

Energy efficiency initiatives and the academic community's behaviour: a Brazilian experience

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Abstract

The Sustainable Development Goals are part of the 2030 Agenda and the seventh goal is dedicated to affordable and clean energy, aiming to ensure access to affordable, reliable, sustainable and modern energy for all. Energy efficiency is an important component of this goal and is associated with reducing energy consumption and its costs and increasing the source of clean energy production. Some authors have been discussing the relation between theory and practice of sustainability, and how the practice can contribute to behaviour change. In this context, the purpose of this paper is to assess the level of knowledge of the academic community about energy efficiency practices implemented during recent years by the University of Passo Fundo, in Brazil, and students, professors and employees' energy behaviour. The paper intends to illustrate how education practices on energy efficiency can be added to universities' actions to improve the progress towards reducing energy consumption and promoting occupants' change of behaviour on campus. The methodology represents a case study of the University, based on a questionnaire applied to the academic community, with a sample of 400 respondents. The results showed that the university should invest more in its energy efficiency actions but always connecting these with the academic community and highlighting their importance for the success of the practices and for a more sustainable culture on campus. Our findings show the importance of connecting energy efficiency initiatives to the academic community's behaviour, and especially of making these initiatives more visible and engaging. The contribution of this study is expected to support other educational institutions developing similar strategies in the energy context, but could also be useful to other sectors and sustainability topics, as the need for further dissemination and awareness-raising efforts is universal.

Keywords Energy efficiency · Universities · Energy behaviour · Energy conservation · Sustainability · SDGs

1 Introduction

Education for sustainable development is a critical component to promote sustainable development and improve people's capability to address environmental and development issues[1]. Tang [2] affirms that education for sustainable development aims to change attitudes and behaviours of future generations towards sustainability through educational institutions and educators' efforts.

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However, Bull et al. [3] highlighted that many factors prevent universities from succeeding in incorporating sustainable policies and practices. An example is the involvement and leadership of students, which are essential to achieving the deep transformations necessary for sustainability in higher education through the bottom-up pressure they offer [4]. Also, Parece et al. [5] reflected that having no financial incentives for conserving resources and no input into decisions concerning the efficiency of appliances, building renovations, or university operations is a key issue faced by universities in promoting environmentally relevant behaviour among students. Reinforcing this view, Carrico and Reimer [6] indicated that campus sustainability can be challenging because students, staff, and faculty do not have a direct financial interest in energy conservation.

As complex organizations, higher education institutions have a significant carbon footprint split across their direct and indirect emissions [7]. On account of that, several studies focus on investigating energy efficiency and behaviour at universities. Among them, Marans and Edelstein [8] found that the academic community was unaware of the need for energy conservation and related long-term efforts or initiatives implemented on campus. Parece et al. [5] found that when students living in university residence halls were introduced to electricity conservation strategies, their behaviour changed and resulted in positive consumption reduction. Escobar-Tello and Bharna [9] reported the results of an education project for the reduction of students' energy consumption and the enhancement of their happiness to promote sustainable lifestyles. Results from Boulton et al. [10] show that energy challenges can be also an effective way to reduce electricity consumption due to behaviour change.

Although there are some studies about the influence of students' behaviour in sustainability, specifically in energy consumption and energy efficiency, there is still a lack of studies analysing a potential connection between the initiatives already developed by universities and the knowledge or change of behaviour of academic community towards them, particularly in the energy context. This paper aims to fill in this gap by presenting the case study of University of Passo Fundo (UPF) and investigating (a) whether the academic community is aware of the university's energy efficiency initiatives and (b) if they think they may support behaviour change, therefore contributing to sustainability.

In addition, this paper is a continued study of a previous paper entitled "Energy efficiency actions at a Brazilian university and their contribution to Sustainable Development Goal 7" [11], in which the authors analysed the progress related to the energy practices at University of Passo Fundo and discussed opportunities, threats, strengths and weaknesses of applying energy efficiency at universities and its contributions towards Sustainable Development Goal (SDG) 7. In this paper, we go one step further and focus on the level of knowledge about energy efficiency initiatives implemented by UPF and the academic community's energy behaviour.

The structure of the paper is as follows: first, the authors explored the relevant literature for the context of environmental and energy behaviour. Then, the methodology is introduced prior to data analysis, results and discussion. Finally, research limitations and implications are discussed, and concluding remarks are provided.

2 Background

As previously mentioned, some studies are focusing on behaviour towards sustainable use of energy. These experiences have drawn from different methodologies and contributed to different aspects of the literature. For having served as a basis for this paper, the studies presented in Table 1 represent an important background for understanding past experiences on this topic and are related to the results and discussions of this investigation.

Within this context, this research is somewhat similar to the study of Staddon et al. [15] that analysed behaviour change through initiatives and of Bulunga and Thondhlana [18], who described how the benefits of raising awareness and increasing knowledge of pro-environmental behaviour can contribute to energy savings. On the other hand, it has this innovative approach of assessing how energy efficiency practices (not initially thought as awareness-raising actions) can contribute to awareness and potential change in behaviour.

3 Methods

This case study was performed at University of Passo Fundo, a multi-campus university, located in Southern Brazil. The main campus occupies a peripheral zone of the city, with a built-up area of more than 110 thousand square metres, receiving a population of approximately 14,000 users (including students, professors and staff) with several impacts

Table 1 Studies and theories of environmental and energy behaviour

Author(s)	Brief summary of aim/approach
Bekker et al. [12]	The study demonstrated that the combination of visual prompts, feedback, and incentives can effectively encourage behaviour change regarding electricity usage.
Emeakaroha et al. [13]	The authors proposed the combination of environmental and human psychology with technological feedbacks to assist real-time energy conservation and carbon reduction among students.
Mokhtar Azizi et al. [14]	The study verified that people working in green buildings perform better energy-saving behaviour than people in conventional buildings. Important strategies to encourage energy-saving behaviour and raise education on energy efficiency include: distribution of guidelines, posters, and e-mails; distribution of live updates on the energy usage of the building; and reminders on the goals of the commitment to energy efficiency.
Staddon et al. [15]	The authors used behaviour change as a framework to analyse initiatives on the topic of energy and found that the most successful initiatives had a combination of technological automation and enablement (opportunities for building users to move beyond education and training to more participatory approaches).
Ishak [16]	This study focused on developing energy consumption behaviour models and assessing potential energy savings, considering how important data on behaviour and consumption are to promote sustainability.
Lefkeli et al. [17]	By assessing knowledge and attitudes of students regarding energy saving, the results of this study showed that investing in energy education since early ages is important for acquiring skills on energy management and sensitivity to the topic.
Bulunga and Thondhlana [18]	By developing a pilot programme to reduce energy consumption via behaviour change interventions, this study suggested that energy savings can be attributed to awareness raising and increasing knowledge on the benefits of engaging to a pro-environmental behaviour.
Axon et al. [19]	This study highlighted the existing knowledge gap between what is known to work and what is put into practice concerning engagement in behavioural changes for energy use.
Piccolo et al. [20]	A case study on collective intelligence tools to build knowledge on energy conservation is reported. These tools can be useful to engage users, generate awareness and promote behaviour change.
Sony and Mekoth [21]	The authors promoted a discussion on the gap between reported intentions and actual behaviour and aim at understanding the reasons for consumers not engaging in electricity energy-saving behaviour. The results point out lack of information, lack of communication and lack of reward and motivation as the main factors.
Allen [22]	The authors defended that it is important to develop strategies to encourage and facilitate employee energy conservation behaviours at universities. As an example, the use of university planners that have information on employee awareness of energy issues, behaviours and constraints on performing other conservation behaviours.
Kuo et al. [23]	The study showed that energy behaviour could be changed by designing interventions and strategies, including education, persuasion, incentivizing, correction, training, enablement, modelling, environmental restructuring and restrictions.

Table 1 (continued)

Author(s)	Brief summary of aim/approach
Vicente-Molina et al. [24]	This study made a questionnaire with students of the courses related to economic development, with the purpose to analyse the influence of environmental knowledge on pro-environmental behaviour based on the different countries of the students. The results showed that motivation and perceived effectiveness are not significant variables.
Côrtes et al. [25]	Through a survey, the authors assessed how is the structure of the environmental behaviour of students from different universities, to analyse the similarities and differences between them. The results showed that the environmental behaviour is related to economic growth.
Chuvieco et al. [26]	The authors applied a questionnaire to students of different universities and countries with the aim of analysing their environmental habits. The results showed that the differences between the countries were not significant, while the self-perceived environmental commitment being significantly related to the sustainability habits of each student.
Almeida Barbosa et al. [27]	The authors developed a study with the purpose of assessing the environmental attitudes and knowledge of students of two different countries. The results showed that the differences between the two countries were significantly related to the differences in attitudes and knowledge levels between students in each country.
Heeren et al. [28]	The authors described an online survey with students from different universities to understand the relationship of sustainability knowledge and pro-environmental behaviour. The results showed that knowledge about sustainability has a significant impact in the environmental behaviour of the students.
Eppel et al. [29]	A study based on the literature review of important research related to environmental behaviour. The results showed that it is important to do research about environmental behaviour, because this can improve the effectiveness and promote more sustainable lifestyles.
Murray [30]	The author developed a systematic literature review on topics related to student-led action for sustainability in higher education. The results described that students are increasingly concerned about sustainability through multi-stakeholder collaborations, collective action and interdisciplinarity.
Dirk et al. [31]	The study analysed students' sustainability attitudes and behavioural intentions related to energy use, promoting energy saving and decarbonisation in higher education settings. It highlighted challenges and opportunities of working with key stakeholders and affirmed that universities should consider the need for a new business model in which shared and multiple value creation is a key feature.
Hay et al. [32]	The paper described student attitudes and beliefs towards climate change adaptation and sustainability-related behaviours based on a questionnaire. The results show few significant differences in sustainability-related behaviours between first- and third-semester students, with an increase in scepticism regarding the reality of climate change among the latter.

on the neighbourhood context and mobility [33]. UPF is the focus of this research due to recent approaches towards a more sustainable university and some energy efficiency initiatives implemented in the main campus to promote the environmental development and to transform it into a greener campus [11, 34].

The questionnaire was developed to collect data from UPF's academic community. It aimed to analyse the academic community's behaviour in relation to the energy efficiency initiatives performed by University of Passo Fundo in the last years, in order to understand the level of knowledge and personal attitudes towards energy consumption. Most questions were multiple-choice, considered a closed type [35] due to its characteristics to have uniform responses and to be easier to process. Additionally, one question was descriptive, considered open-ended [35] as participants could add their own responses.

The questionnaire was adapted from the methodology developed by Pato and Tamayo [36] in the topic Energy Saving, related to the use of renewable energy sources and energy saving's behaviour. Based on this, the items were developed by the researchers according to the main objective of this study. The questionnaire had 14 questions in total (Appendix A), divided into three categories: questions 1 to 8 related to energy efficiency initiatives, questions 9 to 12 about behaviour, and questions 13 and 14 associated with future initiatives.

The questionnaire was applied through a web-based survey, in which participants answered the questionnaire in the platform Google Forms. The participants of this study were students, professors, and staff, representing the academic community of UPF. The Research Division sent an email to these groups in order to share the survey, totalising approximately 14,300 emails sent (12,510 students, 1040 staffs, and 801 professors). The survey received 400 responses, representing a response rate of almost 3%—which could be considered a low number but it is a common characteristic of online surveys [37]. The survey remained open from May to June/2019. The data was analysed using descriptive statistic techniques.

4 Results

4.1 Sample characteristics

The highest proportion of respondents (64%) were students, followed by staff (19%) and professors (17%). About the gender of participants, 58% were women and 42% men. The majority of the participants (45%) were between the age of 18 and 24 years. More than 45% have not conclude higher education yet, and 39% are post graduated. There were respondents from 40 different courses, and 4 working sectors. The highest number of respondents are from graduate programs (37%), then courses of civil engineering, law and administration. The main results concerning sample characteristics are presented in Fig. 1.

4.2 Knowledge about UPF's energy efficiency initiatives

As part of the questionnaire, this study included 7 questions with options of answer "yes/no" to check respondents' current knowledge of the university's energy efficiency initiatives. In general, most part of the sample did not know about 5 out of 6 initiatives implemented by the university. The only positive result is related to the Photovoltaic Solar Generation Park initiative, which 62% of the respondents indicated knowing about. However, when analysing the categories (students, professors, staff) in separate, some results are different and are described in the following paragraphs. This positive result shows that visible initiatives are noticed easily by the academic community, such as results from Mokhtar Azizi et al. [14], who verified that people working in green buildings perform better energy-saving behaviour than people in conventional buildings.

Concerning the lighting initiative (the change from fluorescent to LED lamps), 44% of the respondents knew about the change at the campus main avenue. Even though the difference is visible at night, it should be considered that many respondents use the campus only during the day. The majority of these answers (63%) strongly agreed that the change improved visual quality and safety. This result changes when the categories are analysed separately: 63% of professors and 66% of staff knew about this initiative (against 33% of students), showing more awareness of those working at the university, as Fig. 2 illustrates. At the campus library, only 26% of the sample noticed the new lighting system, and all the categories answered mostly negatively about knowing about this initiative. However, of those who answered yes, 64%

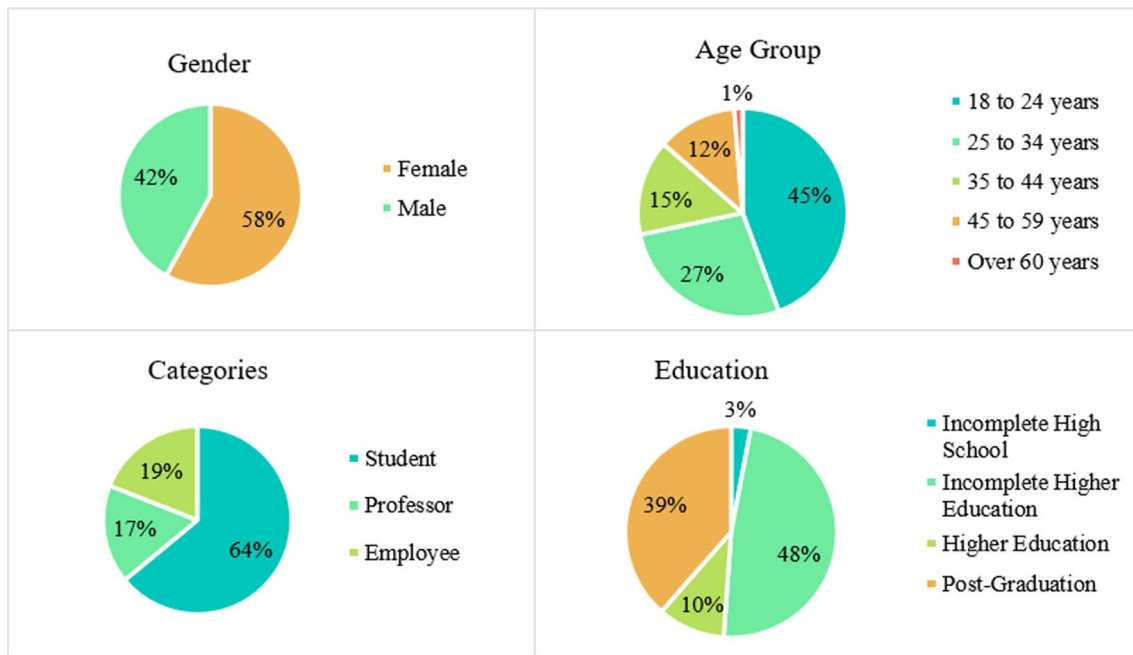


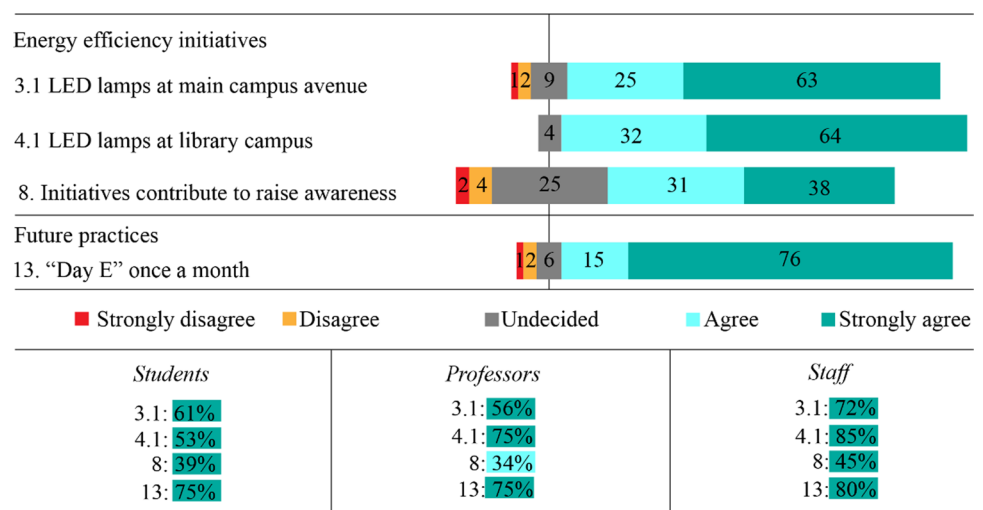
Fig. 1 Sample characteristics: gender, age group, category of classification and education

strongly agreed that the visual comfort improved after the retrofit. Lefkeli et al. [17] demonstrated that investing in energy education since early ages is important for acquiring skills on energy management and sensitivity to the topic of energy saving. This supports the importance of involving students in energy efficiency initiatives for better results and awareness.

The university campaign “Be aware and help take care of our environment” was not noticed by most of the respondents (56%). On the other hand, staff represented 70% of the respondents that knew about this campaign, and half of the professors answered positively as well. A campaign can be effective and influence more people when well-planned along with other actions, as shown by Bekker et al. [12] about how the combination of visual prompts, feedback, and incentives can effectively encourage behaviour change regarding electricity usage. Also, Axon et al. [19] suggest that there are significant knowledge gaps between what is known to work to engage individuals in behavioural change and what is currently being applied in practice. An over-reliance on education and awareness-raising projects is evident, illustrating that such projects do not sufficiently aim for sustained behavioural changes.

Most respondents (81%) did not know that the university buys energy through the Free Market Energy in all three categories. It shows that the only publishing the news at the university website [38] was not enough for people to be

Fig. 2 Level of agreement of respondents when asked about energy initiatives and improvements in visual quality and safety, visual comfort, awareness-raising and intention to participate



aware of this important change, when the university started to buy energy only from renewable sources, reducing its ecological footprint. It is clear the commitment of the university on purchasing electricity from renewable sources; however, the academic community should know about this important initiative as a potential way to improve individual behaviour. Sony and Mekoth [21] promoted a study on the gap between reported intentions and actual behaviour, and the reasons for consumers not engaging in energy-saving behaviour. The results point out lack of information, lack of communication and lack of reward and motivation as the main factors.

Regarding the University Social Responsibility Policy, which is a document with guidelines to implement sustainable actions encompassing social, economic and environmental aspects, most respondents (86%) did not know about it. This tendency was also observed in each category of respondents, which indicates a general lack of awareness about the university's commitment to the environment and society.

The next question asked if respondents had contact with class, research, extension, or any other educational activity that influenced their energy efficiency behaviour. In total, only 26% said yes. The question asked to describe the contact, and 80 answers were investigated through content analysis by searching similar categories present in each response according to the main topics (class, research, extension or other). Responses connected to contact with class received 64% of the comments, including mainly mentions to academic disciplines in both undergraduate and graduate levels. Less comments were provided concerning actions related to research (9%) and extension (2%), and described experience in research and extension groups and activities. One quarter of the comments was classified as "other educational activity", since they encompassed experiences related to the contact with energy efficiency and change of behaviour through professional activities (inside or outside the campus), campaigns/courses developed by the university or by specific sectors, personal initiatives to learn more about the topic, the University Social Responsibility Policy, and university actions such as the investment in the Photovoltaic Solar Generation Park and the "academic weeks", where students can share their research experiences. These results illustrate that although UPF does not have a specific course on energy efficiency, other approaches are connected to this important topic.

The last question in this first section asked if respondents believe that the actions carried out by UPF contribute to raise awareness about energy efficiency in the academic community and 38% answered that strongly agreed with it, especially the category of staff (with 45%). These results demonstrate that all categories believe in the initiatives applied by the university, given the importance to the continuity of this work towards a green campus. In addition to pro-environmental attitudes being part of a person's beliefs, Kuo et al. [23] show that energy behaviour could be changed by designing interventions and strategies, including education, persuasion, incentivizing, correction, training, enablement, modelling, environmental restructuring and restrictions.

4.3 Behaviour at home/university

The second section was about the respondents' behaviour home and at the university. For the first question related to the use of electricity consciously, the answers are 45% usually—when the focus is the home practice, mainly by the students' category (49%); and, 49% always—when the focus is the university practice, mostly due to staff (62%) and professors' (also 62%) responses. It is possible to perceive that students do not always use energy consciously, neither at home nor at university, as shown in Fig. 3. Another question asked if the person turns off the lights when leaving empty rooms; most answers are always both at home (69%) and at the university (67%), demonstrating that this behaviour is common for students, professors and staff.

As shown in Table 2, in terms of behaviour, the highest mean (4.60) is for turning off lights when leaving empty rooms at home, followed by the same habit at the university (4.49). For this reason, it is possible to affirm that this attitude is the most common for the academic community.

4.4 Future practices

The last section of the questionnaire covered future practices at UPF. One initiative applied by the university is called Day "E", aiming to promote actions to change academic behaviour in relation to energy consumption, such as reducing the use of air conditioning, using natural lighting, and turning off the monitors when they are not in use, among others. The question asked if respondents would agree to participate in this initiative, resulting in 76% of "strongly agree" answers between students, professors and staff. Some other examples to improve this topic in a university are exemplified by Piccolo et al. [20], reporting a case study on collective intelligence tools to build knowledge on energy conservation. These tools can be useful to engage users, generate awareness and promote

Fig. 3 Frequency indicated by respondents to the behaviour section, regarding conscious use of electricity and the practice of turning off lights, at home at and the university

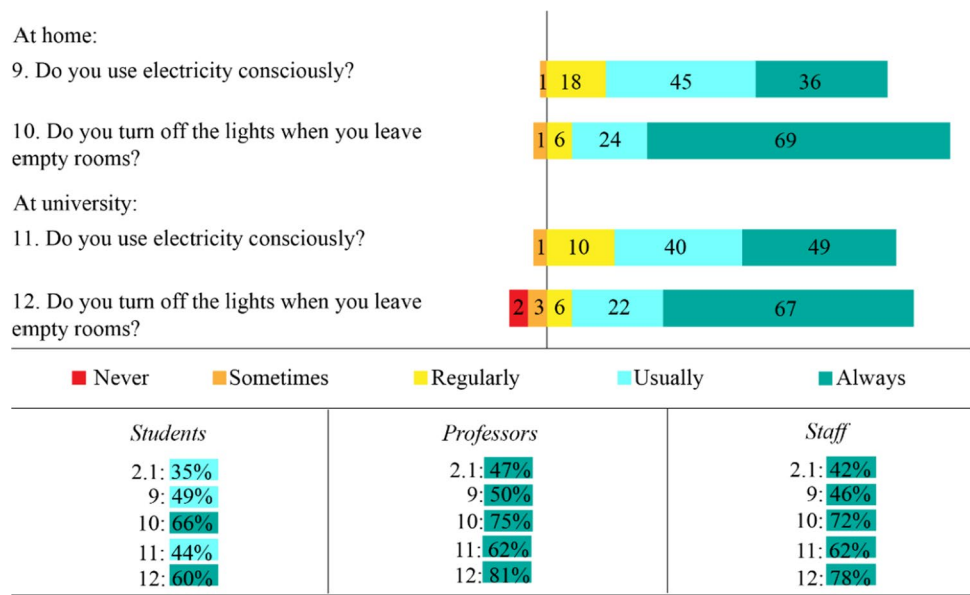


Table 2 Descriptive statistics for questions on behaviour (N=400)

	Mean	Std. Deviation
9. Use of electricity consciously at home	4.14	0.771
10. Turn off the lights when leave empty rooms at home	4.60	0.660
11. Use of electricity consciously at university	4.37	0.714
12. Turn off the lights when leave empty rooms at university	4.49	0.890

Table 3 Answers to the question 14: In your opinion, how can you contribute to the topic energy efficiency on campus together with UPF?

Options	Number of responses	Percentage of responses
Turning off lights when leaving rooms and/or bathrooms	371	93
Turning off the air conditioner when leaving the room and checking if the windows are closed when the air conditioner is on	357	89
Shutting down computers when leaving computer labs	315	79
Making others aware of the importance of the topic	303	76
Disconnecting the devices/machines when leaving the research labs	271	68

behaviour change. The study of Ishak [16] focused on developing energy consumption behaviour models and assessing potential energy savings, considering how important data on behaviour and consumption are to promote sustainability.

The final multiple-choice question asked about the opinion of respondents related to how they could contribute to the topic of energy efficiency on campus together with UPF. As shown in Table 3, most voted options are related to turning off the lights and air conditioning when leaving the room, and checking if the windows are closed when the air conditioner is on.

5 Discussions

The analysis of the questionnaire showed a lack of knowledge about energy efficiency initiatives at University of Passo Fundo, as reported by Marans and Edelstein [8] about the academic community being unaware of initiatives to promote energy conservation. Even though this result seems negative, the academic community believes that the actions carried out by UPF can contribute to raising awareness about energy efficiency among them. Comparing this information with respondents' behaviour, it is clear that the academic community has environmental awareness due to the rational use of electricity and turning off the lights when leaving empty rooms at the university. This finding is similar to the findings of Al-Naqbi [39], Casey and Scott [40], and Levine and Strube [41], who suggested that attitudes in benefit of the environment can be associated with higher education practices.

This research found that the campaign developed by UPF was not enough for the academic community's awareness of energy consumption behaviour. The campaign remained known just by staff and it was inconclusive for professors, not affecting the students. In this sense, this paper suggests the increase of publicity regarding UPF's initiatives towards energy efficiency. Other researches [7, 42] reinforced the importance of an "active intervention strategy" such as student engagement projects and collective "holistic" campaigns with interventions focusing on achievable behaviours that students can have control over. In addition, it is important to give feedback displays about the importance of interventions and behaviours so people can feel they are part and responsible for this change, motivating them to always do more [13, 15, 43]. This theory comes along with Blake's affirmation [44] that people can only act pro-environmentally when they perceive they can change the situation.

Cotton et al. [45] affirmed that a university may be engaging with exceptional energy-saving measures on campus, but efforts go unseen by students or "mixed messages" may undermine efficacy. In this way, Carrico and Reimer [6] and Bulunga and Thondhlana [18] suggested that effective approaches to promote energy efficiency are peer education and group-level feedback provided promptly and regularly. These theories reinforce the university needs to think in a solution that not only gives feedback for the academic community about its initiatives toward energy efficiency, but also educates and increases their awareness on the topic and how they can contribute more on campus to achieve sustainability.

Given that just a few people (26%) had contact with energy efficiency topics in class, research, extension, or other educational activity, it is clear the need for a solid relation between curriculum and sustainability. Regarding this importance, Leal Filho et al. [46] suggested that integrative approaches ensure that sustainability permeates all aspects of university business and synergies are created. Because of this result, creating a course with energy efficiency topics (to improve general awareness) in the curricula, not only in science and engineering courses, would be important to implement and disseminate energy efficiency practices among students and teachers.

Previous researches also raised issues around communicating sustainability within the university environment, such as Djordjevic and Cotton [47] and Cotton et al. [48]. They conclude that there are some barriers to effective communication, suggesting greater efforts to link formal learning daily life to enhance awareness of how individuals use energy in everyday practices, such as educational initiatives with more lifestyle-related interventions. That would be useful in the current situation perceived in this case study.

Although the University of Passo Fundo has formulated the University Social Responsibility Policy document for the years 2012–2016, and then for the years 2017–2021 - with guidelines to implement sustainable actions encompassing social, economic and environmental aspects, the academic community (86%) answered not knowing about it. This finding shows the same as Leal Filho et al. [49], as the existence of environmental policies is not a precondition for universities to actually engage in sustainable development, but it has more probability to include it in the curriculum and joint it in local and regional activities.

Even though people affirm they can contribute individually towards energy efficiency, they also believe (76%) they can make others aware of the importance of the topic. To enhance this solution, universities need to strengthen teachers, staff and students' capacities to apply an integrative approach to sustainability [50]. In the same way, the results make clear that the knowledge of ecological processes and situations can influence people; however, they can be more efficient when people change behaviour to achieve sustainability [51].

6 Conclusion

This paper assessed the awareness of the academic community of University of Passo Fundo on recently implemented energy efficiency initiatives and whether they think these initiatives may support behaviour change.

The results show that the initiatives applied by the university towards energy efficiency were, in general, not known by the academic community. The most known practice was the Photovoltaic Solar Generation Park, with 62% of positive answers, followed by the use of more efficient lamps in the main street of the campus and by the campaign “Be aware and help take care of our environment”, both with 44% of positive responses. The least known practices were the use of more efficient lamps in the library, the purchase of electricity from the free energy market and the implementation of the University Social Responsibility Policy, with only 25%, 19% and 14% of positive answers, respectively.

On the other hand, the academic community believes that the actions carried out by UPF can contribute to raising awareness about energy efficiency among them. 69% of the sample reported agreeing or strongly agreeing with this contribution. These results show that the university should invest more in its energy efficiency actions but always trying to connect these with the academic community and highlighting their importance for the success of the practices and for a more sustainable culture on campus.

The awareness about the university initiatives and the opinion of the respondents concerning the contribution of these initiatives to their knowledge on energy efficiency support the conclusion that UPF should invest more on making their practices more visible to the academic community. During the last years, many advances have been performed, which is certainly positive in terms of sustainability and contribution to energy efficiency and renewable energy. However, in addition to investing in campus operations, the university should pay more attention to education for sustainable development, therefore increasing awareness on the topic of energy efficiency on campus. Having more students, professors and staff aware of the importance of these actions may contribute to more sustainable actions also outside the university.

The contribution of this paper is towards the understanding that the academic community needs to feel part of the energy efficiency practices to increase their awareness on the topic and be potentially led to behaviour change. A university campus needs to not only have the action done, but also show to students, professors and staff how important the initiative is and how they are part and can contribute more to it.

The experience presented in this paper is useful to other universities which may have the same situation and could take advantage of existing practices by sharing more about them with their academic community. Universities which are now planning to invest more in energy efficiency or renewable energy on campus or are starting to do so, can also learn from this experience and include in their strategy more dissemination and awareness activities connected to the energy initiatives.

The data presented in this paper is limited to the sample of respondents of the case study university. Other limitations include the sample size and the methods adopted. However, the results allowed discussion on the importance of connecting energy efficiency initiatives to the academic community’s behaviour (and especially on the importance of making these initiatives more visible). Future studies may use additional methods to assess the influence of the practices in actual change of behaviour.

Funding Not applicable.

Data availability The datasets generated during the current study are available from the corresponding author on reasonable request.

Code availability Not applicable.

Declarations

Ethics approval and Consent to participate The questionnaire and methodology for this study was approved by the Ethics Committee in Human Research of the University of Passo Fundo, Brazil (Ethics approval number CAAE: 09235319.0.0000.5342). Informed consent was obtained from all individual participants included in the study.

Competing interests The authors declare that they have no conflict of interest.

Appendix A: summary of the online survey

Energy efficiency initiatives	1. UPF has a Photovoltaic Solar Generation Park with 54 panels and has a total energy generation potential of 2,300 kWh / month, located in front of the law building, near CETEC. Did you know that the park was implemented and started operating in May 2018?	() Yes () No () N
	2. In the year 2018 UPF started the campaign "Be aware and help take care of our environment" through the publication of a folder in the units and via e-mail for students and staff of the institution. Did you know about this campaign?	() Yes () No
	2.1 If so, have you changed your behaviour to reduce energy consumption after the UPF campaign: "Be aware and help take care of our environment"?	Likert Scale for frequency*
	3. The main street lighting of Campus I was replaced in the year 2018. Existing sodium lamps were replaced with LED lamps. Did you know about this initiative?	() Yes () No
	3.1 If so, do you agree that replacing lamps on the main campus avenue has improved visual quality and safety?	Likert Scale for level of agreement**
	4. The library lighting was also changed in 2017 by replacing sodium lamps with LED lamps. Did you notice this change?	() Yes () No
	4.1 If so, do you agree that your visual comfort has improved after replacing library lighting?	Likert Scale for level of agreement**
	5. The free energy market is the possibility of acquiring electricity from a renewable source of energy and also of hiring the supplier that best meets consumer and financial needs. In October 2018, did you know that UPF started buying electricity through the free energy market?	() Yes () No
	6. The UPF formulated the University Social Responsibility Policy document for the years 2012–2016, and then for the years 2017–2021, with guidelines to implement sustainable actions encompassing social, economic and environmental aspects. Do you know this document?	() Yes () No
	7. Do/Did you have contact with class, research, extension, or any educational activity that influenced your energy efficiency behaviour?	() Yes () No
	7.1 If so, please describe:	(open space for response)
	8. Do you believe that the actions carried out by UPF contribute to raising awareness about energy efficiency in the academic community?	Likert Scale for level of agreement**
Behaviour	At home:	
	9. Do you use electricity consciously?	Likert Scale for frequency*
	10. Do you turn off the lights when you leave empty rooms?	Likert Scale for frequency*
	At university:	
	11. Do you use electricity consciously?	Likert Scale for frequency*
	12. Do you turn off the lights when you leave empty rooms?	Likert Scale for frequency*

Future practices	<p>13. The university intends to reserve one day a month, Day “E”, which promotes actions to change academic behaviour in relation to energy consumption, such as avoid turning on the air conditioning, use natural lighting, turn off the monitors when they are not in use, etc. Do you agree to participate in this initiative?</p> <p>14. In your opinion, how can you contribute to the topic energy efficiency on campus together with UPF?</p>	<p>Likert Scale for level of agreement**</p> <p>() Turning off lights when leaving rooms and/or bathrooms</p> <p>() Shutting down computers when leaving computer labs</p> <p>() Disconnecting the devices/machines when leaving the research labs</p> <p>() Turning off the air conditioner when leaving the room and checking if the windows are closed when the air conditioner is on</p> <p>() Making others aware of the importance of the topic</p>
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* Never, Sometimes, Regularly, Usually, Always ** Strongly disagree, Disagree, Undecided, Agree, Strongly agree.

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