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## Engaging students in education for sustainable development

**Citation for published version:**

Howell, RA 2021, 'Engaging students in education for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies', *Journal of Cleaner Production*, vol. 325, 129318. <https://doi.org/10.1016/j.jclepro.2021.129318>

**Digital Object Identifier (DOI):**

[10.1016/j.jclepro.2021.129318](https://doi.org/10.1016/j.jclepro.2021.129318)

**Link:**

[Link to publication record in Edinburgh Research Explorer](#)

**Document Version:**

Peer reviewed version

**Published In:**

Journal of Cleaner Production

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# Engaging students in Education for Sustainable Development: the benefits of active learning, reflective practices and flipped classroom pedagogies

## Abstract

Effective Education for Sustainable Development (ESD) requires appropriate pedagogies that engage learners in transformative learning. These pedagogies include reflective and active learning, involving experiential, collaborative and learner-centred activities. This paper discusses student experiences and perceptions of an interdisciplinary social science ESD course at a UK university that incorporated reflective and active learning by using a 'flipped classroom' (FC) design and innovative assessments. FC creates time in class for reflective and active learning by moving content acquisition to pre-class study. Adoption of the flipped classroom in social sciences is rare and literature on use of FC for ESD is very scarce; hence this paper offers valuable insights into the design of a flipped social science ESD course, and participants' responses.

Results of two surveys demonstrate very positive student perceptions of the course, and illustrate several benefits of the FC design. Over 90% of respondents agreed that in-class active learning exercises made the classes more engaging and the material more memorable than usual, offering useful opportunities to put information/learning into practice, with most students expressing strong agreement. In-class mini-lectures were nevertheless also appreciated, as were reflective practices. A large majority of the students considered the workload reasonable. Findings also reveal the importance of incentivising pre-class preparation using graded assessments such as quizzes, which additionally helped students understand/remember content, and gave confidence about contributing in class. It is clear that the active and reflective learning that FC facilitates engages students in ESD. The paper concludes by offering recommendations for successfully implementing this approach.

**Keywords:** Education for Sustainable Development; sustainability education; flipped classroom; active learning; reflective learning; transformative learning; student engagement

## 1. Introduction

Sustainability education is sought and valued by university students (Drayson et al., 2014). A recent survey found that significant majorities of university students worldwide want to learn more about sustainable development and think it should be covered by all courses (SOS, 2021). UNESCO has adopted a new global framework for Education for Sustainable Development (ESD)<sup>1</sup>, which it defines as "holistic and transformational" education that "empowers learners with knowledge, skills, values and attitudes to take informed decisions and make responsible actions for environmental integrity, economic viability and a just society" (UNESCO, 2020: 8). Similar concepts are expressed by the terms 'Education for Sustainability' or 'sustainability education'; the term 'ESD' is used in this paper because it is judged likely to be the most recognisable.

ESD addresses not only learning content (integrating sustainability issues into the curriculum) and outcomes (empowering learners to contribute to societal transformation), but also pedagogy: ESD should employ "interactive, project-based, learner-centred pedagogy" (UNESCO, 2020: 8). Barth et al. (2007) argue that ESD should be interdisciplinary and promote self-direction in the learning process (e.g. through independent project work), while Foster and Stagl (2018) emphasise the importance of problem-solving, reflexivity, and collaboration. However, UNESCO (2020) states that ESD is too often narrowly focused on conveying scientific information about environmental issues, not a holistic approach including attention to appropriate pedagogies that engage learners in truly transformative learning.

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<sup>1</sup> Available to download from <https://unesdoc.unesco.org/ark:/48223/pf0000370215>

Some writers claim that traditional lecture-based university teaching (alone) is inadequate for ESD; lectures are ineffective learning approaches to values and skills (Abeysekera and Dawson, 2015) and “cannot faithfully convey a sustainable point of view” because they are not cooperative (Kwon and Woo, 2018: 2). ESD may raise concern about ‘indoctrination’ (Cotton and Winter, 2010); arguably it is important to avoid a transmissive approach to assuage these concerns, and to model key ESD principles such as participation, collaboration and openness to different perspectives (Goodman and Richardson, 2010).

More generally, conventional lectures offer limited opportunities to interact with the lecturer and ask questions, and the content cannot be tailored to meet differing student needs (van Alten et al., 2019). Students find it difficult to maintain attention during lectures (Bunce et al., 2010). Even interactive tutorials/seminars can be problematic if they comprise only unstructured discussion of readings or lectures: there may be a tendency for the same students to speak up/keep quiet, poor quality discussion due to lack of preparation, and limited engagement and skills development due to lack of variation in learning activities. ESD requires a shift in pedagogical approaches (Table 1).

**Table 1**  
The pedagogical shifts necessary for engaging and effective ESD

From	To
Transmissive instruction	Constructivist, participatory, and transformative learning
Passive learning	Reflective and active learning
Teacher-centred approach	Learner-centred approach
Discipline based	Inter- and transdisciplinary based
Learning dominated by theory and accumulation of abstract knowledge	Praxis-oriented learning linking theory and experience/real-world knowledge
Few learning styles	Multiple learning styles
Individual learning	Collaborative learning
Emphasis on cognitive objectives	Cognitive, affective and skills-related objectives

Adapted from Sterling (2012: 37) and Bedi and Germein (2016: 128)

As shown in Table 1 and discussed in Section 2, reflective and active learning is essential to ESD. This paper explores student experiences and perceptions of an interdisciplinary social science ESD course that incorporated these pedagogies by using a ‘flipped classroom’ (FC) design and innovative assessments. The purpose of the research was to discover whether/how integrating active learning exercises and reflective practices, facilitated by FC design, offers benefits to students in terms of engaging them in ESD.

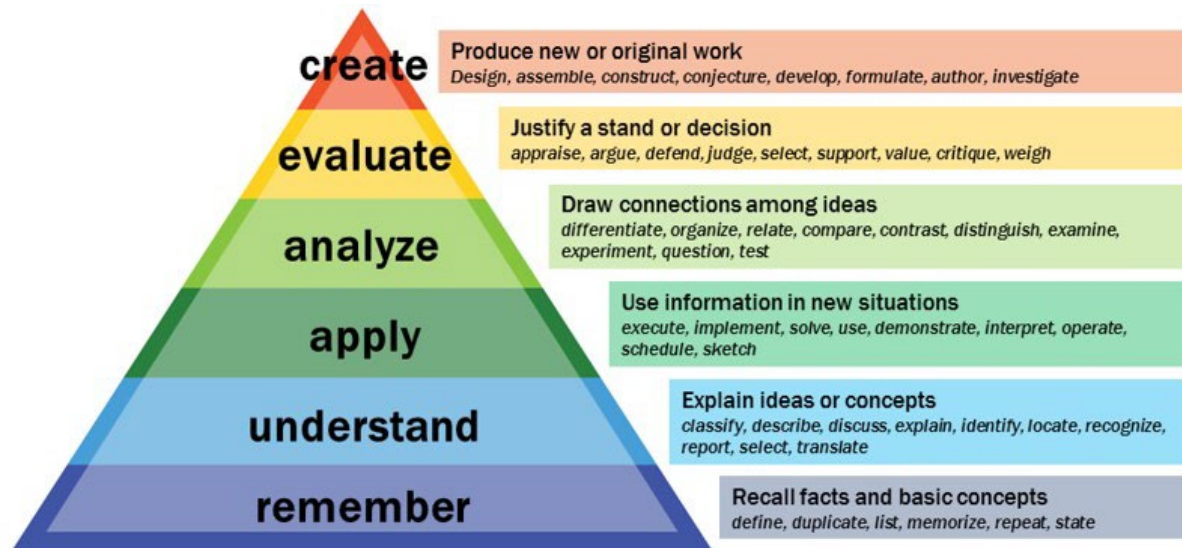
FC creates time in class for reflective and active learning by moving content acquisition to pre-class study (Jong, 2019). Adoption of the flipped classroom in social sciences is rare and social science lecturers express concerns about understanding the pedagogy and being able to design suitable activities; time demands; and whether students will engage (Jong, 2019). Literature on use of FC in ESD – especially for social science courses rather than subjects such as sustainable engineering – is very scarce (Foster and Stagl, 2018). Hence this paper offers valuable insights into the design (structure and learning activities) of a flipped social science ESD course, and participants’ responses to the course.

The following section discusses the theory and previous research related to these pedagogies. Section 3 outlines the design of the case study course examined in this paper. Section 4 describes my research into students’ experiences and opinions of the course, and Section 5 presents the survey results. Section 6 offers discussion and conclusions.

## 2. Theoretical background and previous research

### 2.1. Active learning (AL)

“Active learning is an umbrella term for pedagogies focusing on student activity and student engagement in the learning process” (Roehl et al., 2013: 45) rather than transmission of information by the instructor. Examples include problem-based learning, co-operative and collaborative learning, experiential learning, role-play, and peer instruction (Foster and Stagl, 2018; Prince, 2004; Roehl et al., 2013). These pedagogies engage higher-order cognitive processes (Albert and Beatty, 2014; Thomas, 2009) as classified in Bloom’s (1956) taxonomy of educational objectives (Figure 1): AL class time is focused on applying knowledge and analysing, evaluating and creating material.



**Figure 1.** Revised version of Bloom’s taxonomy of educational objectives (cognitive skills)

Source: Vanderbilt University Center for Teaching, released under a Creative Commons Attribution Licence

AL promotes creativity and critical thinking (Kwon and Woo, 2018), provides feedback to teachers and students (McLaughlin et al., 2014), and increases student engagement, improving motivation and class attendance (McLaughlin et al., 2014; Slavich and Zimbardo, 2012). Students taught using AL report less surface and more deep approaches to learning than in traditional courses (Lizzio and Wilson, 2004). Cooperative learning promotes self-esteem, social support and interpersonal relationships (Prince, 2004), so it helps to create a learning community. It is not surprising then that AL produces better student performance (Baepler et al., 2014; Lasry et al., 2013; Prince, 2004).

It is not necessary to use the FC model to include active learning in a course, but FC creates more time for it (Arnold-Garza, 2014; Burke and Fedorek, 2017), allowing for the introduction of AL activities without sacrificing course coverage (Lage et al., 2000). Jensen et al. (2015) suggest that the benefits of FC may be simply due to its active learning element (cf. also Yong et al., 2015).

### 2.2. The flipped classroom: definition and design

FC is “a set of pedagogical approaches that:

- (1) move most information-transmission teaching out of class
- (2) use class time for learning activities that are active and social and
- (3) require students to complete pre-class activities to fully benefit from in-class work” (slightly modified from Abeysekera and Dawson, 2015: 3). The purpose of this is to promote “active engagement with the content, the instructor, and other students; rather than passive reception of the content transmitted by the instructor” (Cheng et al., 2019: 796).

Jensen et al. (2015) identify two phases of teaching: the 'content attainment phase' when students acquire conceptual understanding, and the 'concept application phase' during which they evaluate concepts and/or apply them to novel problems/situations. In contrast to traditional lecture-based teaching, where class time is primarily focused on content attainment, the FC model places this beforehand, so that class time can be used for concept application. While students are engaged in learning activities requiring 'higher order' thinking skills such as analysing, evaluating, or creating material (Anderson and Krathwohl, 2001; Hwang et al., 2015) they therefore have (more) support from the lecturer and other students. The FC approach is not merely about re-ordering teaching; the emphasis on group-based, interactive in-class learning activities expands the curriculum (Bishop and Verleger, 2013).

Although videos are often used for pre-class instruction, it may be desirable to include readings as preparatory work (e.g. so that students become familiar with how to write academic texts, or to reduce the lecturer's course design workload), and Moravec et al. (2010) found written information equally as effective as videos for pre-class learning. Where video lectures *are* used they should not exceed 20 minutes, otherwise students' concentration may fail (Thai et al., 2017).

Non-completion of FC pre-class work negatively affects both under-prepared and well-prepared students and can lead to complaints (Butt, 2014; He et al., 2016). Giving credit for low-stakes assessment of understanding of the preparatory material, such as quizzes, can motivate pre-class preparation (Tune et al., 2013). Meta-analyses by Hew and Lo (2018), Lo et al. (2017), and van Alten et al. (2019) found that including quizzes in the FC model has a positive effect on student performance.

### *2.3. Benefits and drawbacks of FC*

Research suggests many benefits of FC. At the 'content attainment' stage, being able to pause and re-watch recorded lectures enables students to learn at their own pace (Roach, 2014; Yong et al., 2015), and may help manage cognitive load (Abeysekera and Dawson, 2015).

At the 'concept application' stage, FC promotes teacher-student interaction (Lage et al., 2000; Pierce and Fox, 2012), which allows teachers insight into students' grasp of material (Roehl et al., 2013). Support from teachers and peers while learning can promote deeper understanding (van Alten et al., 2019), and the varied activities mean that FC suits different learning styles (Arnold-Garza, 2014). Forsey et al. (2013) observed FC students discussing ideas with more confidence than in other classes. Abeysekera and Dawson (2015: 5) argue that because FC meets "student needs for autonomy, competence and relatedness, the flipped classroom approach is likely to facilitate and generate intrinsic motivation in students" and Thai et al. (2017) did find this effect. FC students reported more engagement and had higher attendance rates compared to a traditional class (Fadol et al., 2018; McLaughlin et al., 2014), and FC students engage in less 'multitasking' (checking social media, texting etc.) during preparation and class (McLean et al., 2016).

FC also promotes creativity (Al-Zahrani, 2015), stronger self-efficacy beliefs (Pierce and Fox, 2012; Thai et al., 2017), and cooperation (Kwon and Woo, 2018; Strayer, 2012). It may be particularly beneficial for certain students: Lage et al. (2000) found that women were more active participants in FC than in the comparator traditional class, while Luna and Winters (2017) ascertained that improvements shown on pre-post-tests were greater for FC compared to the traditional class especially for students of colour. Several cross-disciplinary meta-analyses (Betihavas et al., 2016; Cheng et al., 2019; O'Flaherty and Phillips, 2015; van Alten et al., 2019) find small but significant positive effects of FC, compared to traditional approaches, on students' academic performance. Some studies also show higher student satisfaction for FC than traditional classes (e.g. O'Flaherty and Phillips, 2015) but van Alten et al. (2019) found no effect.

Students often report increased workload for FC (Betihavas et al., 2016; Findlay-Thompson and Mombourquette, 2014; Hew and Lo, 2018; McLean et al., 2016), which may explain cases where student satisfaction is not higher. Students also complain about being unable to get responses to questions while watching recorded lectures pre-class (Gilboy et al., 2015; Yong et al., 2015). It may take time for students to adapt (Mason et al., 2013; Roehl et al., 2013); Luna and Winters (2017) found that first-year students did not do so well with FC as traditional lectures for their first two course sections. It is very commonly reported that FC courses require more staff time for initial development (e.g. Arnold-Garza, 2014; Betihavas et al., 2016; Gilboy et al., 2015; Herreid and Schiller, 2013; O'Flaherty and Phillips, 2015) and support/reward for integrating AL into courses may be lacking (Moravec et al., 2010).

#### *2.4. FC and ESD*

What little literature there is on FC and ESD suggests that ESD benefits from FC pedagogy. Kwon and Woo (2018), teaching corporate sustainability, compared FC and traditional classes using pre-post-tests and found that the FC students displayed increased cooperative, and decreased competitive, mindset scores compared to the traditionally-taught groups. Buil-Fabregá et al. (2019) report positive student perceptions of sustainability-related FC courses, and suggest that FC students are more alert to sustainable development issues. Foster and Stagl (2018) discovered that flipping their economics for sustainable education course led to higher grades and positive feedback.

Other literature on ESD argues that certain pedagogies are essential for transformative sustainability education. Foster and Stagl (2018: 1325) contend that “sustainable education could not exist without student centred learning and active learning”, while Warburton (2003) asserts that deep learning is particularly crucial for ESD and that teaching styles should therefore be varied and learning made relevant to students. Sipos et al. (2008) claim that transformative sustainability education needs to encompass cognitive, affective, and practical skills-based learning and should include experiential, collaborative, applied learning. FC makes more class time for such pedagogies, including beneficial reflective practices.

#### *2.5. Reflective practices*

Foster and Stagl (2018) assert that they would include reflection as an FC pedagogy, while Altobello (2007) argues that contemplative engagement is essential to promote higher learning. Examples of reflective practices include deep listening<sup>2</sup>, exercises that encourage reflection on personal experience, and mindfulness (“intentional, compassionate, and non-judgmental attentiveness to the present moment”; Wamsler et al., 2018: 144). Mindfulness promotes emotional regulation, improved concentration, and more effective performance, including in academic tests (Hart, 2004; Wamsler, 2020). Schwind et al. (2017) found that including brief mindfulness exercises in classes helped students focus and feel less stressed.

It may be particularly important to include reflective practices in ESD. Wamsler et al. (2018: 143) – who offer an extensive review of literature on mindfulness and sustainability research, practice and teaching – contend that mindfulness “has the potential to contribute to understanding and facilitating sustainability [...] at all scales” and so should be a key aspect of all sustainability education. Contemplative teaching approaches may promote transformation of values, beliefs and worldviews, thereby helping to create a more just, sustainable, and compassionate society (Wamsler, 2020). Hensley (2020: 2) argues that the “emotional and mental toll that sustainability challenges yield necessitates a mindful approach to education”, and Hart (2004) claims that contemplative practices catalyse transformative learning and excluding them is a disservice to students.

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<sup>2</sup> <https://www.mindful.org/deep-listening/>

### 3. Case study: Responding to Sustainability Challenges course

The case study discussed in this paper is a 10-week course called ‘Responding to Sustainability Challenges: Critical Debates’ (RSC) which includes concepts and material from social and environmental psychology, sociology, business studies, policy studies, geography, ethics, and sustainability education. It is a 20-credit core course for third year students on the four year undergraduate MA (Hons) Sustainable Development degree at the University of Edinburgh<sup>3</sup>. RSC may optionally be taken by fourth year students who studied abroad in their third year, and by certain visiting students. The course was first offered in 2016-17, and the content and activities were the same in the first two years. Table 2 gives an outline of the course, including the core concepts covered.

**Table 2** Outline of course content

Session title	Core concepts covered
<i>A. Engaging individuals in behaviour change for sustainability</i>	
Introduction: what is a sustainable lifestyle?	Pro-environmental behaviour (private-/public-sphere); behavioural intentions vs impacts; carbon offsetting
Communicating sustainability challenges: messages and messengers	Fear appeals; framing of information/narratives; loss and gain frames; pros and cons of celebrity messengers
Beyond information: factors influencing sustainability-related concern and action	Information-deficit model; audience segmentation (cultural theory); individual, social, and material barriers to action
Saving money, the planet, or other people? Promoting change by appealing to self-interest vs other values	Schwartz value circumplex; intrinsic/extrinsic values and motivation; altruistic/biospheric values
Promoting pro-environmental behaviour using norms, nudges, and community networks	‘Nudge’ policies (liberal paternalism); descriptive and injunctive norms; types of action-oriented community (e.g. place-based; virtual)
<i>B. Beyond individual responses to sustainability challenges</i>	
Creating sustainable societies: the need to change social and material structures	ISM (Individual, Social, Material) model; social practice theory
Business and non-governmental organisation responses to sustainability challenges	Grey/green BINGOs; proactive/reactive companies; divestment
Personal Carbon Allowances: a case study of considerations for designing demand-reduction policy	Personal Carbon Trading/PCAs; efficiency, effectiveness, acceptability, equity, and distributional impacts of policies
Should we consider geoengineering the climate?	Geoengineering; solar radiation management; carbon dioxide removal
What now? Further questions and course review	Deep listening without discussion to how students <i>feel</i> (not just think) about issues raised in some more radical final readings

<sup>3</sup> The MA is a full-time, trans/multidisciplinary social science degree which now accepts about 35 new entrants each year. A large majority of the students are female, 18-20 years old at entry, and white. Fee status on entry 2012-2017 was 31% ‘overseas’ students; 43% Scotland and EU; 26% rest of the UK. For more information, see <https://www.ed.ac.uk/studying/undergraduate/degrees/index.php?action=view&code=HL23>.

### *3.1. Pre-class: preparatory material and quizzes*

Students were assigned preparatory work each week, including watching videos or screencasts (videos showing PowerPoint slides with audio narration); listening to podcasts; reading; and occasionally other tasks. The screencasts and podcasts I made were between 9 and 15 minutes long. Preparatory material was available on the course virtual learning environment, 'Learn' (Blackboard) a week before each class. Students were required to complete an online quiz based on the preparatory work by noon the day before each class.

The quizzes (created using the Blackboard 'test' facility), consisted of multiple choice and open questions. Each quiz was worth 10 points, with half those points each week available for writing a short reflective response to the preparatory material. Many of the closed questions required students to apply learning rather than just recall information; e.g. identifying whether (fictional) notices contain descriptive and/or injunctive norms. The students received their marks and feedback the day before each class. Quiz marks from week 2 onwards contributed 10% of the overall grade for the course in total. The quizzes were intended to encourage students to complete the preparatory work, to give them and me feedback on their understanding of the material, and to increase their confidence about contributing in class.

### *3.2. In-class activities: reflective and active learning*

Classes consisted of one two-hour session each week. Various active learning exercises were employed, as outlined in Table 3. These were designed to engage students in using a range of cognitive skills, according to the revised version of Bloom's taxonomy of educational objectives (Figure 1). Variety was also intended to ensure that students with different personalities and learning preferences were comfortable at times and challenged at others. For example, all sessions involved discussion, but some activities allowed students to express their opinions non-verbally, so as to be more inclusive of those who find it difficult to speak out. Activities were carried out in pairs, small groups, or plenary sessions. They included peer learning (e.g. explaining different papers to each other); problem-based learning (e.g. designing policies to overcome barriers to sustainable behaviour); collaborative exercises (distinguished from peer learning by involving working together to produce some kind of group output, e.g. an informal presentation); and reflective exercises.

Each class began with a brief (c.3 minute) mindfulness exercise, during which I invited students to focus on their breathing to rid themselves of distractions, and then to silently make an intention for the class, if they wished to do so. The purpose of the exercise (to encourage focused attention during class) was explained during the first session, and students were asked whether they wanted to continue the practice (anonymous responses were enabled). All students who chose to comment wanted to continue. I stressed that the practice was not compulsory; any student who did not want to take part was welcome to wait until this exercise was over before entering the classroom, but no student consistently did so. I also included a reflective deep listening exercise during the last session, making space for emotional as well as cognitive engagement with a challenging reading (about societal collapse due to climate change).

Most classes also incorporated some lecture time, included to build on the preparatory work or to introduce new dimensions to the debate, and to avoid the perception that 'the lecturer was not doing her job' (a concern I had after reading a blog about one professor's experience of flipping her classroom<sup>4</sup>). Six sessions incorporated mini-lectures of around 10-25 minutes; two included lectures of c.45 minutes, and two involved no lecturing.

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<sup>4</sup> <http://teachingwithoutpants.blogspot.com/2013/08/re-imagining-class-time-in-flipped.html>



**Table 3**In-class activities and the cognitive skills/learning processes involved (classified using the revised Bloom's taxonomy of educational objectives<sup>a</sup>)

Activity	Details	Primary cognitive skills/processes
<i>Pre-class preparation</i>		
Reading	Mandatory and optional readings from academic and other sources	Remember, understand
Podcasts and screencasts	Mini lectures created by Course Organiser	Remember, understand
Videos	From sources including YouTube and Theoretical Theatre <sup>b</sup>	Remember, understand
Mini research task	Each student gathers information from 5 people on factors that prevent them engaging in sustainable behaviour (week 3)	Remember, understand
Weekly quiz	Mix of closed/open questions; some knowledge recall, but most require knowledge application and every quiz included a requirement to write a reflective response to preparatory material	Remember, understand, apply, analyse, evaluate
<i>In-class activities</i>		
'Carbon footprints' game (week 1)	In groups, students rank fictional people in order of size of carbon footprint after being given some information about their lifestyles; more information is then revealed and they have to re-rank	Apply, analyse, evaluate
Creating class guidelines (week 2)	Create guidelines to promote inclusive, effective learning by sharing ideas in pairs then plenary	Evaluate, create
Gallery walk (week 2)	Students individually write evaluative comments regarding movie trailers/video clips watched as prep material on posters around the classroom, and discuss with others they meet at each station	Apply, analyse, evaluate
'Barriers to action' game (week 3)	In groups, discuss and classify barriers to action elicited by pre-class task; in several plenary rounds each group in turn announces a different barrier; extra points awarded for unique responses	Understand, analyse
Creating campaign adverts (week 4)	In groups, students design an advert to promote pro-environmental behaviour, making use of Schwartz's value theory, avoiding appeals to financial or 'save the planet' motives	Apply, create
Peer instruction (weeks 5 & 9)	Students read different preparatory material and explain it to each other in groups	Apply, analyse
(Informal) student presentations (weeks 4, 5, 6)	Students present outputs from their group tasks (e.g. adverts created; synthesis of different readings they have explained to each other; ISM analysis)	Apply, analyse, create
Analysis using ISM model (week 6)	In groups, students analyse different sustainable practices using the ISM model to identify factors affecting the performance of the practice and suggest policies to promote it	Apply, analyse, evaluate, create
'Opinion lines' (weeks 7 & 8)	Students place themselves along a line to indicate dis/agreement with various statements, discussing each one and trying to persuade others to change position	Apply, evaluate
Formal debate (week 9)	Formal debate on geoengineering, following in-class preparation of arguments in for/against groups	All
Deep listening (week 10)	Go-round in a whole class circle; each student has the opportunity to speak about their personal response to preparatory readings without interruption or discussion	Evaluate (+ reflection and emotional engagement)
<i>Post-class follow-up/activities</i>		
Posting further resources on VLE	e.g. student work from in-class activities; updated slides; further readings	Remember, understand
Blog assignment	Requires students to choose their own 'sustainability challenge' and write 3-5 blog posts linking reflections on personal experience of challenge to course material and literature	All
Final essay	Students choose a sustainability debate to present and discuss in a standard essay	All

Notes: <sup>a</sup> Anderson and Krathwohl (2001); <sup>b</sup> [https://www.youtube.com/watch?v=OZms\\_j83\\_s&t=2s](https://www.youtube.com/watch?v=OZms_j83_s&t=2s)

### *3.3. The blog assignment: experiential, reflective, individual project-based learning*

All assessment involves active learning; the RSC mid-semester assignment is discussed here as it is an example of experiential, reflective, project-based learning, thus drawing together several types of AL that proponents argue are necessary to ESD (Foster and Stagl, 2018; Sipos et al., 2008). Worth 40% of the overall course grade, it required students to write 3-5 blog posts, totalling 1,500-2,000 words, on a private course blog site (on which all students could see and comment on each other's blogs). Students were asked to write critically and reflexively about a sustainability challenge they each set themselves, relating this to course material (and other learning if desired). Examples of challenges the students chose include eating a vegan diet for a month; joining an activist group; and promoting sustainability in student accommodation. The assignment was due at the beginning of week 7 and students were encouraged to build up the blog cumulatively, blogging tasks being suggested during the course. They had the option to request formative feedback on one post of up to 500 words.

The main aims of this assignment were to make sustainability issues more personal to students through engagement in a self-chosen sustainability challenge; to offer the opportunity for students to write in a different style to an academic essay, encouraging development of communication skills; and to enable them to learn from each other's blogs. The assignment was designed to be a significant learning activity in itself (Boud and Associates, 2010), and a relevant and authentic task (McDowell et al., 2011; Meyers and Nulty, 2009).

The final assignment, worth 50% of the overall course grade, was a more typical academic essay on a question of the student's own choice, and will not be discussed here.

## **4. Method and participants**

### *4.1. Participants*

Students taking RSC were surveyed at the end of the course in November/December 2016 and 2017, using online Qualtrics survey software, to investigate their engagement with the various components of the course and their opinions of them. The purpose of the survey was explained in class, and by email to those who missed the last class, as well as on the first page of the survey. It was stressed that the survey was optional and anonymous, with no identifying data requested. It was also explained that the results would potentially be presented at conferences and seminars as well as being published, rather than simply being for internal feedback. After reading the participant information, students were invited to tick a statement of consent to take part in the research and for their data to be used in the ways stated, before they could continue to the questions. One email reminder was sent, with a link to the survey.

All 18 students enrolled on the course in 2016 completed the survey, as did all 21 students who took the course in 2017 (though one survey question was not answered by one of the 2017 cohort). I believe this exceptionally high response rate reflects the students' engagement and positive feelings about the course, as well as their interest in the hope I expressed that publishing research about the course might encourage more use of active learning and flipped classroom pedagogies in universities. There was an unusually high response rate to the (separate) internal feedback questionnaire for this course each year too.

### *4.2. Survey design*

The survey consisted of a mix of 20 closed and open questions. The structure of the survey, including the section headings and number of each type of questions used, is shown in Table 4. The complete survey is included in the Supplementary Material.

**Table 4**  
Structure of the research survey

Section	Questions
Preparatory material and quizzes	5 closed; 1 open inviting any further comments
Blog assignment	1 closed; 1 open inviting any further comments
Mindfulness/focussing exercise	1 closed, with an 'other' option allowing free text entry
Class activities	2 closed; 1 open inviting any further comments
Feedback	4 closed; 1 open inviting any further comments
Workload	2 closed
Final open question	Inviting "any further comments you would like to make on any aspect of the course (or this survey)"

Similarly to other research on FC classes (see e.g. Fadol et al., 2018; Foster and Stagl, 2018; McLaughlin et al., 2014), survey items were designed to ascertain students' perceptions of various aspects of the course. Measuring student perceptions aligns with current research practice in this field and provides information about which elements of course design are successful from the student point of view (Foster and Stagl, 2018). Because the survey is very specific to this course, it was developed by reflecting on the course structure, activities and purposes to devise appropriate survey items to capture students' experiences and opinions of different course elements. For example, questions about the quizzes, blog assignment, and active learning exercises were designed to check whether students believed the purposes of those activities (as described in Section 3) were successfully fulfilled, using a five-point scale to indicate dis/agreement. Further details of the questions are included with the results in Section 5, for ease of reference. In line with similar research, validation by experts was not sought and "[T]he survey's external validity is limited by its small sample size and unique setting" (Foster and Stagl, 2018: 1329). This is unavoidable, but I believe the findings are nevertheless valuable since there is so little research specifically related to the use and evaluation of FC design for ESD.

#### 4.3. Analysis

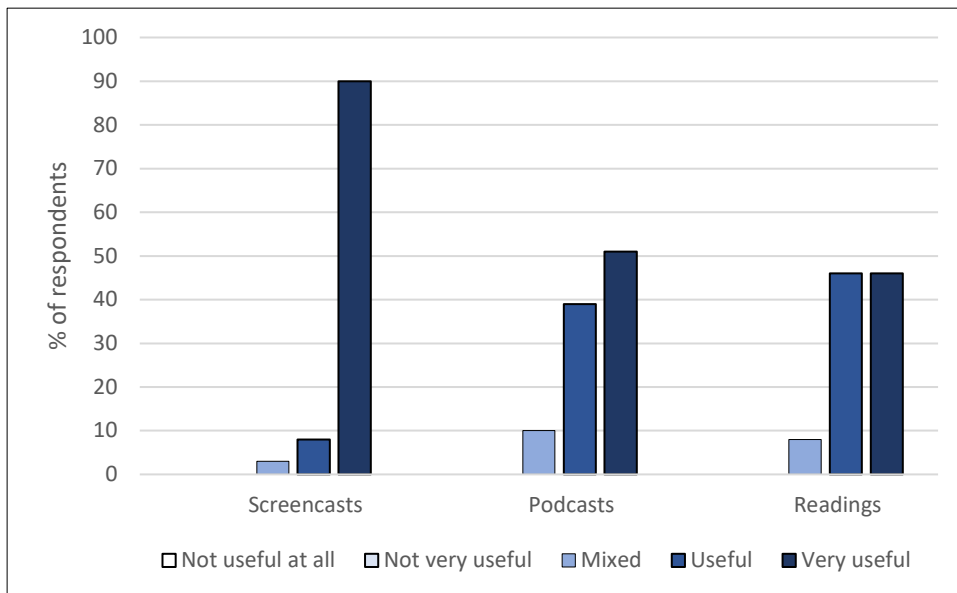
The data were exported from Qualtrics to SPSS Statistics version 22, for analysis of response frequencies for the closed questions. Responses to the text-input questions were analysed using an inductive process involving repeated reading and comparison of responses to discover recurring themes and 'stand-out' answers. It was not possible to conduct analyses comparing opinions of subgroups based on factors such as gender as I did not ask survey participants for any demographic data. This is because I was concerned that with such small cohorts, including very few men, older students, or people of colour, asking for any such data might make some students feel vulnerable to identification by me and put them off responding.

## 5. Results

The results from the two cohorts (18 students in 2016; 21 students in 2017) were very similar, so they were combined into one dataset of 39 responses. Thirty students were women and nine were men. Almost all were in their early to mid-twenties. (This information comes from my knowledge of the students, gained from personal interaction, since I didn't ask for demographic data.) The assessment feedback questions, which are tangential to the focus of this paper, are not discussed here due to space constraints.

### 5.1. Preparatory material and quizzes

Figure 2 shows how useful students found each of three types of preparatory material. Screenshots were most popular, though all materials were generally appreciated: no student chose the options 'Not very useful' or 'Not useful at all' for any type of preparatory material, while only a small minority (1-4 students, 3-10%) reported 'mixed' usefulness of each type.

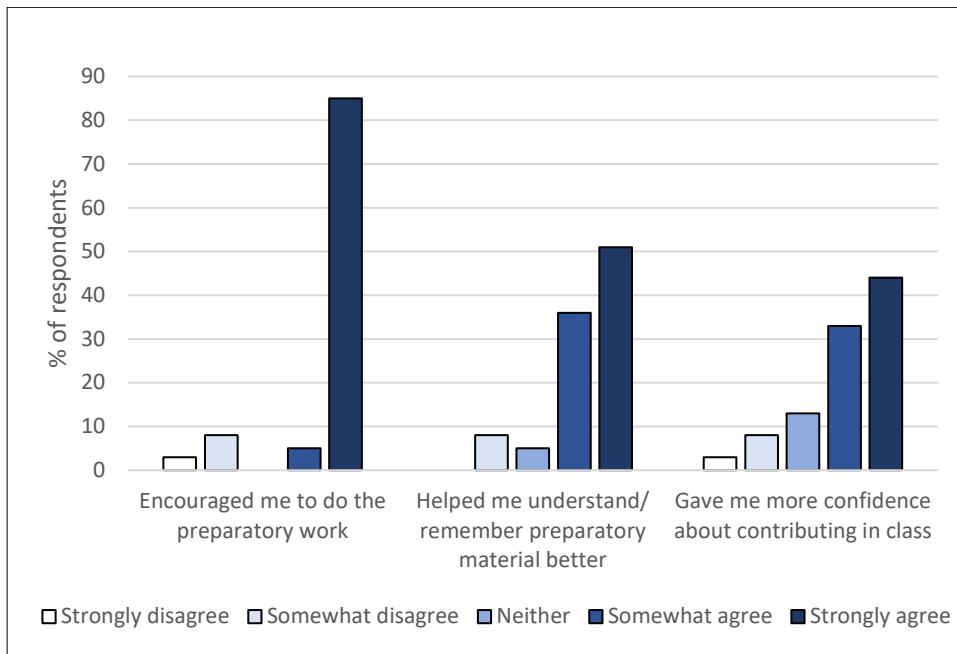


**Figure 2.** Students’ opinions of the usefulness of different types of preparatory material

The most common response to the free-text question asking for an estimate of how much time respondents spent preparing for the class was 2 hours (11 students, 28%); overall, 27 students (69%) gave a response of between 2 and 4 hours. The range was 1 hour to “10-12?” but the latter response was an outlier; the next highest estimate was 4-6 hours. A majority (62%; 24 students) said that if quiz marks had not counted towards the final grade they would have done ‘a bit less’ preparation and 26% (10 students) admitted they would have done ‘a lot less’, while 13% (5 students) stated they would have done ‘the same’ amount of preparation.

Twelve students (31%) reported that they never discussed the preparatory material or quiz questions with anyone before the class. One-third (13 students) did so ‘occasionally’; 21% (8 students) did so ‘sometimes’, and 15% (6 students) reported ‘often’ having such discussions.

The penultimate question in this section asked respondents to state agreement on a five-point scale with the following statements: (a) The quizzes encouraged me to do the preparatory work; (b) The quizzes helped me understand/remember the preparatory material better; (c) The quizzes gave me more confidence about contributing in class. The results are shown in Figure 3, demonstrating strong agreement with all three statements, with only four students (10%) disagreeing with (a) and (c), and three (8%) disagreeing with statement (b).



**Figure 3.** Students' views on the weekly quizzes

Free-text responses to the question “Would you like to make any further comments about the preparatory work and/or quizzes?”, of which there were 22, were overwhelmingly positive. One significant theme was the critical engagement with the material that students felt the quizzes encouraged:

The quizzes encouraged me to think critically about the material and to reflect not just on the material, but also how it fits in to the whole course and how I might relate to it.

The quizzes really moved me away from passive reading towards engagement and reflection on the articles/screencasts.

Often when I do reading I make notes however don't look back to assess whether I've properly understood them - the quiz really helped me to do this.

Encouraged a critical engagement with the material which helped me both with remembering the main concepts and arguments, and engaging with them on a deeper level. I think this is because we were asked to write a personal response that went beyond simply summarising the material.

Another was the rich discussions in class because students were well prepared:

Everyone knew what we were talking about, everyone was always prepared and therefore people could think beyond the basic acquiring of knowledge and bring in very interesting, sometimes highly personal comments and ideas.

...the quizzes ensured that we always had a good discussion because we did not need to focus (as much) on the basics.

The quizzes was good way [*sic*] to make sure that everyone had a good grasp about the material during discussions in class. This made it much more enjoyable to participate since the discussion always was at a high level and it was possible to learn from each other.

One student also commented that “Having the ability to pause [the recordings] and write detailed notes about my thoughts has made a HUGE difference to my learning and the depth of understanding I have gained.”

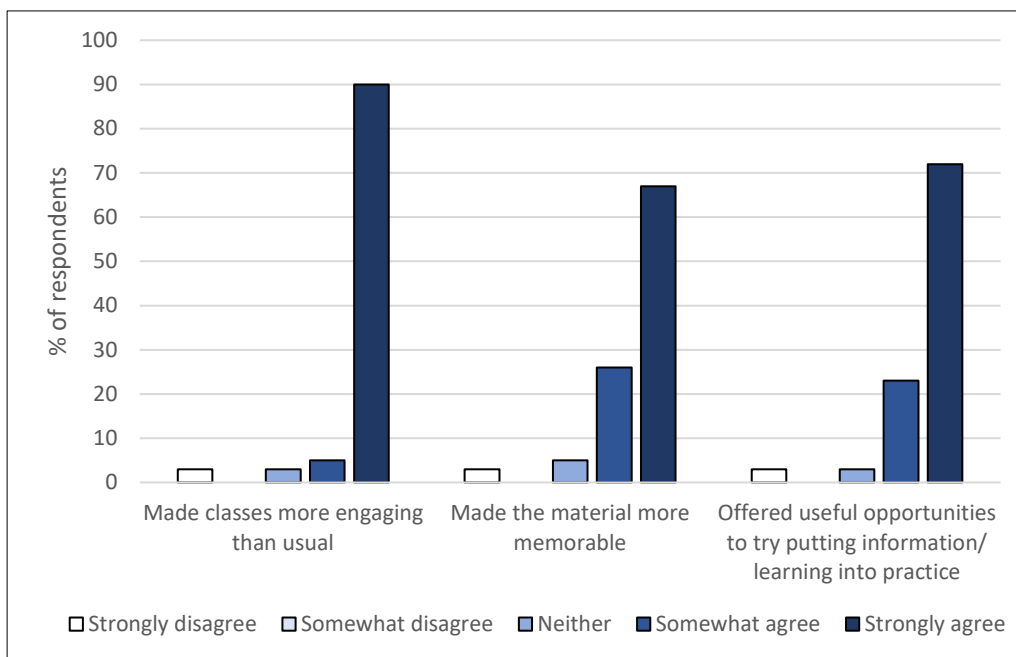
### 5.2. Mindfulness

The short mindfulness exercise at the beginning of each class was generally regarded positively by the students. A majority (25 students; 64%) agreed that 'I generally enjoyed it', 39% agreed that 'It helped me focus more', and 54% agreed with the statement 'I would like to begin more classes this way'. Four students (10%) agreed that 'I found it a bit uncomfortable', but of these, two also stated that they found it enjoyable and that it helped them focus more. Just two students agreed with the statement 'I thought it was a bit of a waste of time'. (Respondents were able to choose as many statements as they wished.)

Nine respondents gave free-text responses instead of/in addition to choosing pre-set statements. Four were clearly positive (e.g. "Increased focus and therefore made participation more enjoyable/less stressful (created a good atmosphere)"). Three were neutral (e.g. "Didn't have much of an opinion on it – neither good nor bad"; "i was always late and often missed it"), and two were classified as more negative (e.g. "was too early in morning, my brain switched off, felt sleepy").

### 5.3. Class activities

Figure 4 displays students' opinions of the in-class active learning exercises. A large majority of students – over 90% in each case – agreed that they made the classes more engaging and the material more memorable, and offered useful opportunities to put information/learning into practice, with most students expressing strong agreement.



**Figure 4.** Students' views on the in-class active learning activities

Asked "Overall, would you have preferred more/less lecture time from me?", one student responded 'A lot less', while two chose 'A bit less'. A narrow majority (22 students; 56%) answered 'About the same amount' while just over one-third (14 students; 36%) would have preferred 'A bit more'. No students wanted 'A lot more' lecture time.

Sixteen students offered free-text comments in response to the question "Would you like to make any further comments about the class activities?" One notable theme was that the balance of activities during class time helped students remain focused and attentive:

When being lectured for a long time, you tend to lose focus while with the combination of lecture and activity, it was much easier to engage and remain engaged throughout.

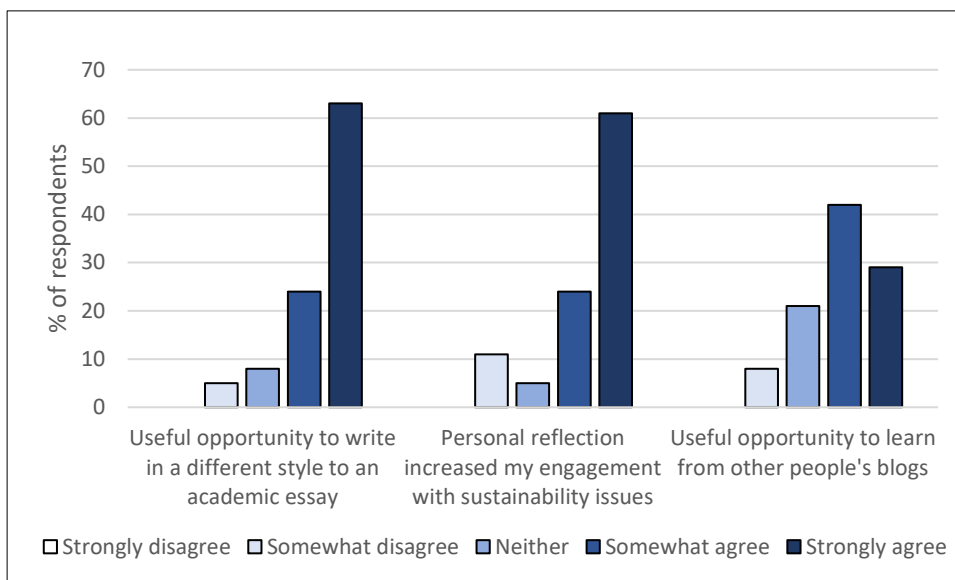
Having different activities in the sessions helped to keep me focused

...a more lecturing heavy balance could have resulted in lesser attention/engagement from the class given the schedule [*sic*] time slot [9-11am]

Several comments were about specific activities the students had enjoyed/valued (peer instruction; opinion lines; debating; listening exercise) or (in a couple of instances) not found useful (opinion lines); unfortunately the respondents mostly didn't explain why this was the case.

#### 5.4. Blog assignment

Figure 5 shows student opinions of the blog assignment. (One student in the 2017 cohort did not answer this question so  $n = 38$ .) There was strong agreement that the assignment provided a “useful opportunity to write in a different style to an academic essay” (33 students, 87% agreed in total) and that “Personal reflection increased my engagement with sustainability issues” (32 students, 84% agreed). There was lower but still majority agreement that it offered a “useful opportunity to learn from other people's blogs” (27 students, 71% agreed); unlike the previous statements, fewer students were in strong agreement with this statement compared to those who ‘somewhat’ agreed.



**Figure 5.** Students' views on the blog assignment

The question “Would you like to make any further comments about the blog assignment?” attracted 23 free-text responses, which were more mixed than responses to the other open questions. Several of these were positive comments about the reflective aspect of the assignment, which the students experienced as having various benefits:

The reflective approach was really useful in getting me to make links between my actual life and my academic life which can often feel disjointed. Applying academic material to my personal experiences helped me to better understand and remember the content of the literature.

Person[a]l reflection aspect of the blog was great - helping me to think about how I can live more sustainably and what changes I should make.

Very creative, and extremely helpful for engaging with the material on a personal level. Helped me to see sustainability challenges in 'real time'.

There were also several positive comments about the experiential nature of the assignment, and the potentially lasting impacts of engaging in a self-chosen sustainability challenge:

The sustainability challenge aspect to the blog has been extremely valuable to show myself that I can make the changes I want to if I put effort in. This knowledge and comfort in my own ability has led me to continue with the challenge I set myself, hopefully indefinitely.

Pushing me to challenge myself genuinely did lead to a change in my behaviour which I believe will be long-term.

It's clear that it has had a lasting impact and people are continuing their challenges such as staying Vegan.

However, students had mixed feelings about the style of writing required:

Although I enjoyed this assignment, I found it quite difficult to be graded on something not as academic as other assignments.

I found it difficult to find a balance between academic enough but not too informal style of writing

I deeply enjoyed engaging in a less formal way of writing, especially the opportunity to use media. My own effort to make the blog understandable for anyone who does not know the subject [...]made me re-read the papers and know more about the projects than I would normally do

Comments regarding the opportunity to read other students' blogs were also mixed. Some students found it helpful, but one commented that "I didn't look at other people's blogs, mainly because I was worried theirs would be better than mine and it would stress me out." Another student explained that "i found i didn't really check other people's blogs thoroughly, with the rest of my workload it did not become a big priority". The low level of commenting on blogs was mentioned, and solutions suggested:

I was a bit disappointed that the commenting on each other blogs didn't work as well as it could have. It might be an idea to make commenting on each other's posts part of the blog assignment/one or two weekly quizzes?

I think we all would have benefited more if there was more interaction between course-mates. Perhaps next time, anonymity may help encourage responses.

##### *5.5. Student workload*

Asked "How did the amount of work for this course compare to other courses you took this semester?", 36% of the students answered 'a bit more than most' and 10% 'much more than most', but 26% said 'about the same as most' and 28% responded 'a bit less than most'. Of the 18 students who stated that the course required more work than others, 15 (83%) thought they had got more out of the course because they had to work more, while two disagreed and one was not sure. In response to the question "How do you regard the amount of work you had to do for this course?", the majority (35 students; 90%) replied that the workload was 'reasonable', with three taking the view that it was 'somewhat too much' and one that it was 'too little'. No student felt the workload was 'far too much'.

Twenty students responded to the invitation "Please add any further comments you would like to make on any aspect of the course (or this survey)". Over half these responses were about workload, perhaps because this question followed immediately after the closed questions about that issue. A major theme that emerged was that having a manageable workload promotes engagement:

...in other courses [...]the vast overload of readings definitely correlated to a lesser engagement and demotivation of students to stay on-top of their preparatory material

By giving reading and prep for each week in a manageable amount, I always did it.

##### *5.6. Other comments*

Others commented positively on various aspects of the course, including the learning environment:



It was great. A friendlier and more supportive environment to learn in. I really enjoyed the interactive learning- as peers we were able to interact and share ideas rather than feel like we were in competition.

I always felt that it was a safe space to share ideas, and I always looked forward to coming to class.

The flipped classroom structure was also interesting to, and appreciated by, the students:

The way that flipped classroom was applied was extremely successful

I think it would be interesting if there was an exam to see how the scores for it compare with other courses without this inverted classroom teaching style.

PLEASE PLEASE PLEASE CAN THIS COURSE STRUCTURE BE ADOPTED MORE WIDELY IN ACADEMIA AND TEACHING!!!!

## 6. Discussion and conclusions

These results demonstrate a significant positive student response to the design of this course, and illustrate several advantages of including active learning and reflective practices to engage students in ESD. The findings therefore offer evidence that is very rare in the field of the benefits of using an FC design to facilitate transformative ESD. They also suggest some recommendations for successfully implementing the FC approach for other educators who wish to contribute to ESD in this way.

### 6.1. Pre-class work

While the students found all types of preparatory material at least partially useful, screencasts were clearly favoured over podcasts and readings. This reflects others' findings that students consider screencasts more engaging than readings (de Grazia et al., 2012; Herreid and Schiller, 2013; Triantafyllou and Timcenko, 2015) and podcasts (Copley, 2007). The appreciation for being able to pause the recordings to make notes echoes comments by students taking other FC classes (Roach, 2014; Yong et al., 2015). However, I have not turned my podcasts into screencasts, nor dropped readings from the preparatory material. The content of the podcasts does not need to be illustrated, and the time necessary to create a screencast is an important consideration. I have kept required readings because (a) I think it is necessary for social science students to read in order to learn by example how to structure and justify an argument; (b) readings contain a lot of detailed information that it would be too time-consuming to turn into screencasts; (c) variety of media and tasks develops different skills and may be more engaging: students might be less positive about screencasts if they were required to watch a lot more of them with no other information sources in the mix.

My data very clearly demonstrate the importance of graded quizzes (or other tasks) to motivate pre-class preparation: 90% of RSC students said the quizzes encouraged them to do the preparatory work, and 87% would have done less preparation if the quiz marks didn't count towards the final course grade. This finding accords with other FC research (e.g. Tune et al., 2013) and the education literature more generally, which shows that students don't do preparatory reading (Sappington et al., 2002) or other preparatory work unless they gain credit for it (Rust, 2002). But motivating preparation is not the only benefit: with 87% of students agreeing that quizzes helped with understanding/remembering material, and 77% agreeing they gave confidence about contributing in class, there are several reasons for employing this kind of assignment. Rust (2002) suggests that continuous assessment is also likely to reduce anxiety.

Comments demonstrated that students found the short personal reflection on preparatory material a valuable quiz element, as did I; reading these reflections I gained insight into students' interests, ideas, and abilities. This type of task could be the incentivising assignment without the need to create multiple choice quiz questions. However, commenting on the reflections was very time-consuming for me (see 6.5).

### *6.2. In-class activities*

The mindfulness exercise with which we began each class was appreciated, even by half of those who found it a bit uncomfortable. Comments that it improved focus and reduced stress echo the findings of Schwind et al. (2017). One student commented in the free-text box about class activities that “The last listening exercise in week 10 was wonderful”.

Similarly to other findings (Lizzio and Wilson, 2004; McLaughlin et al., 2014; e.g. Slavich and Zimbardo, 2012), the active learning exercises were very highly rated, with large majorities of students agreeing that they made the classes more engaging and the material more memorable than usual, offering useful opportunities to put information/learning into practice. The free-text responses made clear that the mix of activities also helped students to maintain focus, a benefit which received less attention in the literature on active learning that I reviewed. It is notable though that despite enjoying AL, almost all the students wanted about the same or a bit more lecturing by me during class time. Again, this echoes other research; the review by van Alten et al. (2019) noted a trend for higher student satisfaction when FC included in-class lectures and commented that Walker et al. (2008) had earlier concluded that in-class ‘microlectures’ are highly valued. One student explained their preference for ‘a bit more’ lecturing, saying “it’s very helpful to have your input, which is often quite different from our undergraduate thoughts”.

### *6.3. The blog assignment*

Although student opinions about the blog assignment were more mixed than for other aspects of the course, it should nevertheless be noted that a large majority agreed that the blog offered useful opportunities to write in a different style and learn from others’ blogs, and that the reflective aspect of the assignment increased their engagement with sustainability issues. The free-text responses emphasise this latter benefit. The comments, and the blogs themselves, also show that the experiential nature of the assignment led to skills-based and affective learning (considered an essential aspect of transformative learning by Sipos et al., 2008), and significant behavioural changes. The students obviously found the task relevant to their lives and interests (McDowell et al., 2011; Meyers and Nulty, 2009).

It is also clear from the comments that some students were nervous about an unfamiliar form of assessment. I had anticipated this and tried to offer guidance and allay concerns by providing an exemplar blog post (as recommended by Jonsson, 2012), and the opportunity to receive formative feedback on one post before submission. However, 16 students did not take the latter opportunity; of these, one had extenuating circumstances which meant he did not take part in this assessment, but twelve others stated that the reason for not seeking feedback was that they hadn’t written a (suitable) post in time. Many students who did not get formative feedback gained lower marks than their classmates who did, which may demonstrate the benefit of formative feedback, though this is probably only part of the explanation. My perception is that often the students who are perhaps most likely to need formative feedback are also those who are least likely to be organised enough to have prepared their work in time; it is the lack of organisation/engagement that explains the marks as much as the failure to seek feedback. One student who said they “would’ve liked to” write a post for formative feedback but “didn’t get around to it” suggested that it should be compulsory to submit a post by the deadline (but did not consider how this could be enforced). The similar suggestion that commenting on others’ blogs should be made part of one of the assessments seems to bear out Rust’s (2002) contention that students are more likely to engage with learning tasks that carry credit. I am reluctant to turn every opportunity into a required task, preferring instead to allow students some autonomy over their learning; instead I emphasise that the more they engage, the more they are likely to gain from the course.

### *6.4. Student workload*

Somewhat contrary to reports of FC increasing student workload (e.g. reviews by Betihavas et al., 2016 and Hew and Lo, 2018), less than half of the RSC students thought this course involved more

work than others, and 28% said it entailed less. A large majority of students considered that the workload was reasonable. I agree; most students reported doing no more than four hours preparatory work for the two-hour class each week, leaving at least six hours per week (on average) for the major assignments (given that students should be working about 12 hours per week per course during the semester), plus extra time for the last essay after teaching has finished.

It may be the case that students were willing to accept the workload because this was an Honours-level course, counting towards their final degree result. Most of those who thought they'd had to do more work than usual agreed that they got more out of the course as a result; thus there was a clear benefit associated with the increase. It is possible that pre-Honours students might feel differently about the workload of an FC class, since they merely have to pass their courses to progress (and therefore it seems likely that some/many work less than Honours students).

#### *6.5. My experience as Course Organiser*

Overall, the experience of facilitating this course was very enjoyable. I found classes engaging, and gained far more insight into the students' thinking than is possible in lectures or most tutorials. Having said that, there was also significant emotional labour involved (cf. Bennett, 2014). I felt anxious about whether students would engage and whether particular exercises would work well and fit to time. Students could send anonymous feedback each week and this helped assuage my concerns. It also gave me the opportunity to respond, including explaining certain design features when these were commented on, which perhaps increased understanding and 'buy-in' from the students.

The course involved a high workload for me, not only for initial development as is commonly reported (e.g. Betihavas et al 2016; O'Flaherty and Phillips, 2015), but also marking the text-based quiz questions each week. From 2020 onwards, I have had to remove these questions – including the personal reflection that students reported finding valuable – because the time necessary to read and comment on them became unmanageable as the class doubled in size from the first year. The quizzes now consist solely of computer-marked multiple choice questions.

This is not the only problem related to increasing student numbers. Other learning activities have been affected; for example, larger numbers mean more small groups and therefore less time for each group to report back to the whole class. I now have to split the group into two for the deep listening exercise, requiring a suitable co-facilitator (who can't be paid). Physical space was becoming a problem before the Covid-19 pandemic; the university has hardly any flat-floor classrooms with moveable furniture that are large enough for 30+ people to sit in a circle as well as being able to work in small groups, as this course requires. Due to the pandemic, the seminars were held live online in 2020 and 2021, but when in-person teaching is possible again space will be a significant issue. Such problems have been discussed by others such as Warburton (2003), who notes that active, transformative learning activities are "not well served" by large class sizes.

#### *6.6. Recommendations*

My experience and the insights gained from this research suggest several points to consider which may improve the chances of successfully using an FC approach to engage students in transformative ESD. It is advisable to use graded quizzes or other regular, low-stakes assessments to incentivise pre-class preparation. Such assignments have the additional benefit of giving the teacher feedback on students' understanding. I suggest planning most of the class time to involve active learning, including reflective exercises which are appreciated by students and engage them practically and emotionally as well as cognitively, but include some in-class mini lectures (which build on, rather than repeat, the preparatory material) to ensure that students don't feel they are left too much to their own devices. Expect the workload associated with preparing such a course to be greater than for a traditional lecture-based course; assistance from colleagues (e.g. information

services/technology-enhanced learning staff who can help with software, training etc.) could be valuable.

For large courses, the range of possible AL exercises will probably be limited by student numbers and the layout/furniture of the teaching room. Such classes can employ activities such as online voting followed by discussion with neighbours about factual or opinion-based questions. It may be that only a partial 'flip' is possible; i.e. moving some content out of class to make time for AL, but retaining a significant amount of lecture time. It is likely that short lecture segments interspersed with AL (including reflection) will help students concentrate (Bunce et al., 2010). A partial flip may be most appropriate for pre-Honours classes anyway, so that the workload is not too much greater than students expect or are willing to engage in.

Partial use of FC pedagogy may also be a way for staff to 'ease into' this mode of teaching, reducing emotional labour and upfront workload; a more complete flip could be achieved over time if desired. It is clear that the active and reflective learning that FC facilitates engages students in ESD and helps create transformational learning essential to the fundamental personal and societal shifts necessary for a sustainable future.

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