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Embedding Environmental Sustainability in the Audio Curriculum

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ABSTRACT

Environmental sustainability is a vitally important topic globally but is all too often absent from university level courses in favour of a core curriculum. Using examples of good practice in the curriculum of the BSc (Hons) Audio Engineering course at Leeds Beckett University, the paper will explore ways of embedding environmental sustainability into common audio related classroom exercises and assignment work. The outcomes of running these exercises over the last 5 years will be evaluated and suggestions made regarding how the audio education community can improve their practice in this area.

1 Introduction

There is little doubt that environmental sustainability is becoming increasingly important globally. Audio activities are often seen as a tiny part of global industry. However, audio has great reach, with audio equipment and components a fundamental part of all computing, communication and entertainment. As well as being the primary part of music and radio, audio-based activities are a key part of film, games and television. Through activities such as mass production of audio equipment in the far east which is then shipped across the world, worldwide travel of people, the manufacture and use of a variety of materials for acoustic treatment, energy use and the disposal of waste products the audio industry has great potential to do harm to our environment. However, with such wide reach and influence, it has great potential to influence and inspire changes in

practice throughout a wide cross section of global industry.

Audio educators must consider how they will nurture environmentally aware graduates who have the skills and understanding to make themselves more employable in the short term and potential leaders on environmental sustainability in the future. A wider awareness of the environmental impact of their activities will contribute towards producing a more rounded and employable graduate. We will face great challenges with respect to our planet and environment in the coming years and we need to prepare our students with the awareness and skills to face up to and overcome these challenges.

We face awesome environmental challenges: climate change, food production, overpopulation, the decimation of other species, epidemic disease, acidification of the oceans.

Together, they are a reminder that we are at the most dangerous moment in the development of humanity. We now have the technology to destroy the planet on which we live but have not yet developed the ability to escape it. Perhaps in a few hundred years, we will have established human colonies amid the stars, but right now we only have one planet, and we need to work together to protect it.[1]

2 The Wider View

Environmental sustainability features prominently in the press, academia, government and industry. It is often considered as one part of a wider concept of sustainable development, alongside social and economic sustainability [2].

The United Nations defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [3].

In 2016, members of the United Nations signed up to 17 Sustainable Development Goals and 169 targets as part of its 2030 Agenda for Sustainable Development. These goals are wide in scope and focussed on improving people’s lives throughout the world but include a range of statements relating to the environment and infrastructure that have important implications for our everyday activities both in industry and our personal lives [3].

Morelli defines the more specific concept of environmental sustainability as

meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them, ...and more specifically, ... as a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity. [4]

The Intergovernmental Panel on Climate Change’s most recent research suggests that

human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. [5]

Climate change is often the headline issue and most discussed aspect of environmental sustainability. However, environmental sustainability covers a wide range of issues such as emissions to air, releases to water, releases to land, use of raw materials and natural resources, use of energy, energy emitted, generation of waste and use of space [6].

Environmental sustainability is a significant issue for business and industry already and will become more and more pressing in the coming years. If your view of education is that it should prepare students for industry, then a strong understanding of environmental sustainability issues makes them more employable and improves their opportunities for success. If your view of education is to improve the intellectual, cultural and moral capital of a society then there is little argument that environmental sustainability is a vital part of any educational experience.

3 The University Sector

Embedding sustainable development teaching in university curricula faces many challenges. Dawe *et al.* found four major barriers to the successful embedding of education for sustainable development into many of the subject disciplines in UK Higher Education: an overcrowded curriculum, perceived irrelevance by academic staff, limited staff awareness and expertise, and limited institutional drive and commitment [7].

Ralph and Stubbs highlight a lack of understanding and awareness of sustainability issues, resistance to change, a lack of staff commitment, engagement of all levels of stakeholders in the decision-making

process and initiatives as important factors in developing sustainability in the university environment [8].

All too often educators become so focussed on the core curriculum that they may neglect the wider context, and sustainability is often a victim of this. Dmochowski *et al.* note that although many universities offer courses that address topics of sustainability within the existing curriculum, the connection to sustainability is not always clear in course documents and that connection is not as strong as it could be [9].

4 Teaching Sustainability

There is a wealth of guidance documents and policy available to help develop teaching materials and guide curriculum. In the UK, Julies Bicycle support sustainability in the creative industries with guidance, research and data. The Albert Sustainable Production Certification process initiated by BAFTA helps film and TV companies put sustainability at the heart of their productions [10]. Many broadcasters also have detailed sustainability policies as part of their corporate responsibility programmes [11, 12, 13, 14]. UNESCO, Engineers without Borders, Global Dimension in Engineering Education and Practical Action all produce excellent teaching materials in sustainability [15].

Based on the guidance, policy and resources from the above organisations, key issues that require consideration when planning teaching environmental sustainability are:

- Energy – consumption, efficiency and renewable sources
- Waste products – reduction of waste and increase of recycling
- Travel – minimizing emissions and reducing
- Awareness – targets, leadership, documentation, planning

Guerra suggests that ‘an engineering curriculum for sustainability must embed education for sustainable development learning principles and create opportunities for students to learn and practise

critical, holistic and systemic thinking, apply it to real-life situations and enhance lifelong learning, responsible decision-making and professional practice’ [16]. Guerra’s suggestion appears to be an appropriate approach to take based on examples from the area.

The exercises and activities discussed below have all been delivered as part of the BSc (Hons) Audio Engineering course at Leeds Beckett University in the UK. The course is a 3-year undergraduate programme and has between 15 and 20 students per level. This course is very much at the technical and engineering end of the Audio Education spectrum. It features acoustics, programming, electronics, system design, game audio, spatial audio and audio recording. This is reflected in the technical nature of most of these exercises. However, they can be easily modified to take into account the experience and specialisms of any cohort studying audio related courses. Exercises have been adapted where appropriate to the student’s study level, study environment and the particular module that the exercise is embedded into.

5 Classroom Exercises

Surroundings

This short exercise can be carried out as a worksheet or as a discussion session. It is intended to draw attention to a student’s work environment, how this environment consumes energy and how the energy consumption could be minimised. Responses should be discussed, recorded and summarised for student’s further use.

Students should be asked to take a little time to look around their current surroundings and then make a list of the three main consumers of electrical energy. For each of these they should write down ways of reducing their energy consumption. Students should also consider how is the room heated or cooled and write down how they think the energy to do this is generated, what are the main areas of the space where heat energy is wasted and how the space could be made more heat efficient?

Daily Activities

This short exercise can be carried out as a worksheet or as a discussion session. It is intended to draw attention to a student's own daily activities and their impact on the world around them and can be repeated at various intervals during a course in order to encourage students to monitor how this impact might change over time. Responses should be discussed, recorded and summarised for student's further use.

Students should consider their activities today/yesterday and name 3 things they have done that have consumed significant energy and how they could have reduced the energy consumption of these activities? They should also list the waste items that they have generated and whether these are likely to be recycled given the nature of their disposal.

It is also interesting at this point to look at what recycling options are available around the university/school/college and how these might be improved.

Policy Documents

This exercise encourages students to engage with key policy documents. It develops students' reading and critical evaluation skills. It can be carried out as homework or could be an assessed activity, resulting in an extended critical report on a specific document or range of documents.

Students should be asked to find and download the environmental sustainability policy for either their university/college/school, a broadcaster or a relevant professional body.

For the chosen document students should summarise the main points of the policy, discuss and critique the policy and suggest improvements and changes. Students can also consider how easy it was to find the document and how this document might impact on their own work and/or daily activities?

Materials - Acoustics

This exercise works best in a recording studio environment and draws student's attention to the materials and the manufacturing processes required

to produce the acoustic treatment for a recording studio/critical listening environment. It can be run as a discussion or an assigned activity. Students should make a list of the main materials used for acoustic treatment in the studio and find out how each material is manufactured. Students should consider the sustainability of these materials and look into alternative materials from sustainable sources.

Materials - Electronics

This is a case study exercise that is easy to scale from a short classroom-based studio exercise to a longer assignment piece. Students should choose an audio device from their own recording studio or live sound rig and note down the main materials that are used in the manufacture of this device. They should then explore where the materials were sourced from, how sustainable the materials are and whether there any sustainable alternatives or ways of producing these materials in a more sustainable way. The manufacturing processes involved in the production of the device can also be explored along with sustainability issues in packaging and shipping the device.

The Off-Grid Sound System

This project requires students to produce a design for a sound reinforcement system for an outdoor event that runs from purely renewable energy sources and works well as an in-depth assignment or a group exercise. The project works best where students are given clear guidelines and a specification to meet, including requirements for channel counts, outboard, monitor feeds and target sound pressure levels.

The main challenge for this project is calculating the energy requirements of the sound system and designing a sustainable energy generation system that can reliably supply this energy. This requires a lot of detailed calculation work using specification sheets and published information and also many assumptions on issues such as efficiency, weather conditions and worst-case scenario using often incomplete information. Students will have to carry out a lot of reading into energy efficient audio equipment and off-grid energy generation and make justified choices for both aspects if the system.

The Sustainable Recording Studio

In this acoustics project students are asked to produce an acoustic design for a recording studio control room using purely sustainable materials. Many audio courses include some element of recording studio design in the curriculum and it is an easy extension to integrate environmental sustainability into this process.

Students should be given clear guidance on target predicted reverberation times, early reflection levels and operational room response. General control room design philosophy will obviously be explored here but there should be special focus on the sustainable credentials of the materials used to implement absorption, diffusion and insulation in the design.

This is an in-depth project requiring a great deal of reading and calculation work, resulting in a detailed design and report. This project can be made even more in-depth by adding the requirement for live rooms and target sound reduction levels between the live and control rooms and between the control room and external environments. Another possible extension includes specifying the equipment for the control room and predicting power requirements and energy consumption. This can lead to cost prediction calculations and exploration of green energy tariffs to supply the energy for the studio.

Major Projects – Ethics and Environmental Impact

At final year and postgraduate levels, students should be capable of integrating environmental sustainability awareness into their work, rather than as separate structured exercises. Good practice here includes requiring students to consider the environmental impact of their project work as part of the ethics approval process and asking students to devote a section of their final written work to discussing and evaluating the environmental impact of their work. Grading criteria and rubrics can be used to give credit for discussion of environmental impact in their work. Where students are working on extended creative productions (such as films, music recording projects and games) they should be

encouraged to engage with the Albert checklist in order to mirror industry practice in broadcast.

6 Evaluation

Student engagement overall with these projects and exercises has been very good. Students are keen to learn about this area and show reasonable initial awareness of the subject area. Students were aware of the wider climate change debate and many of the actions that they should be taking in order to reduce their impact on the environment. Where students were less aware was in areas such as energy production, waste recycling and specific policy details. The prevalence of environmental sustainability in the news has a part to play in this and students generally agree with regards to the importance of the subject. From discussion with the students it would appear that, despite environmental sustainability being part of the UK national curriculum at school level, few of them had explored the subject at school and, where they had, it was not a memorable experience.

The classroom exercises in awareness and skills are best kept as short sessions of around 30 – 45 minutes. The discussion sessions after these exercises looking at the student's responses and exploring the key issues were by far the most valuable part of the sessions and produced a wide range of interesting views and perspectives. Students were able to demonstrate their analysis and communication skills. The discussions also ensured that key ideas were shared with the rest of the class, as most of the exercises were individual or small group tasks.

Students also really appreciated context and real-world examples for these activities and the responsibility for providing this does fall on the educator to a certain extent. Student feedback on these discussions were overwhelmingly positive, ranging from "thanks for talking about this" through to "this has inspired me to look at my choices".

The larger projects (sound system and studio design) were delivered as part of a choice of 2nd year undergraduate project briefs. The projects seem

quite straightforward and interesting for the students at first glance; however, the task soon opens up a wide range of issues and challenges that develop the student's skills in multiple areas.

Students often got frustrated with the lack of environmental data available for equipment and materials and struggled with many of the assumptions that were required in order to calculate energy usage. One student working on the 'green' festival stage project admitted to being very lost and unsure about the project in the initial stages but once they had got through this period and completed some of the key calculations, they commented that they had "never learned so much" during a project.

Despite the challenging subject (and possibly because of it) these projects produced some innovative work. Students have produced fully pedal powered solutions and hybrid systems using biomass generators. One student even mapped the UK's average hours of sunshine and average windspeeds to produce regional and seasonal variations for the maximum and minimum solar and wind energy available for a 'green' festival stage.

Where students were asked to integrate sustainability into major project work the engagement was not as good. Students often saw this as just "another hurdle to jump through" when all they wanted to do was get on with their own project work. One way to address this was to integrate environmental sustainability into the standard research ethics process for the institution. This gives it more formal weight from the student's perspective.

Post Covid – The Move Online

The course team have found it challenging to keep up the momentum with sustainability teaching as a result of the move to online delivery due to pandemic restrictions. Delivering content in this area relies heavily on classroom interaction and dynamics which is difficult to replicate in an online environment.

Despite some of the challenges of delivering the material, there have been many successful outcomes.

The current cohort of 2nd year undergraduates have all chosen to carry out projects with an environmental theme for their 'Level 5 Project' module. Given a choice of 8 project briefs they have all chosen either the 'Off grid Sound System' or a concert hall design that should be 'a flagship for sustainability'. Of the current final year students, one student is looking into sustainable acoustic materials for their final project and 3 students are looking into aspects of environmental noise. This suggests an increase awareness of environmental issues in the cohort and a desire to explore this further.

7 Future Direction

These are early days for sustainability in audio courses and early days for the author's attempts to develop this area. It would appear that sustainability does not feature in many audio courses and there is much work to do. It is clear, however, from the general direction of industry and government policy that it is a vital area that needs to be integrated into all audio-based courses.

Useful future work in this area would be to develop a repository of audio specific classroom exercises and project-based activities that are open for educators to access and use. These resources could be developed into a structured Environmental Sustainability in Audio curriculum that could form the basis of a module within a university program or a short course to run alongside a university program. Certification for this course could be offered by an educational or industry body.

Context is really important. Students are much more likely to engage if the exercises and activities are closely related to their own practice. Educators should try and relate examples to audio and music wherever possible. Embedding environmental sustainability within wider projects has also been shown to be a successful approach in improving student awareness of this topic. Encouraging students to take ownership over their actions and highlighting the employability benefits of a strong understanding of sustainability issues are also very important in improving student engagement.

Making significant changes to university curricula can be challenging but Ralph and Stubbs concluded that “people, in particular committed individuals, was a key success factor for operational and teaching areas” when integrating environmental sustainability into university courses [8]. Developing this feature in higher education courses is a complex and long-term ambition and may require a paradigm shift in education. It is not only a matter of transforming institutional responsibility but also curriculum reorientation and teaching to better serve the needs of current and future generations. This will take time and will require a resilient and inclusive approach [17].

8 Conclusions

Much of the writing on embedding environmental sustainability in higher education recognises that there are many challenges but also stresses that this is an issue that cannot be ignored. Educators must rise to these challenges in order to prepare our graduates for an industry that is placing great importance on sustainability in its day-to-day operations.

Policy and guidance from the UN, UNESCO, ISO, BSi and EU bodies provide a clear mandate for embedding sustainability in education and many useful starting points for making this happen. The fact that major broadcasters and creative industry bodies are clearly and dynamically addressing this area means that educators must respond in kind.

There are many useful resources out there to support educators in developing teaching materials in sustainability. Very little of this is specific to the audio sector but much of it can be easily adapted. The examples provided in this paper have been shown to work well and it is hoped that these will be of help to fellow audio educators.

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