



## The Theory of Planned Behavior model and students' intentions to use bioenergy: A cross-cultural perspective



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### ABSTRACT

The present study tested the Theory of Planned Behavior (TPB) model in explaining high school students' intentions to use bioenergy in Finland and India. Data were collected from 402 Finnish and 130 Indian students studying in the ninth and tenth grades in nine schools. Structural Equation Modeling was applied to test the TPB model. The results revealed that the construct 'Attitude' had the strongest and statistically significant positive effect on the students' intentions to use bioenergy in a cross-cultural setting and also within the Finnish context. The other constructs such as 'Subjective Norm' (SN) showed the second most positive effect on intention, whereas 'Perceived Behavioral Control' (PBC) had a negligible effect on 'Intention'. However, SN was the only construct that had the strongest and statistically significant positive impact on the Indian students' intentions to use bioenergy. The results indicated the applicability of the TPB model in explaining students' intentions to use bioenergy in a cross-cultural context. Future studies could use an extended TPB model by including additional socio-psychological and contextual variables in explaining young students' renewable energy-related behavioral intentions.

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### 1. Introduction

Global energy consumption has been on the rise despite strong evidence of mounting international concerns over climate change and increasing use of fossil fuels. Some recent studies have further anticipated a substantial intensification in the energy consumption over the coming decades [1,2]. Amidst this energy scenario, two of the most challenging tasks are to reduce the consumption of fossil fuels and increase the use of renewable energies (REs). Concerted global efforts are needed to implement both the tasks at a greater pace to mitigate climate change and address several impending energy related issues. Although a primary concern will remain over the increasing consumption of fossil fuels, the silver lining lies in the fact that the usage of REs has been growing significantly, a trend that is expected to continue in the future [1]. Among various REs (e.g., solar, wind, hydro, biomass, and geothermal), the use of biomass for cooking and heating is the oldest practice, and it is still prevalent in many regions of the world. However, the modern use

of biomass for heat, electricity, and transport fuel is also gaining momentum in a number of developed and developing countries. It has been predicted that the consumption of bioenergy will rise by three-folds by 2040, and advanced biofuels would be able to address much of the concerns related to the sustainability of the conventional biofuels [2]. There is a consensus that apart from technological and economic factors, various social dynamics also influence the development of various RE technologies [3] and, therefore, these factors likely to determine the projected growth in biofuels in the future. One of the important social factors is public acceptance of biofuels as a viable alternative to fossil fuels in this regard and much of the public recognition, on the other hand, depends on their perceptions and attitudes related to biofuels that could significantly vary across countries.

Frewer et al. [4] have claimed that technological development and application mostly relies upon public attitudes to it. Wüstenhagen et al. [5] have also stressed that technological solutions must be in parallel with social ones, and new energy infrastructures would have to be acceptable to the consumers. In this regard, application of social science methods can be extremely helpful in understanding human behaviors in energy and climate change related issues [6]. However, different energy sources and

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related technologies have been found to carry various environmental and health risks, which often contribute to the difficulty of making individual and societal decisions on those technologies [7,8]. Therefore, other than fossil fuels and nuclear energy, the low public acceptability of REs in many places can hinder their wider development and implementation [9,10]. It has been argued that bioenergy related developments will be greatly influenced by its stakeholders' awareness of the consequences of using bioenergy as an alternative to fossil fuels [11]. However, the increasing usage of bioenergy to mitigate climate change can also pose significant risks to the environment and society in spite of its promise of a sustainable development [12]. In this regard, a considerable number of studies have investigated the social context related to bioenergy from the perspectives of different stakeholders such as policy-makers, biofuel industries, civil society organizations, biomass producers, academia, and the general public [13]. Among these diverse groups, some authors have studied school students' perceptions and attitudes related to bioenergy from a cross-cultural perspective [14,15] to understand the future directions in the social acceptance of bioenergy among young generations in different countries. It is believed that young students' attitudes to adopt the RE technologies would be a key driver towards the RE transition as they are the future users of different RE options such as bioenergy. Thus the inclusion of school students' perceptions and attitudes related to bioenergy appears to be crucial to any study dealing with bioenergy's future since students, who are perceived as the leaders of tomorrow, are at the juncture of consolidating their habits and behavioral patterns [16,17]. Therefore, this study focuses on school students' intentions to use bioenergy from a cross-cultural perspective.

### 1.1. Students' perceptions and attitudes related to renewable energy

School students' knowledge, perceptions, and attitudes related to energy and environmental issues have been studied extensively by researchers over the last decades. Some of those studies are related to exploring pupils' energy literacy, attitudes to energy, and energy saving behaviors [18–23]. Others have reported students' awareness, perceptions, and attitudes regarding different energy sources such as REs and nuclear energy. Since a comprehensive review of both of these studies is beyond the scope of this paper, this section aims to focus chiefly on the studies that are closely linked to different RE sources including bioenergy.

Despite a growing consensus on the importance of educating students about REs, research on students' perceptions and attitudes related to them are not many to date. In this regard, Kılınc et al. [24], for instance, reported mixed perceptions of REs among 13–14-year-old-school students in Turkey. In one hand, the Turkish students perceived that REs could contribute towards reducing greenhouse gasses as well as they would also be cheaper than other energy sources. On the other hand, they also perceived that the RE technologies would have some adverse impacts on humans and other living organisms. In another study, Çoker et al. [25] found that the Turkish primary and secondary school students had difficulties in differentiating between REs and non-REs, whereas only a handful of those students were able to recognize wood as a source of energy. In a study from Jordan, Zyadin et al. [26] also reported Jordanian school students' limited ability to distinguish between REs and non-REs even though the students demonstrated positive attitudes towards adopting REs. Most recently, in another study from Turkey, Çelikler and Aksan [27] found several misconceptions about REs among school students who also demonstrated somewhat negative attitudes towards REs. Their study suggested the fact that only a small number of the students were able to recognize biological materials as a source of energy.

It appears that studies primarily focusing on students' perceptions and attitudes related to bioenergy have been evolving over the recent years though their number is still small. In this direction, Halder et al. [15,28] studied ninth grade school students' knowledge, perceptions, and attitudes related to bioenergy based on the data collected from Finland, Taiwan, Turkey, and Slovakia. They found a moderate to low level of knowledge related to bioenergy among the students in these countries, and the students showed negative perceptions of forest-based bioenergy production, whereas their attitudes to bioenergy, in general, were positive. In another study, Kapasaa et al. [29] pointed out Greek secondary school students' lack of knowledge of bioenergy feedstock even though the students recognized the benefits of using bioenergy for limiting the use of fossil fuels and reducing the emission of greenhouse gasses. Evidence from these studies indicate that gender differences in school students' knowledge, perceptions, and attitudes related to bioenergy appeared to be somewhat diverse. For instance, Halder et al. [15] did not find significant gender differences related to the students' knowledge and attitudes concerning bioenergy, whereas perceptions of bioenergy significantly varied between the male and female students. The study by Kapasaa et al. [29] also revealed significant gender differences among the Greek school students' knowledge, beliefs, and attitudes related to bioenergy. Though the studies mentioned above provide valuable insights into school students' perceptions and attitudes related to bioenergy, there is a significant gap of understanding between students' attitudes to bioenergy and their future intentions to use it. This study, however, argues that such gaps can be bridged if young students' RE related intentions are mapped by the Theory of Planned Behavior (TPB, Azjen [30]) model. Therefore, the paper applies the TPB model to explain Indian and Finnish school students' intentions to use bioenergy from a cross-cultural context.

### 1.2. The Theory of Planned Behavior (TPB)

The TPB is one of the most widely cited and applied theories that explains human behaviors through a cognitive approach, which center on their attitudes and beliefs [31]. TPB, which originated from the Theory of Reasoned Action [32], claims that an intention to act is the best predictor of behavior as intentions capture motivational factors that influence behavior [30]. In the TPB model, the intention to act is primarily determined by three following psychological constructs: Attitude towards the behavior, Subjective Norm (SN) and Perceived Behavioral Control (PBC) [30]. Attitude refers to an individual's positive or negative evaluation of a given behavior and its expected outcomes. SN refers to a person's "perceptions of the extent to which significant others would endorse a given behavior and personal motivations to comply with this social pressure" [33]. PBC refers to the perceived ease or difficulty of engaging in the behavior, which indicates an individual's control over performing a behavior [34]. It needs to be mentioned that no socio-demographic variables are included in the TPB model as it is assumed that such structural variables influence intentions and behaviors indirectly, through the TPB constructs [35].

In recent years, the TPB model has been used widely in predicting school students' pro-environmental intentions and behaviors [36], University students' recycling intentions and behaviors [37], and their purchase plans of organic food [38]. The TPB has also been applied to predict adults' use of the car in commuting and their plan to reduce it [39], and their choice of transport modes [34]. In specific energy-related issues, the TPB framework was applied to explain adults' energy conservation behaviors [33,40,41] and their acceptance of RE technologies [42]. Additionally, it was used to explain public intentions towards afforestation and carbon reduction [43], and private forest owners'

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