Integrating Role-Play with Case Study and Carbon Footprint Monitoring: A Transformative Approach to Enhancing Learners' Social Behavior for a More Sustainable Environment

Simon Oliver
University of Chester, UK

Learners were separated into groups representing the interests of parties that typically negotiate environmental affairs in real world scenarios (conservationists, scientists, politicians, NGOs, stakeholders), and tasked with preparing role-play simulations using a variety of flipped learning techniques. Learners' carbon footprints were monitored pre and post intervention, and CO_2 emission scores were used as a proxy for their behaviour towards the environment. Five role-play simulations were run overall. These were integrated with case studies associated with fisheries issues, and climate change. Anonymous participant surveys indicated that learners responded positively to the intervention, and participants' CO_2 emission scores improved significantly ($T_{1,59} = 2.723$, p = 0.009). In the context of environmental sciences, learners that engage in the integrated role-play and case study approach may benefit from flipped learning techniques to prepare their simulations, and gain confidence from self-actualizing moments of achievement when they realize an improvement in their environmental behaviour.

Keywords: case study, carbon footprint, environmental behavior, transformative learning, role-play.

INTRODUCTION

The natural environment is under threat across the globe due to human interference, and the effects of climate change are well documented (Field, Barros, Stocker, Dahe, Mach et al, 2011; Qin & Stocker, 2013). In recognising that threats to the environment will persist unless the world's citizens radically alter their social

behaviour, the United Nations Education, Scientific, and Cultural Organisation (UNESCO) convened an intergovernmental conference at Tbilisi in 1977 to develop a framework for environmental education (UNESCO, 1978; Lefay, 2006). The resultant 'Tsbilisi Declaration' has evolved many education programmes to address issues associated with environmental degradation across the cultures of the world (Thomas, 2009). Current adaptations of the Declaration emphasise enhancing public knowledge and awareness of environmental sustainability by improving learner access to, and retention of information through a "Four Thrusts of Education for Sustainable Development" education plan (UNESCO, 2012). The approach has been met with resistance from transformative pedagogs who consider knowledge-based learning to be ineffective in the face of Earth's current environmental challenges because it does not directly encourage individuals to practically apply learned concepts in real life scenarios (Uzzell & Räthzel, 2009; Chen & Martin, 2015). In this study I explore the use of 'integrated role-play and case study' (IRPCS) (Deaton & Cook, 2012) as a transformative tool for altering the social behaviour of adult learners to promote environmental sustainability.

The integrated role-play and case study model is designed to infuse role-play with a real-to-life context of association that is pertinent to a practitioner's targeted learning outcomes (Deaton & Cook, 2012). In science disciplines, case studies are selected on the merit of their relevance to issues that learners are tasked with investigating, with the expectation that they will embed their long term memory with knowledge by exploring new metaphysical processes, and social perspectives through role-play (Allen, 1999; Paschall & Wüstenhagen, 2012; Rao & Stupans, 2012). The technique has been described as a highly engaging process in which learners may benefit from 'self-actualising' moments of achievement (Huiit, 2001) that manifest in enhanced communication, critical thinking, problem solving, observation, teamwork, listening, emotive, and conceptual understanding skills that are developed in a group setting (Allen, 1999; Deaton & Cook, 2012; Kamerăde, 2011; Rao & Stupans, 2012; Chen & Martin, 2015).

In this paper I provide evidence to show that the integrated role-play and case study learning strategy can effect positive change in how learners behave towards the environment. I quantified learners' carbon footprints to respond to the following hypotheses: (1) the IRPCS approach embeds learners' long-term memory with a cognitive connection to environmental knowledge; (2) IRPCS encourages learners to put theory into practice in real-to-life environmental scenarios. The use of IRPCS is discussed in the context of current pedagogical approaches to promoting a more sustainable environment for the world's citizens, and climate change.

Conceiving the intervention

The idea of using integrated role-play and case study first came to me a year ago when I found myself trying to explain why conservation biology doesn't work to a group of 30 undergraduate animal behaviour students. It occurred to me that I could combine 'working in small group' techniques with role-play in a metaphoric and participatory approach (Cohen, 1994; Biggs, 2003; Webb, 2010; Kamerāde, 2012; Chen & Martin, 2015) that would connect learners to the different social perspectives that have traditionally confounded progress in dialogue associated with climate change (Lefay, 2006; Deaton & Cook, 2012). I loosely experimented with 'group role-play' (Kamerăde, 2011) by separating learners into groups that represented the interests of different Intergovernmental Panel on Climate Change (IPCC) member states, and tasked each group with bartering their carbon emissions during a mock United Nations' (UN) debate. The role-play provided learners with an opportunity to emote their views of topical environmental material in peer to peer interactions, and thereby engage in 'higher cognitive processes' (Livingstone 1983;

Kamerăde, 2011). The success of the pilot exercise motivated me to develop it further as an intervention that I could use to underpin the targeted learning outcomes for a conservation biology course on 'Managing Marine Environmental Impacts' (MMEP).

METHOD

The participants

At the beginning of the academic year, all of the learners who had enrolled on MMEP were asked to read a University of Chester Learning and Teaching Institute (UCLTI) approved participant information (PIS) form that invited them to participate in this study (Appendix 1). From a total of 33 learners, three requested to act as passive observers, which left 30 active participants.

Data collection tools

Anonymous pre and post intervention questionnaires, which were designed to gauge learners' awareness of, connection to, and attitude towards the environment, and environmental education were distributed to all of the study's participants at the beginning, and end of term (Appendices 2 & 3). These were completed and submitted during the first formal lecture session in October 2015, and January 2016. Participants were also asked to complete anonymous feedback forms after each role-play simulation so that they could reflect on the core knowledge that underpinned their narratives (Appendix 4). These enabled me to monitor participant engagement, and make adjustments to the design of the simulations so that I could meet learners' needs as and when they arose.

Carbon footprints

After completing their pre intervention questionnaires, participants were provided with tablets, and directed to the World Wildlife Fund's (WWF) online carbon footprint calculator (WWF, 2015). Participants were then tasked with calculating their CO_2 footprints by answering a series of questions that related to their behaviour towards the environment. Carbon footprint scores, which represented the percent of an individual's share of current UN global emission targets, were then anonymously submitted on a piece of paper. The exercise was repeated with the same participants at the beginning of the second semester (January 2016), and the data were analysed in GentStat® 10 using a Students T-Test (with sample date as a factor, and CO_2 footprint scores as response variables) to compare for differences between the two sample periods.

Interest groups

Participants were separated into five groups (6 participants per group) representing the interests of policy makers, non-governmental organizations, stakeholders, conservationists, and scientists, who typically negotiate environmental issues in real world scenarios. Initially, I made an effort to place participants into groups that did not necessarily reflect their individual views to promote a higher cognitive process in which learners could explore and rationalize opposing perspectives. As role-plays progressed throughout the semester, the interest groups were rotated to expose participants to different environmental priorities until each group had gained experience from representing all of the different perspectives.

Case studies

Case studies were selected on the merit of their relevance to current lecture material, as well as their potential to expose participants to historically divisive material. A total of five role-play simulations were run, each of which integrated one of the following case studies: (1) the Dee Estuary cockle fishery; (2) climate change talks in Paris; (3) the Maldivian sea level rise threat; (4) managing the Cumbrian floods; (5) Japanese whaling.

Preparation of simulations

Participants were notified a week in advance of upcoming role-play simulations, and tasked with investigating the selected case study by undertaking an online scavenger hunt for media articles and scientific papers that pertained to the topic in question (Chalmers, 2003; De Souza-Hart, 2010; Wesp & Baumann, 2012). I set up topic specific Wikis on the module's virtual learning space for participants to post material, and make comments of their peers' contributions. This enabled me to monitor the extent to which participants were engaging with the intervention, and tailor the practical running of the role-play simulations to be inclusive of all of their preparation efforts. By using this 'flipped classroom' approach (Huelskamp, 2015) learners were able to gain confidence from designing their own role-play simulations, and achieve self-actualising moments of gratification (Huitt , 2001) when the material that they had investigated was debated.

Ethics

Since this study involved learner participants, a range of ethical issues were considered and addressed (Stringer, 2007) in a research proposal that was approved by the UCLTI ethics committee. Learners were required to consent to participating in the research, and informed that they could withdraw from the study at any time without affecting their performance on the course module. Data were collected anonymously and handled under the rules of confidentiality that are currently mandated by the UK's Data Protection Act.

RESULTS, FEEDBACK AND INTERPRETATIONS

Role-play simulations

To set the scene for a role-play simulation I separated participants into their interest groups, and reviewed the case study material that the learners had investigated. I then tasked each group with preparing a unified response to a topical question that I had scripted to elicit discussion. The interest groups were arranged in a semi-circle so that participants could face their opponents, with myself acting as a moderator in the middle to simulate a council meeting type setting. Simulations began with a representative from each group rising to present a formal statement of their group's position to the council. Once they had spoken, each representative scribed their declaration onto a Power Point slide that I projected. The floor was then opened, and debate ensued. The case studies, topical questions, and interest group perspectives are presented in Table 1.

The integrated case studies, along with their associated debate questions, and the perspectives of the policy makers (PM), scientists (SCs), conservationists (CONs), stake holders (SH), and non-governmental organisations (NGOs) are presented for each of the role-play simulations that were undertaken.

Table 1. Outline of integrated role-play and case study simulations.

Case Study	Debate Question	Group Perspectives
Dee Estuary cockle fishery	Should the harvesting of cockles be controlled?	PM: Yes to prevent illegal migrants from drowning in the tides. SCs: Yes to ensure population sustainability. CONs: Yes to ensure that the birds have enough to eat. SH: No we need to make as much money as possible. NGOs: Yes to ensure ecological balance and economic stability.
Paris climate change talks	Should global carbon emission targets be mandated?	PM: Yes on a nation-to-nation basis depending on needs. SCs: Yes to avoid mass extinction. CONs: Yes to preserve the world's biodiversity. SH: No climate change is an urban myth. NGOs: Yes but scaled to address the needs of developing nations.
Maldivian sea level rise threat	Should citizens be expatriated?	PM: No it will cost too much. SCs: Yes the carrying capacity of the islands is no longer sustainable. CONs: Yes overpopulation is decimating marine biodiversity in the area. SH: No our business interests are local. NGOs: No because it would threaten Maldivian cultural heritage.
Managing Cumbrian floods	Should flood defenses be reengineered?	PM: No we are already spending too much money on flood defenses. SCs: Yes flood defenses are clearly inadequate in their current form. CONs: Yes floods are threatening wildlife in the area. SH: Yes floods are seriously impacting our economy. NGOs: We should seed more forests to absorb ground water.
Japanese whaling	Should the Japanese be allowed to exploit whales in Antarctica?	PM: Yes whaling is important to Japanese culinary culture and Japan is no longer bound by the jurisdiction of the International Court of Justice. SCs: No the Japanese are not whaling for scientific purposes as they claim. CONs: No whale populations are threatened around the world. NGOs: No whaling is illegal in Antarctica.

The interest groups were given 15 minutes to reconcile their arguments, and come to a united resolution for each case study. Initially some participants struggled to emote views that contradicted their personal perspectives. This was overcome by directing them to become more engaged in their preparatory investigations, and through peer-to-peer encouragement to 'think outside of the box' (Webb, 2010). None of the role-play simulations resulted in reconciliation, which reinforced the notion that conservation biology doesn't work because interest group priorities are so typically autonomous that most real world environmental issues struggle to get resolved (Lundeberg & Yadav, 2006; Sutherland et al, 2009).

Prior to participating in this study, 17 of the 30 participants declared themselves to be passive learners in their responses to a pre-intervention questionnaire. When surveyed with a post intervention questionnaire at the end of the semester, eight of the 'passive learners' responded that the role-plays had influenced their learning strategies, and that they now considered themselves to be active learners. The selected case studies underpinned the role-play simulations with narrative gaming features that participants appeared eager to engage with (Rao & Stupans, 2012). They also connected learners to different perspectives that are associated with some of the real socioscientific issues that impact communities across the globe (Deaton & Cook, 2012). This was evidenced by participants' feedback when they were asked "What did you like about this role-play?":

"*I got to see other people's views as well as explore my own. I really enjoyed hearing different perspectives of the interest groups, which is something that we never focus on in other course modules. Seeing how we can apply what we learn in real life situations was great.*"

"*It allowed me to think about different viewpoints. I developed my teamwork skills and learned new things in real life situations.*"

"*I really enjoyed being given the chance to get involved rather than just sitting their absorbing information like we do in our other modules. I gained confidence from being able to express different views and taking ownership of my learning.*"

Carbon Footprints

The mean ± SE percent share of current UN global carbon emission targets for participants tested in October 2015, and January 2016 was 12.75 ± 7.99, and 9.97 ± 6.75 respectively. Participants' carbon footprint scores dropped significantly between the two test periods $(T_{1,59} = 2.723, p = 0.009)$ (Figure 1).
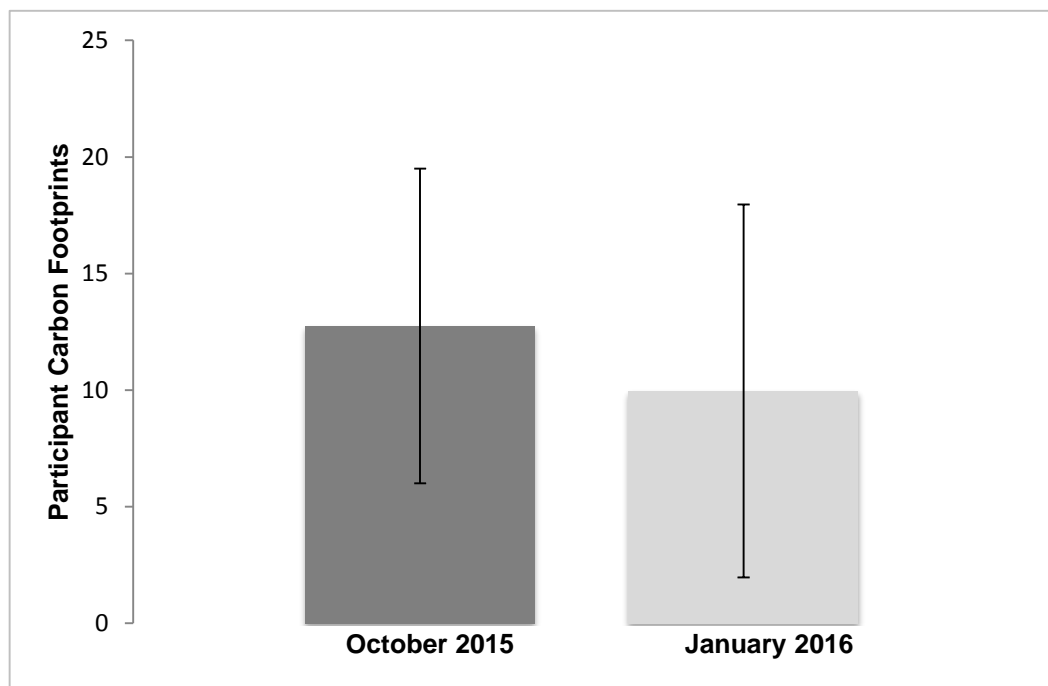
Figure 1. Participant carbon footprint scores.

Scores represent the percent of an individual's share of current UN global emission targets, and are presented for the two test periods along with their respective error bars.

Carbon footprint scores typically rise during the cold winter months when energy demands are high (Laurent, Olsen & Hauschild, 2012; West, Owen, Axelsson & West, 2015). Yet participants' CO_2 emissions improved significantly when they were tested in January. Although it was not possible to directly attribute the improvement of the carbon footprint scores to the role-play simulations, participants' feedback indicated that the integrated role-play and case study sessions had enhanced their attitude, and promoted change in their behaviour towards the environment:

"*I applied the knowledge that I gained to radically change the way I act towards the environment. I am now on a plant based diet, I recycle everything I can, and I walk to university instead of taking the bus.*"

"*I now buy energy saving light bulbs and turn off sockets at the wall when they are not in use.*"

"*I buy locally sourced food and avoid palm oil.*"

"*The role-plays led me to reduce unnecessary power usage, increase recycling, and change my diet from meat and fish to grains and vegetables.*"

"*I have a much greater appreciation of the environment thanks to the role-play sessions.*"

CONCLUDING REMARKS

Guidelines for the use of role-play in pedagogic contexts are well represented in the literature (Freeman & Capper, 1998; Rao & Stupans, 2012). These typically emphasise preparedness, clear learning objectives, the provision of an appropriate physical environment, reflective discussion, and learners' evaluation of simulations (Pescuric & Byham, 1996; Taylor 1999; Joyner & Young, 2006). In the context of environmental sciences, role-play participants may also benefit from the use of the flipped learning techniques that were explored in this study (online scavenger hunt, carbon footprint monitoring) to prepare their simulations, develop a metaphysical connection to some of the socioscientific issues that are so difficult to negotiate in real life environmental scenarios, and gain confidence from the self-actualising achievements that may be associated with this type of transformative practice.

ACKNOWLEDGEMENTS

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APPENDIX 1

PARTICIPANT INFORMATION SHEET

Enhancing Teaching, Learning and Assessment through Action Research: Role-play; a transformative approach to changing student social behaviour for a more sustainable environment.

Name of Researcher: ████████

   You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask if there is anything that is not clear, or if you would like more information, my contact details can be found at the end of this sheet. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

   This project will examine the impact of role-play on how you think and behave in relation to creating a more sustainable environment. We are doing this because past experience has shown that the methods of teaching and learning used previously have **not** resulted in changes to students' social behaviour for a more sustainable environment, whereas there is evidence to suggest using role play as a method of learning and teaching may result in behaviour change. We want to see if this is the case.

Why have I been chosen?

   You have been chosen because you are registered on BI6172, the module in which this change will be made and evaluated.

What will happen to me if I take part?

   If you decide to take part in this study you will be required to participate in an intervention. The intervention means that, in addition to what you would normally be required to do as a student enrolled on this module, you will be required to complete an evaluation questionnaire (which will be anonymized), which will measure your carbon footprint and your CO_2 score. You will need to do this 3 times (i.e., in October, January, and May). These data will then be compared to see if students enrolled on this course alter their impact on the environment throughout the year by changing their social behaviour.

Do I have to take part?

   No, it is up to you to decide if you wish to take part in this intervention. As completion of each evaluation questionnaire will take place at the end of each class in which the role play took place, everybody will be given a copy of the questionnaire to complete. However, to avoid embarrassment for any non-participants, if you decide not to participate, please just return a non-completed questionnaire with everybody else. This will also be explained in detail at the start of each class.

   You can also decide to participate now, but change your mind at a later date **and** without giving any reason for doing so. In this case, if you choose to withdraw from the study and you have **NOT** returned any questionnaire/s, we will withdraw your data from the dataset. If you decide to withdraw from the study **AFTER** completing and returning any evaluation questionnaires, however, we will not be able to remove your data because of anonymity. Rather, as you are not asked to provide any personally identifiable information on the questionnaire, we will not be able to identify your data. Please note that any decision to withdraw from the study will **not** affect your experience and/or learning on this module.

What are the possible risks of taking part?

   We do not perceive any possible risks to participants, but if you have any concerns, remember participation is voluntary. Participation will, also, only involve your time during class sessions. It is possible that by asking you to monitor your

CO_2 score, you may experience some negative emotions. If this happens, you can seek help from your PAT, or the university's student support and guidance services (student.welfare@chester.ac.uk).

What are the possible benefits of taking part?

By helping to evaluate a change in teaching practice, you will be contributing to an evidence base that will underpin future enhancements to this module/programme. This might benefit future students more than you personally, but such evidence is very important to that process. If you have not experienced being part of a research project before, participating may also help you to gain insight into the practical application of the research methods you will be engaging with.

What if something goes wrong?

We do not anticipate anything going wrong, but if you have any concerns about the conduct of this study, you can make them known to Dr Karen Willis, Dean of Academic Quality Enhancement.

Will my taking part in the study be kept confidential?

As stated previously, no personally identifiable data will be collected during the study, and the anonymous CO_2 scores collected will be stored in a secure manner, as outlined in the University's Research Governance Handbook.

What will happen to the results of the research study?

The results of the study will be used to help staff and students on your course. This might be done by developing a new activity for teaching and learning, or by some other type of intervention to help students learn more effectively. We will write a summary of what happens and make this available to all participants. Researchers may also choose to write a journal article or other publication about the work, so that people outside the university find out about it. Your personal contribution to this project will never be disclosed without your express permission.

Who is organising and funding the research?

This research is organised by the Learning and Teaching Institute and the Department of Biological Sciences at the University of Chester.

Contact details
To find out more about the project, or ask any questions, please contact

Thank you for your interest in this research.

APPENDIX 2
PRE INTERVENTION STUDENT QUESTIONNAIRE

This questionnaire is designed to be anonymous, and is available on the Moodle Space for students who have specific reading/writing requirements. PLEASE DO NOT WRITE YOUR NAME OR STUDENT NUMBER ON THIS SHEET OF PAPER. PLEASE ANSWER THE QUESTIONS ACCORDING TO YOUR VIEWS AS THEY STAND TODAY.

1. Do you consider yourself to be an active (e.g., some who likes to be 'actively' engaged in activities) or a passive (e.g., someone who prefers to sit and listen to information) learner?

_____

2. Describe your views on the importance of maintaining sustainability within nature and the natural environment.

_____
_____

3. What is your definition of 'environmental awareness'?

_____
_____

4. In your opinion, what are the key issues affecting environmental sustainability?

_____
_____

5. What do you think you could do to improve the environment?

_____
_____
_____

MY CURRENT CO₂ FOOTPRINT SCORE IS _____
Appendix 3

POST INTERVENTION STUDENT QUESTIONNAIRE

This questionnaire is designed to be anonymous, and is available on the Moodle Space for students who have specific reading/writing requirements. PLEASE DO NOT WRITE YOUR NAME OR STUDENT NUMBER ON THIS SHEET OF PAPER. PLEASE ANSWER THE QUESTIONS ACCORDING TO YOUR VIEWS AS THEY STAND TODAY.

1. At the start of this module (i.e., pre-intervention) did you describe yourself as being an active (e.g., someone who likes to be actively engaged in activities), or a passive (e.g., prefers to sit and listen to information) learner?

_____

2. At this point (i.e., post-intervention) do you consider yourself to be an active or learner?

_____

3. Describe your views on the importance of maintaining sustainability within nature and the natural environment.

_____
_____

4. What is your definition of 'environmental awareness'?

_____
_____

5. In your opinion, what are the key issues affecting environmental sustainability?

_____
_____

6. What do you think you could do to improve the environment?

_____
_____
_____

MY CURRENT CO_2 FOOTPRINT SCORE IS _____

APPENDIX 4

ROLE-PLAY FEEDBACK FORM

This form is intended to be anonymous – PLEASE DO NOT WRITE YOUR NAME OR STUDENT NUMBER ON THIS SHEET OF PAPER

Date:

1. What did you like about this role-play?

_____
_____
_____
_____
_____

2. What three things do you think should be done differently if this simulation were to be used again for a similar session (if you don't feel any changes are necessary please say so)?

_____
_____
_____
_____

3. Summarize the knowledge that you tapped in to during your role-play simulation. Do you feel that the problem was resolved?

_____
_____
_____