-staff ratio when children are taken out of the setting, for example on nature walks and this can provide potential difficulties with lower staffing levels in smaller settings, which links in turn with limited funding for excursions and trips given the current financial climate. In contrast, it should also be noted that taking children beyond the boundaries of the classroom both physically and imaginatively provides excellent opportunities to broaden experiences (Haas and Ashman, 2014).

In conclusion, schemes such as the John Muir Award could be more frequently used by early years settings to provide a framework to help bridge the gap between theory and practice and could help practitioners build confidence in providing a holistic approach to environmental education.

Reference List

Ampartzaki, M., Kalogiannakis, M. and Papadakis, S. (2021) 'Deepening our knowledge about sustainability education in the Early Years: Lessons from a water project', *Education Sciences*, 11, pp. 251. Available at:

<https://doi.org/10.3390/educsci11060251> (Accessed: 6 July 2024).

Ärlemalm-Hagsèr, E. (2013) 'Respect for Nature – A Prescription for Developing Environmental Awareness in Preschool', *Centre for Educational Policy Studies Journal*, 3, pp. 25-44. Available at: <https://doi.org/10.26529/cepsj.249> (Accessed: 17 June 2024).

Barrable, A. (2018) 'Refocusing Environmental Education in the Early Years: A Brief Introduction to a Pedagogy for Connection', *Education Sciences*, 2019(9). Available at: <https://doi.org/10.3390/educsci9010061> (Accessed: 17 June 2024).

Blanchard, P. B. and Buchanan, T. K. (2011) 'Environmental Stewardship in Early Childhood', *Childhood Education*, 87(4), pp. 232–238.

<https://doi.org/10.1080/00094056.2011.10523184> (Accessed: 18 June 2024).

Boyd, D. (2018) 'Early childhood education for sustainability and the legacies of two pioneering giants', *Early Years An International Research Journal*, 38(2), pp. 227-239. Available at: <https://doi.org/10.1080/09575146.2018.1442422> (Accessed: 6 July 2024).

Bushby, R. (2003) 'An investigation into the John Muir Award and its relationship with outdoor environmental education'. Available at:

https://www.johnmuirtrust.org/assets/000/001/256/RB_Thesis_Summary_original_original.pdf?1611343572&1435770115#:~:text=This%20study%20explores%20the%20relationships%20between%20the%20key,is%20recommended%20as%20an%20area%20for%20further%20research. (Accessed: 8 July 2024).

Cutter-Mackenzie, A., Edwards, S., Moore, D. and Boyd, W. (2014) *Young Children's Play and Environmental Education in Early Childhood*. New York: Springer.

Davis, J. and Elliott, S. (2014) *Research in Early Childhood Education for Sustainability*. Oxon: Routledge.

Dyment, J.E., Davis, J.M., Nailon, D., Emery, S., Getenet, S., McCrea, N. and Hill, A. (2013) 'The impact of professional development on early childhood educators' confidence, understanding, and knowledge of education for sustainability',

Environmental Education Research, 20(5), pp. 660-679. Available at: <https://doi.org/10.1080/13504622.2013.833591> (Accessed: 17 June 2024).

Earth (2023) *What is sustainability and why is it important?* Available at:

<https://earth.org/what-is-sustainability/> (Accessed: 5 July 2024).

Edwards, S. and Cutter-Mackenzie, A. (2013) 'Pedagogical play types: What do they suggest for learning about sustainability in early childhood education', *IJEC*, 45, pp. 327-346. Available at: <https://doi.org/10.1007/s13158-013-0082-5> (Accessed: 7 July 2024)

Edwards, S., Skouteris, H., Rutherford, L. and Cutter-Mackenzie, A. (2013) 'It's all about Ben10™: children's play, health and sustainability decisions in the early years', *Early Child Development and Care*, 183(2), pp. 280-293. Available at: <https://doi.org/10.1080/03004430.2012.67186> (Accessed: 6 July 2024).

Elliott, S., Årlemalm-Hagsèr, E., and Davis, J. (2020) *Researching Early Childhood Education and Sustainability*. Oxon: Routledge.

Engdahl, I. (2015) 'Early Childhood Education for Sustainability: The OMEP World Project', *IJEC*, 47, pp. 347-366. Available at: <https://doi.org/10.1007/s13158-015-0149-6> (Accessed: 17 June 2024).

Engdahl, I. and Rabušicová, M. (2011) 'Children's Voices About the State of the Earth', *International Journal of Early Childhood*, 43(2), pp.153–176. <https://doi.org/10.1007/s13158-011-0031-0> (Accessed: 17 June 2024).

Feriver, Ş., Olgan, R., Teksöz, G. and Barth, M. (2022) 'Impact of early childhood education settings on the systems thinking skills of preschool children through the lens of Bronfenbrenner's theory', *Systems Research and Behavioral Science*, 39(1), pp. 85–103. Available at: <https://doi.org/10.1002/sres.2749> (Accessed: 8 July 2024).

Ginsburg, J.L. and Audley, S. (2020) 'You don't wanna teach little kids about climate change': Beliefs and Barriers to Sustainability Education in Early Childhood', *Education and Child Study: Faculty Publications*. Available at:

https://scholarworks.smith.edu/cgi/viewcontent.cgi?article=1012&context=edc_facpubs (Accessed: 7 July 2024).

Haas, C. and Ashman, G. (2014) 'Kindergarten children's introduction to sustainability through transformative, experiential nature play', *Australasian Journal of Early Childhood*, 39(2), pp. 21-29. Available at: <https://doi.org/10.1177/183693911403900204> (Accessed: 7 July 2024).

Insect Week (2024) *Insect week*. Available at: <https://www.insectweek.org/> (Accessed: 8 July 2024).

Jarvis, P., George, J. and Holland, W. (2013) *The Early Years Professional's Complete Companion*. 2nd edn. Edinburgh: Pearson.

Lasen, M., Skamp, K. and Simoncini, K. (2017) 'Teacher perceptions and self-reported practices of education for sustainability in the Early Years of Primary School: An Australian Case Study', *IJEC*, 49, pp. 391-410. Available at: <https://doi.org/10.1007/s13158-017-0200-x> (Accessed: 6 July 2024).

Mintoff, Z., Andersen, P., Warren, J., Elliott, S., Nicholson, C., Byfield-Fleming, H. and Barber, F. (2024) 'The effectiveness of a community-based playgroup in inspiring positive changes in the environmental attitudes and behaviours of children and their parents: a qualitative case study', *Australian Journal of Environmental Education*, 40, pp. 22-34. Available at: <https://doi.org/10.1017/ae.2023.32> (Accessed: 8 July 2024).

National Resources Wales (2024) *Celebrate nature during Wales National Outdoor Week*. Available at: <https://naturalresourceswales.gov.uk/about-us/news-and-blogs/news/celebrate-nature-during-wales-outdoor-learning-week/?lang=en> (Accessed: 8 July 2024).

NCFE (2022) *Sustainability matters in Early Childhood*. Available at: <https://www.ncfe.org.uk/media/p1socs4v/sustainability-matters-in-early-childhood-resource.pdf> (Accessed: 5 July 2024).

Parry, S. and Metzger, E. (2023) 'Barriers to learning for sustainability: a teacher perspective', *Sustainable Earth Reviews*, 6(2), pp. 1-11, Available at: <https://doi.org/10.1186/s42055-022-00050-3> (Accessed: 8 July 2024).

Prince, C. (2010) 'Sowing the seeds: education for sustainability within the early years curriculum', *European Early Childhood Education Research Journal*, 18(3), pp. 423-434. Available at: <https://doi.org/10.1080/1350293X.2010.5000082> (Accessed: 6 July 2024).

Tinney, G. (2013) 'Perceptions and understanding of Education for Sustainable Development and Global Citizenship (ESDGC) by teachers and trainee teachers and the opportunities and challenges of integrating ESDGC into early childhood learning with the Foundation Phase'. Available at: <https://repository.uwtsd.ac.uk/id/eprint/1718/#:~:text=ESDGC%20is%20a%20statutory%20component%20of%20the%20Welsh,national%20policy%20to%20create%20a%20more%20sustainable%20society>. (Accessed: 5 July 2024).

Tinney, G. and Hirst, N. (2018) 'Early childhood education for sustainability in Wales', in Boyd, D., Hirst, N. and Siraj-Blatchford, J. (eds) *Understanding sustainability in early childhood education: Case studies and approaches from across the UK*. Oxon: Routledge, pp. 104-138.

Tinney, G. and Merriman, E. (2018) 'Early Years Education and Education for Sustainable Development and Global Citizenship (ESDGC) – Two sides of the same coin?' *Wales Journal of Learning and Teaching in Higher Education*, 1(1), pp. 71-76. (Accessed: 17 June 2024).

Tree Council (2024) *Seasonal Campaigns*. Available at: <https://treecouncil.org.uk/seasonal-campaigns/national-tree-week/> (Accessed: 8 July 2024).

UNESCO (2020) *Learning to become 'with' the world: Education for future survival*. Available at: <https://futuresofeducation@unesco.org> (Accessed: 7 July 2024).

UNESCO (no date) Education for Sustainable Development. Available at: <https://www.unesco.org/en/sustainable-development/education> (Accessed: 6 July 2024).

UNICEF (2010) *UNCRC Summary*. Available at: https://www.unicef.org.uk/wp-content/uploads/2010/05/UNCRC_summary.pdf (Accessed: 8 July 2024).

Van Poeck, K. and Östman, L. (2020) 'The risk and potentiality of engaging with sustainability problems in education – A pragmatist teaching approach', *Journal of Philosophy Education*, 54(20), pp. 1001-1018. Available at: <https://doi.org/10.1111/1467-9752.12467> (Accessed: 7 July 2024).

Well-being of Future Generations (Wales) Act 2015 anaw 2. Available at: <https://www.legislation.gov.uk/anaw/2015/2/contents/enacted> (Accessed: 8 July 2024).

Welsh Government (2008) *Education for Sustainability and Global Citizenship*. Available at: <https://www.gov.wales/sites/default/files/publications/2018-02/education-for-sustainable-development-and-global-citizenship-a-common-understanding-for-the-adult-and-community-learning-sector.pdf> (Accessed: 5 July 2024).

Welsh Government (2022a) *Wales paves roads to zero waste with recycled nappies*. Available at: <https://www.gov.wales/wales-paves-road-to-zero-waste-with-recycled-nappies-in-a487-resurface#:~:text=Nappies%20and%20other%20absorbent%20hygiene%20products%20are%20currently,take%20hundreds%20of%20years%20to%20degrade%20in%20landfill>. (Accessed: 8 July 2024).

Welsh Government (2022b) *Wellbeing of Wales: Globally responsible Wales*. Available at: <https://www.gov.wales/wellbeing-wales-2022-globally-responsible-wales-html> (Accessed: 7 July 2024).

Welsh Government (2022b) *Written statement: sustainable schools' challenge*. Available at: <https://www.gov.wales/written-statement-sustainable-schools-challenge> (Accessed: 6 July 2024).

Zoller, U. (2015) 'Research-Based Transformative Science/STEM/STES/STESEP Education for "Sustainability Thinking": From Teaching to "Know" to Learning to "Think"', *Sustainability*, 7(4), pp. 4474–4491. Available at: <https://doi.org/10.3390/su7044474> (Accessed: 8 July 2024).