# Reducing Students' Ecological Footprints through Self-Developed Interventions

Claire Wagner

Department of Psychology, University of Pretoria, South Africa

https://orcid.org/0000-0001-6758-2891

claire.wagner@up.ac.za

Jeremy Gibberd

Engineering, The Built Environment and Technology, Nelson Mandela University, South Africa

## Abstract

An increasing emphasis on taking personal responsibility for making changes to address climate change and support sustainable development is hindered by the limited tools and guidance available that enable the relationship between living patterns and environmental impacts to be readily and accurately discerned. An exception is the Ecological Footprint calculator (EFC) that measures the global environmental impact of everyday activities. This study describes how the EFC is used as part of a master's course in environmental psychology to enable students to understand, change and measure the environmental impacts of their daily activities. A case-study design based on students' exercises was used to collect quantitative and qualitative data. We found relational, environment, financial and self-efficacy themes embedded in their reflections on the intervention process. Our study supports an educational approach that requires students to self-develop, implement and measure interventions to reduce their ecological footprint.

**Keywords**: ecological footprint, environmental psychology, intervention, sustainability education, university students

The climate emergency not only threatens the security of the ecological resources humans depend on for survival, it may also shape our psychological well-being as we have developed an inherent connection with our natural environment. Seen through the lens of the biophilia hypothesis, drastic lifestyle changes over the years, especially in Western, educated, industrialised, rich and democratic (WEIRD) societies, signify a potential loss of opportunities to fulfil the psychological and social needs that nature affords us (Barbiero, 2021; Gullone, 2000). One outcome of the coronavirus pandemic has been a call to reflect on our relationship with the natural world and the sustainability of our current lifestyles. Echegaray (2021) asks "What will post-COVID-19 look like in terms of lifestyles?" and "What implications will the changes in our lifestyles have for progress towards sustainable modes of consumption?" (p. 567). One way of establishing the impact of our lifestyles on natural resources is to measure our "ecological footprint" (EF).

Many factors influence EF, including urbanisation, economic growth and consumption of food, water and fuel (Danish & Kahn, 2020). People's awareness of the impact of their consumption on the environment can assist them in managing their EFs to ensure the renewal of natural resources and sustainability for the future (Fernández et al., 2020). Although there is extensive criticism of the EF concept in the literature (e.g., it is regarded as a simplistic indicator of a complex phenomenon (see e.g., Galli et al., 2016; Van den Bergh & Grazi, 2015)), it remains a popular and user-friendly method to measure people's impact on the environment (Fernández et al., 2020).

The United Nations (UN) ran its Decade of Education for Sustainable Development programme from 2005 to 2014 to mobilise education for a more sustainable future (Buckler & Creech, 2014). Although several techniques have been discussed to improve the integration of principles of sustainable development in higher

education (see e.g., Corscadden & Kevany, 2017; Vasconcelos & Seingyai, 2021; Veisi et al., 2019), there have been challenges. For example, some universities that include the Sustainable Development Goals (SDGs) from the UN 2030 Agenda for Sustainable Development (2015) in their curricula do not have guidance material on moving from theory to real-life practice, which may negatively influence students' attitudes towards sustainable development (Fernández et al., 2020; Gottlieb et al., 2013). This is concerning given that the EF of university students is generally not sustainable (Lambert & Cushing, 2017), a finding that is consistent with data from sub-Saharan Africa, where our study is located (Adjei et al., 2021). Some institutions of higher learning also lack the opportunities for students to participate in sustainable development activities (Mawonde & Togo, 2021). Barriers to educating students about sustainability may in part be due to an absence of the necessary expertise and means, which has led to calls for research that addresses the "limited evidence-based examples of teaching and learning practices to support and inform ongoing teacher education in sustainability education" (Sandri & Holdsworth, 2021, p. 667).

Application of the EF concept is a useful technique for teaching sustainable attitudes and behaviours, and the use of ecological footprint calculators (EFCs) to measure the resources people use in their lifestyles can raise awareness among university students of their sustainability impacts (Collins et al., 2018; Fernández et al., 2020). Teaching students about using psychological science to address the environmental problems caused by human behaviour (in courses such as environmental psychology) is paramount in creating a more sustainable future (Barnwell & Wood, 2022; Malt, 2019). Our study explored whether greater awareness of one's EF resulted in an increased desire for change.

Although research has been conducted, both internationally (see Collins et al.,

2018; Fernández et al., 2020; Lambert & Cushing, 2017; Maurer & Bogner, 2020) and locally (see Bulunga & Thondhlana, 2018), on reducing university students' EFs, there are few published studies on assessing their own interventions. Indeed, Collins et al. (2020) encourage experiential activities and curricula that allow students to co-create solutions to build sustainable identities, and Bulunga and Thondhlana (2018) emphasise the need for students to be autonomous in their participation in programmes focusing on EF reduction. Qureshi (2020) followed a "learning by living" approach, requesting students at a UK university to choose more sustainable activities for six weeks and submit reflective reports on the impact this had on their lives. The study found benefits in a student-led approach involving active engagement in sustainable living practices, but did not use EF as a measure of behaviour change. A lack of progress in achieving international climate change and sustainable development targets has led to an increasing interest in taking personal responsibility for making changes. The present study contributed to understanding how this could happen by providing an evidence-based example of student-led climate change pedagogy which posed two research questions: (1) "What is the outcome of an intervention developed and implemented by psychology master's students to reduce their ecological footprints?" and (2) "What do their reflections reveal about the process?"

## Method

### Design of the study

An environmental psychology course taught as part of a professional master's programme at a public university in South Africa was chosen as a case study to explore an example of a teaching practice in sustainability education. Case-study research typically uses multiple methods to gather information about real-life situations (Guetterman & Fetters, 2018).

**Description of the environmental psychology course**

I (the first author) was introduced to environmental psychology when enrolling as a student in the master's programme in 1994 when the discipline was in its infancy in South Africa. I noted the lack of social scientists working in the field of sustainability despite growing career prospects. When the opportunity arose to take responsibility for the course, I adapted it to equip students with the competencies to understand people–environment transactions based on systems theory as the driving philosophy, and to identify and suggest solutions for well-defined problems using relevant methods of inquiry.

As the subject is not routinely taught in psychology programmes, the first component of the course requires students to choose a theoretical aspect of the field to familiarise themselves with, including: background to the discipline; theoretical approaches; application of research methods in the field; key concepts such as the Anthropocene, environmental racism and justice, pro-environmental behaviour; policies and legislation; and, the future of people–environment systems. This first-semester component forms 50% of the total course mark assessed using a written essay, oral presentation, and question-and-answer session.

The second component (contributing 50% of the total course mark) is offered during the second semester and consists of a project that requires applying theoretical knowledge to address a practical problem. Assessment includes the level of attendance and engagement in meetings, workshops and training as well as a report about the project, the topic of which is determined annually. In the present case, the topic was how to reduce one's EF, allowing interdisciplinary collaboration with the second author, who works in the area of smart and sustainable built environments and is interested in measuring green behaviour through tools such as EFCs.

Although EFCs motivate action and provide users with valuable information, the information may not be sufficient for users to make the changes required to reduce their footprints (Collins et al., 2020). Therefore, the students received training on the composition, implementation, analysis and interpretation of EF tools as well as real-life alternatives to reduce their EFs. A Google group was set up to discuss any aspects that needed clarification, and a pre-project follow-up session was held to confirm the final process. The project documents were uploaded onto the university's online learning system, and students were requested to follow five steps in the project timeline divided into a pre-intervention component (step 1 – measuring their EF and recording patterns of life information to assist with developing interventions and step 2 – developing interventions), an intervention week (step 3 – implementing interventions developed in step 2) and a post-intervention component (step 4 – measuring the effectiveness of the intervention in reducing their EF by repeating step 1 and step 5 – reflecting on the cycle of the interventions in a diary). A post-intervention feedback session was held with the students on completion of the project, which gave some insights into what had happened during the project.

**Participants**

As the population was small ($N = 5$) a purposive method referred to as total population sampling was used, i.e. the entire class was requested to participate in the study (Etikan et al., 2016). Three of the five students in the class consented to contribute their data for analysis.

Two of the three participants were black females, and the remaining participant was a white male. The black female participants lived in accommodation close to campus and used public transport, whereas the white male lived at home and used his vehicle for transport. The two students with the highest EF scores in the cohort (a white

male and a white female) did not contribute their data for analysis precluding insights into EF reduction strategies in this context.

## Instruments

### *Online Ecological Footprint Calculator*

A range of environmental impact calculators are available that enable users to calculate impacts resulting from activities and living and working patterns. The EFC of the Global Footprint Network (see http://www.footprintcalculator.org/home/en) was chosen based on its specific characteristics and functionality: activities are directly related to planetary limits, making it easier to establish whether you are using more or less of your fair share of global resources; the methodology comprehensively measures the multiple impacts of lifestyles that are not captured by, for instance, carbon calculators; local data is reflected in calculations and provides more accurate representations of impact compared to generic calculators; it provides user-friendly, accessible online calculators that capture and present detailed information easily. The calculator measures the amount of biologically productive land and sea that provides the resources that a human population requires and that can absorb the corresponding waste taking into account:

- Food (type and amount consumed);
- Shelter (size, utilisation and energy consumption);
- Mobility (type of transport used and distances travelled);
- Goods (type and quantity consumed);
- Services (type and quantity consumed);
- Waste (type and quantity produced).

Areas of each of these factors are added together to provide an EF in global

hectares (gha) (Wackernagel & Yount, 2000). Given that the earth's surface is finite, a maximum equitable share can be determined at about 1.8 global hectares (gha) per person (Moran et al., 2008). As reflected in the report generated by the EFC, a person should have an EF of under 1.8 gha to avoid using more than their fair share of the earth's resources; "if everyone lived like you we would need x earths", and multiple earths (x) would indicate unsustainable lifestyles.

***Excel spreadsheet***

A spreadsheet was created for the participants to enter the data from the EFC scores and the patterns of life (relating to food, shelter, mobility, goods, and services) measured during the seven-day week preceding and following the intervention. The EFC calculated the differences in the participants' "before" and "after" scores once the intervention had been completed and the data entered.

***Reflective diary***

A diary containing open questions about the process was used to record the participants' reflections on the intervention process. This qualitative tool is commonly used in mixed methods studies; it provides additional perspectives on data collected through other approaches (Cucu-Oancea, 2013), and it has been useful in recent research on increasing sustainable behaviour (see Tröger et al., 2021). Items in the diary included once-off tasks requesting students to describe the process of selecting interventions, record their impressions of the intervention week as a daily task, and indicate what they had learnt about reducing their EF as well as using an intervention for broader application. As reflective diary writing is vulnerable to the amount and quality of information provided by participants (Cucu-Oancea, 2013), the students received training on the requirements of completing the diary before the start of the project to maximise their understanding of the required protocol (Bolger et al., 2003).

Contact was maintained with them during the intervention, and an electronic reminder to record a journal entry at a specified time interval was sent using the online learning system. Diary entries ranged from four to seven pages. The final project reports submitted by the three participants were also used as a source of data to supplement the diary entries.

**Procedure**

The quantitative and qualitative data collected in the project timeline's five steps are depicted in Table 1. These data collected from the tasks required by the practical component of the course would also be submitted as the dataset for further analysis as part of the research project reported in this article.

**Table 1.**

*Data collected in the five project timeline steps*

| Step | Data collection instrument | Type of data |
|---|---|---|
| 1. Measurement of EF & recording of patterns of life | EFC<br>Spreadsheet | Quantitative |
| 2. & 3. Development & implementation of EF intervention | Spreadsheet | Quantitative |
| 4. Measurement of EF intervention | EFC<br>Spreadsheet | Quantitative |
| 5. Reflection on EF intervention | Diary<br>Project report | Qualitative |

**Ethical considerations**

Ethics approval was obtained from the Faculty of Humanities Research and Ethics Committee (reference number HUM040/0621), whereafter the students received a participant information sheet, and those who agreed to participate signed an informed

consent form. Confidentiality of the participants' data was ensured by anonymising their responses. Although the practical project formed part of the course in environmental psychology that students received marks for, the information sheet explained that they were under no obligation to participate in the subsequent study that would analyse their data. Therefore, submitting their course outputs was voluntary. They would receive the necessary course credits whether they participated in the study or not, and would not be penalised in any way.

**Data analysis**

Data from the EFC were analysed by calculating the difference between the pre- and post-intervention scores ($x_{pre} - x_{post}$ = y) to provide an indication of whether a change was present and what its extent was. A thematic analysis was performed on the diary data and the project reports submitted by the three students. We followed Braun and Clarke's (2006) six phases to identify and analyse patterns in the qualitative dataset to describe what the students' experiences revealed about the intervention process, allowing the data to inductively drive the generation of themes. Inferences from the two data sets were then integrated to allow for a broader interpretation of the findings. Inside-outside legitimation was used as a strategy to establish the rigour of the analytic process (see Onwuegbuzie & Johnson, 2006). The first author conducted the initial analysis, and the second author provided inside legitimation by reviewing the quantitative and qualitative interpretations of the data. As both authors are committed to encouraging pro-environmental behaviour, we were cognisant of the potential to focus on the positive elements of the intervention. The student participants were asked to review our analysis of their data to establish outside legitimation, and all concurred that the findings were an accurate reflection.

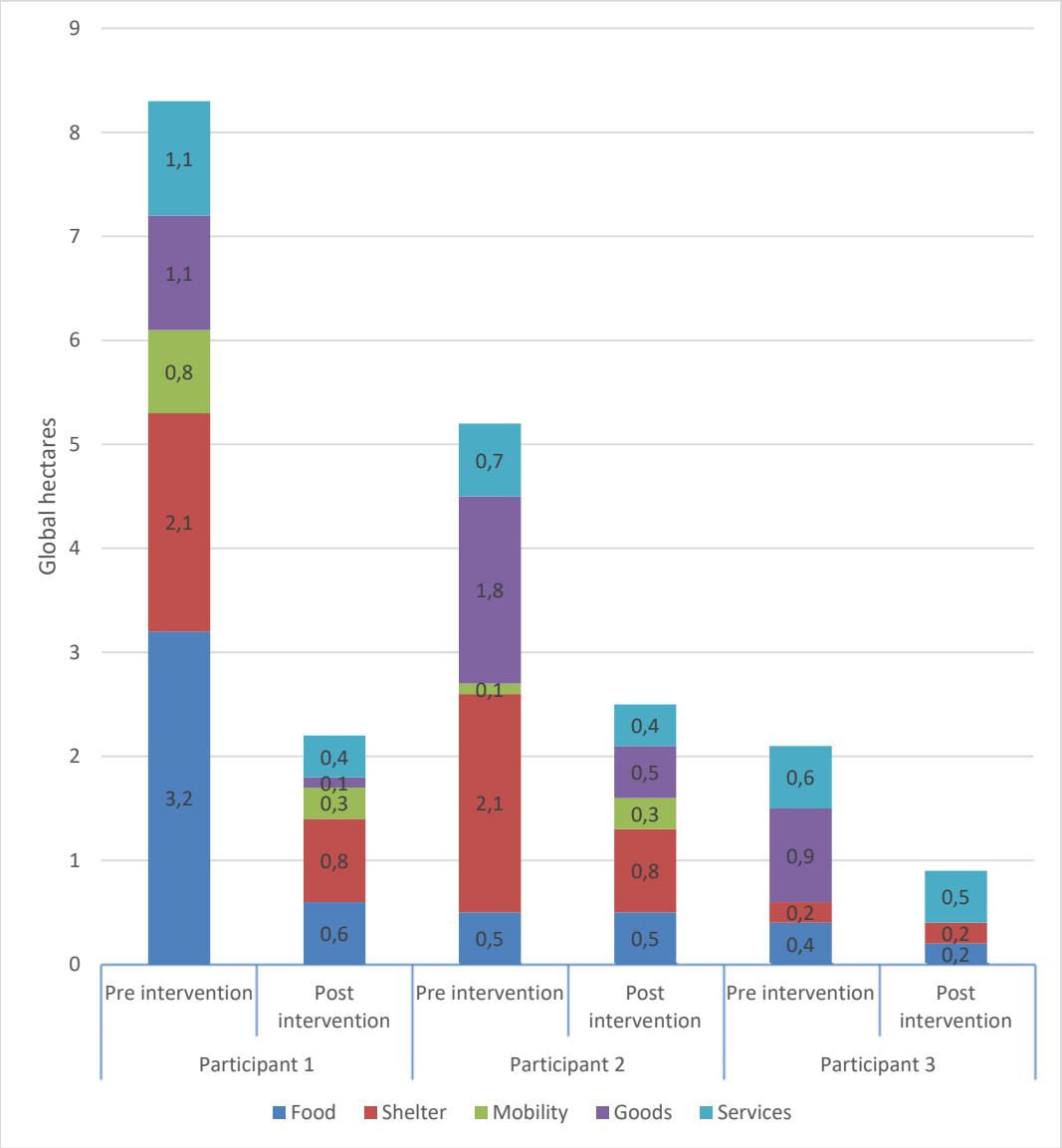
## Results and discussion

### EF footprint scores pre- and post-intervention

Figure 1 shows the results of the EF scores before and after the intervention. The participants lived above the 1.8gha threshold and although two participants made sizeable savings in their EF, with Participant 1 dropping from 8.3 to 2.2 (-6.1) and Participant 2 dropping from 5.2 to 2.5 (-2,7), they still were not able to make the 1.8 gha threshold. Participant 3, whose score of 2.1 before the intervention was closer to the threshold, reduced this further to 0.9 (-1,2) and therefore could be said to have a sustainable lifestyle during the intervention. Participant 1 achieved the highest change, but also had the highest pre-intervention score and substantially reduced EF in all categories. Participants 2 and 3 achieved lower change, but also had lower pre-intervention EF scores than Participant 1. Participant 2 reduced their EF considerably in the areas of shelter, goods and services but not in food, and increased their EF in mobility. Participant 3 had the lowest EF to start with, but achieved reductions in food, goods and services whereas their EF in shelter and mobility remained the same.

**Figure 1**

*Pre- and post-intervention EF scores expressed in global hectares*




The differences in results are likely to be the result of fundamentally distinct living and working patterns related to access to resources and demographics. The low EF of Participant 3 may be attributed to not having a car and having less access to resources, leading to acquiring habits such as walking more often, purchasing less and more locally, and entertaining, travelling and socialising less (particularly at night for

security reasons). The results indicating that access to resources is likely to be a key determinant of high EFs are potentially important as they suggest that people who live with limited resources develop skills to achieve low or lower EF. The results also suggest that these skills are less refined where people have ready access to resources and therefore are less well attuned to minimising their EF. Moreover, the latter group may develop high EF habits (e.g., driving, travelling, meat-based diets, high home energy use) that are difficult to change.

**Selection of interventions to reduce EFs**

The participants reported that the process of choosing interventions to reduce their EF made them more conscious of the impact of their lifestyles on the planet, for example, overeating red meat, driving a car that is heavy on fuel, buying packaged and non-local goods, using cab services, using non-recyclable plastic, and consuming unnecessary electricity. All participants chose to reduce their food EFs by cutting down on or avoiding meat-based dishes and following vegetarian and vegan diets. In all cases, participants reduced shelter EFs—they were more conscious of the energy consumed in residences and switched off appliances not in use. The latter is surprising for students in residences given that they do not receive feedback about their consumption, nor do they have an incentive to save a resource they are not paying for directly. Reducing energy use in residences can provide substantial savings for universities in the face of limited budgets; however, it is seldom cited as a sustainability option (Bulunga & Thondhlana, 2018).

Reductions were achieved in mobility EFs by using a more energy-efficient car (Participant 1) and walking more often (other participants). Some reductions in goods and services EF were achieved by the participants recycling where possible and

avoiding non-recyclable plastic, a form of waste that is in substantial use among university students in other sub-Saharan African countries (Adjei et al., 2021).

**Main impressions of the intervention**

Several factors may have played a part in the EF improvement achieved as a result of interventions. Firstly, participants appeared to have researched potential actions to understand their implications, which validated their choices as they based them on a theoretical understanding of sustainability practices (Qureshi, 2020). Thus, they tended to select high-impact interventions, such as following a vegetarian or vegan diet, unlike in other studies where reducing food EFs was found to be challenging or limited to buying organic or local products (Lambert & Cushing, 2017; Ryu & Brody, 2006). Access to low EF produce in a neighbourhood and personal dietary preferences may play a role in these choices. Secondly, completing a matrix indicating activities against EF factors each day and writing diary entries appeared to help reinforce participants' low EF choices. Classroom projects that use interventions based on daily routines have been shown to reduce students' energy consumption (Maurer & Bogner, 2020).

People living in the Global South are particularly susceptible to deteriorating environments that offer them fewer resources to adapt to stressful situations, whereas those living in WEIRD areas are better resourced and carry the most responsibility for climate change (Barnwell & Wood, 2022). Next, we present four themes that may indicate some contextual elements not typically taken into account in studies focusing on WEIRD countries.

***Role of environments in facilitating decisions to reduce EF***

Interestingly, environments played a role in participants' decisions. Although Participant 2 wanted to walk more, as a single female, she did not feel safe and usually

took an Uber: “Another thing that made my walking experience uncomfortable is that when I would be walking men would approach me and make some sexual advances (asking me out for drinks and say statements about my body that I did not ask for).” In this case, unsafe environments were perceived as a barrier to a lower EF lifestyle. This echoes findings in Bulunga and Thondhlana’s (2018) South African study, where switching off lights in certain parts of university residences presented security issues. Participant 3 commented on how she could walk and readily access all her day-to-day requirements (e.g., buying food and attending lectures). Here, location and access to local facilities promoted a low EF. In contrast, Participant 1’s residential location required the use of a car and lowering EF related to mobility was not an option. Characteristics of services also appeared to play a role. Participant 3 could readily access a water refilling facility, fresh fruit and vegetables, and could share unused food in a charity box in her residence. The convenience and accessibility of these facilities promoted low EF lifestyle habits. This is consistent with Lambert and Cushing’s (2017) finding that ease of access to low- or no-cost interventions could facilitate student behaviour change.

***Financial incentives to reduce EF***

The financial incentive of sustainable living reported in Qureshi’s (2020) study was acknowledged by participants 2 and 3 who reduced their EF by walking more often, using local amenities and buying less non-recyclable plastic. In contrast, students participating in other studies typically reported a lack of resources as a barrier to changing their behaviour (Bulunga & Thondhlana, 2018; Lambert & Cushing, 2017; Mawonde & Togo, 2021). The financial advantages of reducing their EFs could be beneficial in encouraging students to live more sustainably.

### *Relational aspects associated with EF reduction strategies*

Social aspects also appeared to be important in maintaining selected low EF activities. Participant 1's decision to follow a vegan diet was strongly supported by the fact that his girlfriend was already vegan: "I already had all the resources right in front of me as my girlfriend has been a vegan for six years and counting, so she was very glad that she could help me give up meat." Support of families and friends in making and keeping to low EF choices was also considered important. Participant 3 wished for more support: "I think the project would have been a lot easier to implement with people who constantly motivated each other." Besides Bulunga and Thondhlana's (2018) example of participants being encouraged by collective action to achieve sustainability goals, social support as an enabler was not reported in other studies as reducing students' EF. This aspect could signify an avenue for further exploration. As our project took place during the COVID pandemic, an individual approach to participating in the project was taken. Fostering collaboration among students, including members of households where possible, using social media to convey personal EF scores, and sharing updates could help create awareness and competition among groups and friends.

### *Self-efficacy in reducing EF*

Participants expressed appreciation of the exercise and the reflection this had required - taking low EF action made them feel proud. Creating opportunities for students to participate in sustainable development activities is paramount as they are "regarded as one of the most crucial stakeholders in society, and knowledge of SDGs will help them confront present and future environmental calamities" (Mawonde & Togo, 2021, p. 1488). Ideally, environmental courses should be included in all degree programmes to institutionalise sustainability (Heck, 2005). If this is not feasible, universities could continuously encourage sustainability practices and ensure that

corresponding changes in the market are achieved. University campus management could also review the EFs of students and carry out surveys to identify how environments and services could be changed to support lower EFs. This may include increased provision for walking and cycling, increased access to non-meat/low-EF food, increased energy efficiency, and the use of renewable energy in university buildings. It would also be interesting to collaborate with universities' facilities departments on a study that aims to understand students' EFs in different contexts (e.g., living in campus residences or offsite, living with parents, driving a car to campus versus using public transport). Further, student clubs and social activism may be effective in increasing awareness of EFs and in lobbying university management to effect change.

Although two of the participants requested potential interventions to be more structured, we argue that the strength of our approach lies in requiring participants to develop their interventions. This approach addresses the limitations found in previous studies (see e.g., Truelove, 2009) where participants' efficacy beliefs were not strengthened when they were provided with a list of behaviour changes recommended to reduce their energy use. Although the self-development approach relies on participants' understanding of the potentially complex science of reducing EF, it may encourage them to engage in pro-environmental behaviours of their choosing, which promotes self-efficacy and autonomy. Our study's findings highlight the importance of attending to psychological and social needs when intervening in human–environment interaction. They also illustrate how the discipline of psychology can contribute to more sustainable lifestyles through interventions designed to bring about behaviour change.

## Conclusion

Our study aimed to contribute to an understanding of whether and how EF information supports personal reflection and leads to change. In line with previous

studies (e.g., Collins et al., 2018; Fernández et al., 2020; Lambert & Cushing, 2017), the EF concept and calculator, with the addition of reflective activities (e.g., Qureshi, 2020), were useful for raising awareness of sustainability in everyday life and reducing the student participants' EFs. We found relational, environment, financial and self-efficacy themes embedded in their reflections on the intervention process. Our findings endorse interventions that provide students, firstly, with knowledge about reducing their EF and, secondly, the effect of changing their behaviour to reduce their EF (Lambert & Cushing, 2017). We recommend addressing self-efficacy and autonomy needs by involving students in developing and assessing such interventions. Leveraging social support could also be important in behaviour change. This paper encourages a learning by living approach to teaching students about fostering sustainable behaviour. As future professionals in environmental psychology, engaging in this process may give them some insight into the mechanisms of developing, implementing and measuring interventions to address people's relationship with nature, in this case by reducing one's EF.

Although the same individuals participated in the quantitative and qualitative parts of the study (so that meta-inferences could be justifiable), generalisability is not possible because of the non-probability and small sample. We propose that the method used in our study be implemented in a range of contexts and on a larger scale over a longer intervention period to collect more information on its effectiveness in reducing students' EFs. Pro-environmental behaviours are more likely to improve among those who had pre-existing positive attitudes compared to those who did not have positive attitudes towards environmentalism after getting the results of their EF (which tended to be negative and thus discouraging) and it could be argued that the student participants in our study had already been sensitised to environmentalism by virtue of the

environmental psychology course they were completing, making them the ideal group to aim EF feedback at (Brook, 2011). Being evaluated in the course may also have motivated the participants to reduce their ecological footprints.

Our study raises interesting questions about access to resources and about habits and demographics. Future studies could test hypotheses related to these and address questions such as: Do students with limited access to resources find it easier to achieve EF reductions than students with ready access to resources? What fundamental habits and behaviours of students support low EFs? How do demographics and background affect EFs? What are the key drivers of high EF behaviours and habits? A study could also aim to determine how students' living patterns could be changed through adjustments in the environment and services. The consequences of climate change on mental health is a large and specialised topic, the exploration of which was not within the scope of this study. Further questions on personal resistance to change and whether change can be sustained would be interesting aspects to address in future studies.

**Funding Acknowledgements**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Acknowledgements**

The researchers would like to thank the students for consenting to participate in this project.

**Disclosure statement**

Nothing to declare

**References**


Adjei, R., Addaney, M., & Danquah, L. (2021). The ecological footprint and environmental sustainability of students of a public university in Ghana: Developing ecologically sustainable practices. *International Journal of Sustainability in Higher Education, 22*(7), 1552–1572. https://doi:10.1108/IJSHE-08-2020-0318

Barbiero, G. (2021). Affective ecology as development of biophilia hypothesis. *Visions for Sustainability, 16*(5575), 1–35. http://dx.doi.org/10.13135/2384-8677/5575

Barnwell, G., & Wood, N. (2022). Climate justice is central to addressing the climate emergency's psychological consequences in the Global South: A narrative review. *South African Journal of Psychology*. Advance online publication. https://doi.org/10.1177/00812463211073384

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology, 54*, 579–616. https://doi:10.1146/annurev.psych.54.101601.145030

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi:10.1191/1478088706qp063oa

Brook, A. (2011). Ecological footprint feedback: Motivating or discouraging? *Social Influence, 6*(2), 113–128. https://doi:10.1080/15534510.2011.566801

Buckler, C., & Creech, H. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development (final report)*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000230171

Bulunga, A. A. L., & Thondhlana, G. (2018). Action for increasing energy-saving behavior in student residences at Rhodes University, South Africa. *International*

*Journal of Sustainability in Higher Education, 19*(4), 773–789. https://doi:10.1108/IJSHE-07-2017-0107

Collins, A., Galli, A., Hipwood, T., & Murthy, A. (2020). Living within a one planet reality: The contribution of personal footprint calculators. *Environmental Research Letters, 15*(2). https://doi.org/10.1088/1748-9326/ab5f96

Collins, A., Galli, A., Patrizi, N., & Pulselli, F. M. (2018). Learning and teaching sustainability: The contribution of Ecological Footprint calculators. *Journal of Cleaner Production, 174*, 1000–1010. https://doi.org/10.1016/j.jclepro.2017.11.024

Corscadden, K. W., & Kevany, K. (2017). The TREEhouse: A hybrid model for experiential learning in environmental education. *Applied Environmental Education & Communication, 16*(1), 56–67. https://doi.org/10.1080/1533015X.2017.1282334

Cucu-Oancea, O. (2013). Using diaries—A real challenge for the social scientist. *Procedia—Social and Behavioral Sciences, 92*, 231–238. https://doi.org/10.1016/j.sbspro.2013.08.665

Danish, R. U., & Khan, S. U.-D. (2020). Determinants of the ecological footprint: Role of renewable energy, natural resources, and urbanization. *Sustainable Cities and Society, 54*, 101996. https://doi.org/10.1016/j.scs.2019.101996

Echegaray, F. (2021). What POST-COVID-19 lifestyles may look like? Identifying scenarios and their implications for sustainability. *Sustainable Production and Consumption, 27*, 567–574. https://doi.org/10.1016/j.spc.2021.01.025

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1–4. https://doi:10.11648/j.ajtas.20160501.11

Fernández, M., Cebrián, G., Regadera, E., & Fernández, M. Y. (2020). Analysing the relationship between university students' ecological footprint and their connection with nature and pro-environmental attitude. *International Journal of Environmental Research and Public Health, 17*(23), 8826. https://doi:10.3390/ijerph17238826

Galli, A., Giampietro, M., Goldfinger, S., Lazarus, E., Lin, D., Saltelli, A., Wackernagel, M., & Müller, F. (2016). Questioning the Ecological Footprint. *Ecological Indicators, 69*, 224–232. http://dx.doi.org/10.1016/j.ecolind.2016.04.014

Global Footprint Network. (n.d.). http://www.footprintcalculator.org/home/en

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: A quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844–863. https://doi:10.1080/13504622.2013.768602

Guetterman, T. C., & Fetters, M. D. (2018). Two methodological approaches to the integration of mixed methods and case study designs: A systematic review. *American Behavioral Scientist, 62*(7), 900–918. https://doi.org/10.1177/0002764218772641

Gullone, E. (2000). The biophilia hypothesis and life in the 21st Century: Increasing mental health or increasing pathology? *Journal of Happiness Studies*, *1*, 293-321. https://doi.org/10.1023/A:1010043827986

Heck, D. (2005). Institutionalizing sustainability: The case of sustainability at Griffith University Australia. *Applied Environmental Education and Communication, 4*(1), 55–64. https://doi.org/10.1080/15330150590905248

Lambert, M., & Cushing, K. K. (2017). How low can you go? Understanding ecological footprint reduction in university students, faculty and staff. *International Journal of Sustainability in Higher Education, 18*(7), 1142–1156. https://doi:10.1108/IJSHE-08-2015-0145

Malt, B. (2019). Educating students on the psychology of sustainability. *Observer, 32*(4), 34–35. https://www.psychologicalscience.org/observer/educating-students-on-the-psychology-of-sustainability

Maurer, M., & Bogner, F. X. (2020). First steps towards sustainability? University freshmen perceptions on nature versus environment. *PLoS ONE, 15*(6), e0234560. https://doi.org/10.1371/journal.pone.0234560

Mawonde, A., & Togo, M. (2021). Challenges of involving students in campus SDGs-related practices in an ODeL context: The case of the University of South Africa (Unisa). *International Journal of Sustainability in Higher Education, 22*(7), 1487–1502. https://doi:10.1108/IJSHE-05-2020-0160

Moran, D. D., Wackernagel, M., Kitzes, J. A., Goldfinger, S. H., & Boutaud, A. (2008). Measuring sustainable development—Nation by nation. *Ecological Economics, 64*(3), 470–474. https://doi.org/10.1016/j.ecolecon.2007.08.017

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools, 13*(1), 48–63.

Qureshi, S. M. Q. (2020). Learning by sustainable living to improve sustainability literacy. *International Journal of Sustainability in Higher Education, 21*(1), 161–178. https://doi:10.1108/IJSHE-01-2019-0001

Ryu, H.-C., & Brody, S. D. (2006). Examining the impacts of a graduate course on sustainable development using ecological footprint analysis. *International*

*Journal of Sustainability in Higher Education, 7*(2), 158–175. https://doi:10.1108/14676370610655931

Sandri, O., & Holdsworth, S. (2021). Pedagogies for sustainability: Insights from a foundational sustainability course in the built environment. *International Journal of Sustainability in Higher Education*, *23*(3), 666–685. https://doi:10.1108/IJSHE-01-2021-0002

Tröger, J., Wullenkord, M. C., Barthels, C., & Steller, R. (2021). Can reflective diary-writing increase sufficiency-oriented consumption? A longitudinal intervention addressing the role of basic psychological needs, subjective well-being, and time affluence. *Sustainability, 13*, 4885. https://doi.org/10.3390/su13094885

Truelove, H. B. (2009). *An investigation of the psychology of global warming: Perceptions, predictors of behavior, and the persuasiveness of ecological footprint calculators* [Unpublished doctoral dissertation]. Washington State University.

United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development.* UN. https://sdgs.un.org/2030agenda

Van den Bergh, J. C. J. M., & Grazi, F. (2015). Reply to the first systematic response by the Global Footprint Network to criticism: A real debate finally? *Ecological Indicators, 58*, 458–463. https://doi.org/10.1016/j.ecolind.2015.05.007

Vasconcelos, V. V., & Seingyai, A. (2021). Planning for sustainable development: A simulation game. *Applied Environmental Education & Communication*. Advance online publication. https://doi.org/10.1080/1533015X.2021.1936299

Veisi, H., Lacy, M., Mafakheri, S., & Razaghi, F. (2019). Assessing environmental literacy of university students: A case study of Shahid Beheshti University in

Iran. *Applied Environmental Education & Communication, 18*(1), 25–42. https://doi.org/10.1080/1533015X.2018.1431163

Wackernagel, M., & Yount, J. D. (2000). Footprints for sustainability: The next steps. *Environment, Development and Sustainability, 2*(1), 23–44. https://doi.org/10.1023/A:1010050700699