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READING, WRITING, ARITHMETIC… ROUNDNESS? PREPARING YOUNGER LEARNERS WITH FOUNDATIONAL CIRCULAR ECONOMY EDUCATION TO ALLOW FOR A CIRCULAR ECONOMY ACCELERATION AT HIGHER EDUCATION

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ABSTRACT
Education is a moving practice. As new theories, practices, technologies and evidence emerges, all educators have a responsibility to ensure their teaching is at the forefront of their subject and specialism. The traditional 'reading, writing and arithmetic' of old has been replaced with a much wider suite of skills, but as our world changes with the climate crisis and the rise of eco-anxiety, there are new learning paradigms that are essential to the growing learner and engaged human. The circular economy is one such element. A system that aims to keep materials and resources in constant flow, whilst also creating a regenerative future is arguably a critical system to be understood – and practiced in a variety of ways – by even the youngest of learners as a foundational education subject.
This paper covers a case study for a new education paradigm that is believed to be the first of its nature in the UK - working with a local authority to develop an online city-wide circular economy module that all Key Stages could engage with, along with a reflection on how circularity is currently taught and displayed on a UK BSc/BA Product Design course. By looking at how circularity can be embedded at earlier Key Stages as a core skill, the aim is to discuss how higher education can then push the progression and practice of circularity in each specialism and help the acceleration towards a regenerative future. How might our courses change if we were working with more prepared students?

Keywords: Circular economy, pedagogy, education, climate education, climate crisis, eco-anxiety, product design

1 INTRODUCTION

1.1 What actually is a circular economy?
A Circular Economy (CE) seeks to create a closed-loop system of materials and resources, through a variety of business models and practices ranging from Reuse to Refurbishment, Repair and Regeneration (and many more), encompassing practices from government and industry to those of an individual. However, the term 'CE' does not have any clear or singular origin – rather it has been defined and refined over many years from the 1960's by contributors such as Prof. John Lyle; architect and author of 'Cradle to Cradle: Remaking the way we make things' William McDonough; his co-author, chemist Michael Braungart and the architect and economist, Walter Stahel. The principles covered in Rachel Carson's 1962 book 'Silent Spring' have also contributed to the CE principles, as have the three Rs of Reduce, Reuse, Recycle, [1] which came about some time in the 1970's, after the first Earth Day in the USA. [2] However, although the CE encompasses many different, overlapping practices and has been growing particularly in industry and international policy over the last 20 years, the actual terminology is yet to break into everyday language, rather being confined to said policy and industry. The more simplistic 'three R's' are used in common language, or often just 'sustainability' – a nuanced term that has no clear definition as it can relate to, be argued and understood in myriad ways, as discussed by Ramsey in 2015 [3]. This lack of singular definition for the CE is problematic, as whilst each of the elements can be understood alone, such as pure materials, reduction of material use and consumption, reuse, repair, recycling (and include the three R's themselves) and much more, having an understanding

of how all elements combine and interrelate with one another in a functioning CE allows for a deeper understanding not only of the practice, but how they can be actioned on an individual and local level, (as well as within business, local/national government and international collaboration). But whilst the individual is critical to the success and implementation of the CE through behaviour change, there is a deepening concern that the pressures of doing the 'right' thing weighs disproportionately on the younger generations.

1.2 From Eco-Anxiety to Empowerment

The term 'eco-anxiety' is relatively new, and whilst it is not yet deemed to be a diagnosable condition, public health experts have been reporting an increase in both adults and children presenting with increasing levels of 'a chronic fear of environmental doom'. [4] Mala Rao and Richard Powell of Imperial College London's Department of Primary Care and Public Health wrote in a 2021 British Medical Journal Opinion piece of how eco-anxiety 'risks exacerbating health and social inequalities between those more or less vulnerable to these psychological impacts.' Rao and Powell also noted how eco-anxiety had a 'disproportionate' impact on children and young adults – pointing to a 2020 survey of child psychiatrists in England which showed that 57% were seeing children and young adults who were notably distressed about the state of the environment and the global climate crisis. [5] The closing call of Rao and Powell was to global leaders – to 'recognise the challenges ahead, the need to act now, and the commitment necessary to create a path to a happier and healthier future, leaving no one behind'. Another study from the University of Bath in 2021 looked further afield – surveying 10,000 young people aged 16-25 in 10 countries about climate change (UK, USA, Australia, Brazil, Finland, France, India, Nigeria, the Philippines and Portugal). [6] Overall, 75% of respondents said, 'the future is frightening' and more than 50% of respondents saying they felt 'sad, anxious, angry, powerless, helpless and guilty' about the climate crisis.

This trend can also be seen in a more local level. In the early survey results of the 2022 'A-Round: Brighton & Hove' project, from 8 different schools across the city ranging from infants to college level, in both public and private schools, all reported seeing eco-anxiety in their students. This was not particularly surprising for the older students who may be more exposed to the 'Greta Thunberg Effect' [7] but seeing eco-anxiety manifesting in younger students was concerning for the team undertaking the project. [8]

1.2.1 Moving to Empowerment

From the studies above, and by the evidence presented by the school respondents in the city of Brighton & Hove, eco-anxiety can now be seen in young people of all ages, across the world. Whilst some locations are more likely to see the immediate first-hand implications of the climate crisis, the digital connectedness of our world and our younger digital natives ensures that wherever they call 'home', our youth are feeling the burden and uncertainty of what the future may bring. [9] However, in their opinion piece, Rao and Powell also offered suggestions to alleviate the rising levels of eco-anxiety – including 'access to the best and most reliable information', 'how to connect more strongly with nature, contribute to greener choices at an individual level and join forces with like-minded communities and groups'. [4] .Equipping our young with clear, scientifically founded, globally minded as well as locally actioned knowledge and practices could not only help to alleviate eco-anxiety, but also raise generations with a fully embedded set of 'circular skills' that are as familiar as reading, writing and arithmetic. What if circularity and everything that the practice entails was just part of what our students *did*? This paper proposes possibilities, using the case study of the Interreg funded BLUEPRINT to a circular economy Work Package 3 school project 'A-Round: Brighton & Hove' completed in the city of Brighton & Hove in 2022, plus reflections through the lens of a current presentation of a UK-based BSc/BA Product Design course.

2 THE A-ROUND: BRIGHTON & HOVE CIRCULAR SCHOOLS PILOT PROJECT

Formulated as a continuation and development of an earlier BLUEPRINT work package which saw experts visiting schools to conduct short workshops on composting / food waste / clothing and textiles / single-use plastic and packaging / technology and WEEE (Circular Schools, Brighton and Hove led by Sussex Wildlife Trust, 2021), the A-Round: Brighton & Hove circular schools project (ARB&H) sought to explore how CE education could be embedded in as many schools as possible across the city. Given

the restrictions on available expert time, school availability, school staffing levels and ever-changing CV-19 restrictions, 'in-person' sessions had many limitations, thus it was decided that an online resource would instead form the basis of the Phase 2 project (ARB&H). An online resource also had the advantage of being more flexible for schools to fit extra learning into the school week, allowed for accumulative knowledge over a period of weeks, allowed for sessions to be used by as many schools as possible simultaneously– and also allowed resources to be re-run whenever needed – with the same, or different students. Schools across the city were surveyed to understand what elements of circularity were already taught (if any), what students were most concerned about, and what gaps needed to be filled.
Although the responses were small (10 schools ranging from infants to college levels), there were very clear areas that ARB&H could tackle. Climate change, pollution and plastics scored highly on the concern list from students, along with food growing and food waste. Time was listed as being the main reason why schools were unable to embed more CE learning into their week, as well as an unease that teachers 'were not expert enough to provide the right information' [8]. Other elements requested by schools included opportunities for practical (away from the desk / screen) learning, and for activities that could foster collaboration – both areas that were also recommended by Rao and Powell in their study as possible areas to allow the alleviation of eco-anxiety. Phase 1 had also identified the need for city-connection to allow students to understand the real context of subjects being taught in their local environment and this was backed up in the early survey responses – schools wanted the ability to link learning with the city itself.

2.1 Designing A-Round: Brighton & Hove

Working with the 'wish list' from the schools and the learnings from Phase 1, ARB&H was created as a 10-week pilot and published using the online education platform 'Thinkific'. Each main subject of Plastic / Food / Stuff / Climate was covered over a period of 2 weeks, with an introduction to the CE in week one, and a Wrap up in week 10. Each week featured:

- A short (3-5min) introduction video to each subject (intro to the CE/Plastic/Food/Stuff/Climate)
- Downloadable teacher resources and lesson plans
- Local 'circular hero' videos (specially commissioned 3min interviews with business owners/project creators in Brighton & Hove who are showing CE in practice)
- Presentations to use in class (in three different levels of complexity/knowledge for each subject – allowing the teacher to select the correct level for the class based on experience or age)
- Circular School Challenges (where collaborative, whole school activities such as food waste audits, plastic audits, or setting up a swap shop were encouraged)
- Circular Champion Pledges (10 personal pledges for students to take, based on positive behaviour change e.g., visiting a refill shop, buying something second-hand, repairing an item at home)
- Discussion Data (where students were surveyed on pledges and behaviour changes each week)

There was also an online Google Map, with business tagged across the city related to each of the four main subjects (Plastic/Food/Stuff/Climate) to be used for discussion in class and a 'Circular Champion Trail Map Challenge' which saw the creation of a physical trail across the city to specially selected locations / businesses working within a CE, to collect a letter of the alphabet, to create a missing 10 letter word. Locations included refill stores to food waste café's, a 'charity superstore', a wood recycling project and a community bike repair scheme, students were encouraged to explore the city they live in with new eyes. With a very rich and varied set of resources, the ARB&H project aimed to create a testbed for ways to educate school to college level students about the complexities of the CE in action and is believed to be the first such multi-Key Stage online course in the UK to be available to schools for free.

2.2 A-Round: Brighton & Hove – running the pilot

Due to the timings for the end of the BLUEPRINT project in March 2023, the ARB&H project actively ran across the city in the Autumn term of 2022, from the end of September to early December. In total, 8 schools signed up to the pilot – 1 school ran all content as designed with 60 Key Stage 2 students, 1 school used some content with 20 Key Stage 5 students with advanced educational support needs (whilst also running the behaviour change pledges with their staff) and the remaining schools communicated that they planned to use the resources in their pre-planned sessions and themed weeks in Spring/Summer 2023.

2.2.1 Results

Data was collected weekly from students during the 'Discussion Data' sessions – polling them with set questions using a 'hands-up in class' method to determine knowledge changes, changes in behaviour and also attitudes and opinions. Some behaviours were found to be already embedded in their lives (such as carrying a reusable bottle or buying something second-hand), however many aspects of learning were new - the fact that plastic came from fossil fuels, or what the food waste pyramid was (and what it meant for climate). Perhaps the most important data came from the changes in attitude – at the end of each subject covered (Plastic, Food, Stuff, Climate), 100% of students felt that they could create some positive change in that subject area – a general increase of between 15-22% in positivity from week 1 of the subject, which translated to a lowering of eco-anxiety around the subject – the students felt they *could* enact change.

Also, on finishing the course, 100% of students surveyed stated that they understood the elements of the circular economy and how it related to the city of Brighton & Hove (this was also backed up by the teachers, who stated their excitement and surprise when their KS2 students were able to clearly define what a CE looks like, with local, national and international examples). For a very short, 10-week pilot, this was deemed a great success and the project will soon be available online, for free, for all schools in Brighton & Hove to utilise as part of their teaching until 2027. It is hoped that this additional, free resource for schools in Brighton & Hove will not only reinforce and bolster their existing sustainability/eco/environmental education for all, but also re-frame it through a deeper and more detailed lens of the CE. Embedding this 'roundness' to the 'reading, writing and arithmetic' as a foundational academic skill could open up a huge acceleration in the applicable, future-proofed skills and knowledge our next generations require to not only survive, but thrive.

3 THE CIRCULARITY GAP AT UNIVERSITIES – WHAT WE SEE NOW

As of March 2023, there are currently 25 'profiled universities' on the leading CE research charity, the Ellen MacArthur Foundation website. These universities are listed as being involved in the CE in different ways, from 'teaching to campus management' [10]. However, regarding the taught elements of the CE in the context of each university, there is a huge variety of involvement between institutions. The CE is often seen as 'subject niche' and whilst there will certainly be many more courses across the UK that incorporate the CE in some minor ways there are more natural subject areas where CE teaching currently fits in universities, such as courses within schools of Business and Economics, Design, Engineering and International Development. However, there is a growing outcry by students across all disciplines of how they are not being equipped with the information needed to thrive in their changing world – and that this 'specialist' knowledge should not be confined to selected subjects. This was demonstrated by the Nov 22 announcement by the University of Barcelona on how from 2024, all 14,000 students will take a mandatory climate crisis module – a decision that is thought to be a world first - made following a week-long protest and sit in by climate activist group 'End Fossil Barcelona'. The new 125-hour course, (50 hours study in class plus 75 hours study at home) will include not only traditional climate science-based learning, but the social, economic and ecological aspects of the climate crisis. [11] Many aspects that incorporate and are solved by elements of the CE. From 2024, all University of Barcelona student will leave with a new, foundational skillset/knowledge, however, the fact that this course has been hailed a possible 'world first' clearly shows the void we currently have in HE.

3.1 The role of design

Product Design is fortunately one HE subject area where elements of sustainability have been traditionally taught as a core skill in course curricula for a longer time. As creators of often physical 'things' there is a large responsibility on the designer – especially as according to the 2012 Ecodesign study by the European Commission, up to 80% of a product's environmental impact is decided at design stage. [12] This responsibility continues to accelerate for the designer, with a growing global, wealthier population of middle-classes. Same day, one click purchases have become the norm for many and demand for and access to 'stuff' has never been higher. We have the responsibility as educators to ensure that all our graduating students understand the nuances of the CE – a system that they will invariably be working towards (or eventually within) in industry. Plus, studies such as by De Ios Rios and Charnley demonstrate how design skills have to change to create a working CE in industry. [13] As well as a

foundational life skill, as was explored in the ARB&H project in younger students, at HE level, this knowledge becomes a critical employability skill.

3.1.1 Future-proofing students

Within the BSc/BA courses at the University of Sussex the critical approach of CE knowledge 'gap-filling' has been taken. In the final year module 'The role of Design in the Circular Economy', students are taken on an 11-week journey through CE principles such as waste stream identification and implementation in new products, designing for disassembly, repair and reuse, the rental economy, material supply chains, LCA's, doughnut economics, brand transparency, greenwashing, individual incentivisation and behaviour change, business models and legislation. Whilst the very purpose of this module is to equip students with the CE language and practices to implement them in their work (and onwards in employment), an 11-week module with a location specific research-based brief is certainly not enough. Circularity has therefore been embedded in earlier Y1 and Y2 modules in more foundational ways – especially around understanding components/assemblies, construction/manufacturing techniques and material selection. Even a prototyping module in YR1 has removed all materials that are not able to be reprocessed/reused (such as blue modelling foam) and prioritises the use of waste or easily recyclable materials. 3D printing is still encouraged, but at later stages, when form may be more refined through other, simpler modelling techniques – and therefore prints are less likely to fail and be discarded straight into the recycling bin. Other modules introduce concepts of biophilia and environmental regeneration, or within live briefs with industry to explore the concepts of plastic and packaging reduction, or consumer waste reduction – all explained to students within the global context of the CE as well as how it relates to their own design practice. However, many of the CE aspects that are taught on the University of Sussex BSc/BA courses could easily have been covered in earlier education – indeed many of the simpler elements were demonstrated in the ARB&H pilot to be both understood by and applicable to students as young as KS2.

4 CONCLUSION – WHERE WE GO NEXT

This therefore opens a discussion. At present we see either a complete void of CE knowledge in some HE subjects, or very subject specific attempts to educate students in how the CE relates to them, along with some foundational knowledge that these specific elements rest upon. Although the CE will undoubtably form a global, central role in all our future lives, many students are being left out, or left behind in their understanding of the CE due to it not relating as obviously to their own subject specialism at HE. So, what if we saw a widespread integration of the CE as foundational knowledge to *all* learners in earlier education, like the ARB&H pilot project? Instead of universities taking on the current role of gap-filling this knowledge and tackling raised eco-anxiety from lack of understanding and personal empowerment, entrants to HE would already have a wide and varied, embedded knowledge of the CE. We would be able to teach and actively *advance* CE practice, accelerate understanding and research in all fields, and create faster impact on industry as deeper empowered and knowledgeable graduates enter the workplace. Graduates of today are the active change makers and circular creators of tomorrow – and if this new skill, the 'roundness' of circularity was indeed added to the existing 'R's of 'reading, writing and arithmetic' of earlier years, HE institutions could help push and create a positive, regenerative future faster than ever before.

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