The Environmental Cost of Digital Consumption: A Study of Highschoolers in India and Singapore

Medhansh Bhatia*

International Baccalaureate Diploma Programme (IBDP) Year 1 student, NPS International School in Singapore.

*Corresponding Author: medhansh0429@gmail.com

Citation: Bhatia, M. (2025). The Environmental Cost of Digital Consumption: A Study of Highschoolers in India and Singapore. International Journal of Innovations & Samp; Research Analysis, 05(03(II)), 109–121. https://doi.org/10.62823/ijira/5.3(ii).7998

ABSTRACT

Digital consumption refers to the aggregate of entertainment and information media consumed by an individual. It is the way individuals access, engage with, and utilize digital media and technologies in their daily lives. It includes a wide range of activities such as streaming content, social media interactions, online shopping, information consumption and app usage. In today's world, digital consumption is an essential part of an individual's existence. We exist in an interconnected and highly digital world. Digital consumption contributes to rising energy demand through energy consumption at data centres and device usage by billions of users. These activities further drive carbon emissions and e-waste. All online activities, whether it is sending e-mails, attending video calls, playing games or engaging in online shopping have a carbon footprint, about which many people are unaware. Our digital consumption habits have a large contribution in climate change and resource depletion.

Keywords: Environmental Cost of Digital Consumption, Highschoolers, Climate Change, e-Waste.

Introduction

A few studies have been conducted on the environmental impact of Edtech, awareness levels of young consumers regarding carbon emissions, study of behaviour patterns of students when they are made aware of environmental impact of excessive consumption, etc. But there has not been any study that directly links the level of awareness that persists amongst high school students regarding digital consumption habits. Moreover, no cross-country study exists that covers this demographic in Singapore and India. Hence, this primary research based study is unique and covers this particular gap in the research in the field of digital consumption.

Our digital consumption starts at a very young age, depending upon factors like the availability and cost of the technology in the country. High schoolers are students studying in grades 9 to 12 in schools. This group of students/youngsters has become a large consumer of smartphones and other digital devices across the world. The highschoolers are generally more aware of the latest technology, they use digital devices for entertainment and educational purposes. Those aged between 13 and 19 are spending almost 8.5 hours on average daily using their electronic devices in Singapore.²

Teens typically use a variety of screens daily for education or work, entertainment, social networking, health and fitness and shopping. In comparison to other age groups, teens are more likely to be aware of the environmental costs of digital consumption than younger children and older adults, due to their greater exposure of Sustainable Development Goals, which is part of curriculum across the world. Governments around the world have started to educate school going children about the issues causing

^{*} Copyright © 2025 by Author's and Licensed by Inspira. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work properly cited.

pollution and climate change, as rising global temperatures and climate change risks have increasingly affected the countries around the world. Despite teens becoming aware of the common reasons for pollution, there is a gap in the knowledge of the effects of digital consumption.

The purpose of this article is to investigate the level of awareness of high schoolers, primarily in Singapore and India. Teens or students between the ages of 13-19 years demonstrate a vast demographic in both India and Singapore, and this demographic's level of awareness regarding environmental cost of variety of activities is crucial as this is the generation which is going to lead the future of this world. Since this generation is spending a good amount of time every day and are generally having an inelastic demand for the consumption of social media, games, or using gadgets for academics – it provides an interesting area to undertake research. "As more aspects of life and business become digitalized, the digital carbon footprint has become a significant concern. This is due to its significant contribution to climate change in the context of global warming."

Literature Review: Environmental Sustainability in Digital Education

The intersection of educational technology (EdTech) and environmental sustainability has garnered increasing scholarly attention, revealing both promise and peril. Shengjergji et al. (2024) underscore the hidden ecological costs of EdTech, including energy-intensive data centers, Al-driven carbon emissions, and mounting e-waste. Their call for sector-wide collaboration and eco-certification standards reflects a growing urgency to reconcile digital innovation with environmental stewardship.

Nam and Lee (2021) advocate for student-led climate education, positioning learners as active agents in shaping sustainable futures. This participatory model aligns with Nusche, Fuster Rabella, and Lauterbach's (2024) emphasis on localized, cross-disciplinary learning as a lever for systemic resilience in education systems.

Empirical studies on student awareness and behaviour reveal a persistent value-action gap. Saro et al. (2025) and dela Peña et al. (2018) document high levels of environmental awareness among high school students, but they note that limited translation of this awareness takes place into proenvironmental behaviours. Barrett and Cheung (2021) suggest that localized, affective education programs may enhance behavioural outcomes, while Altin et al. (2014) highlight the need to identify mediating factors that influence sustainable action.

Van Huu et al. (2024) apply the Theory of Planned Behaviour to show that digital accessibility and social norms significantly shape students' green consumption behavious and habits. Hajj-Hassan et al. (2024) further validate the efficacy of digital tools in fostering sustainability awareness, though Brzyskiewicz et al. (2025) caution against techno-solutions mindsets, urging school leaders to adopt ethically reflective practices.

A systematic review by Firmanshah et al. (2023) integrates environmental knowledge, attitudes, behaviours, and awareness, revealing complex interdependencies often overlooked in prior research. Their inclusion of awareness as a distinct variable marks a theoretical advancement in environmental education literature.

Despite rich insights, several gaps persist. There is limited data on how digital sustainability education influences long-term behavioural change. The role of cultural and socioeconomic contexts can be explored in understanding the level of awareness of students. A primary research-based exploration, targeting the high school students across two diverse socio-economic backgrounds, Singapore and India, is undertaken by preparing a google form asking them questions about their level of awareness of environmental cost of digital consumption, behaviour with respect to digital consumption and devices and their openness to changes in these attitudes. This will help to analyse the high school students' awareness and compare the results from Singapore and India.

Many countries around the world have also understood the problems that may arise by higher consumption of digital devices by children including teens. Countries like China and Australia have recently formulated new laws to deal with the dangers of rising use of digital devices, by restricting the number of hours of daily use for children under the age of 16.4

The use of digital devices by teens presents a variety of problems and opportunities. Since the use of digital devices is indispensable for teens, it is imperative to understand about their level of awareness regarding its environmental costs.

Methodology

Current study uses both primary and secondary data sources. Since the researcher has hometown in Delhi (India) and studied in Singapore, the idea of undertaking a comparative study between an emerging country and a developed country was conceptualized.

The study encompasses high school students studying in both public and private schools in India and Singapore. The primary data has been collected by devising a structured questionnaire using close ended questions on google forms and circulating through social media. It can be considered as convenience sampling, since friends and family were tapped in to help gather the information from respondents. The data has been collected in Singapore and Delhi (India) during two-month time frame (July-August 2025) by approaching more than 300 high school students. Data of 207 respondents was gathered during this time frame, which required sending them reminders through email and other forms of communication. Collected data was collated in excel and analysis has been undertaken to derive meaningful conclusions.

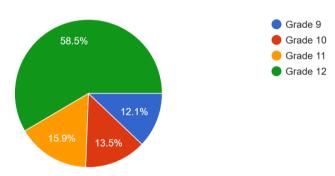
Initial Data Statistics

Primary research has been conducted using the collection of responses from 200 plus respondents. About 40% of respondents belonged to Private and public schools in Singapore and remaining 60% of respondents are from Indian schools.

The profile of the respondents is presented below:

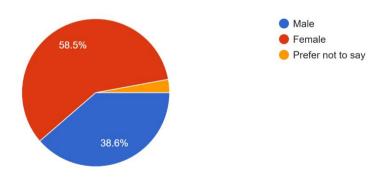
Grade level at School

207 responses

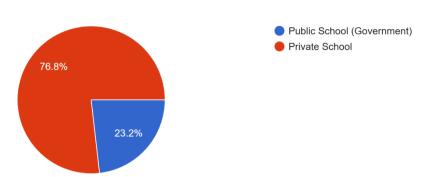


Majority of respondents are females accounting for almost 59% of the total number of respondents, while about 39% were male participants.

Gender 207 responses



Type of school 207 responses



Though the target of the research was to get equal representation from public and private schools, three quarters of all respondents were students in private or international schools. This can be relevant as public/government school students generally belong to the not so affluent section of society and the respondents from these schools may not have equal access to digital media and gadgets.

Results

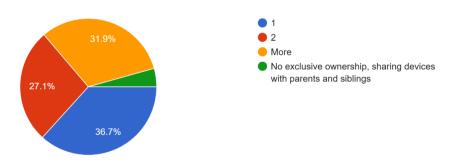
The findings of the primary research can be primarily clubbed into 5 categories.

Number of Devices Owned

Most respondents, about 37%, owned one device – smartphone. While about 27% of respondents had ownership of two devices. A vast number of respondents, approximately 32%, owned more than two devices. Only a very small number of respondents, about 4%, did not own an exclusive device but shared the device they used with their parents and siblings. Upon analysis of the respondent's data, it was found that most of the students who belonged to public/government schools in India were not having exclusive ownership of the devices. Furthermore, out of this subset of respondents, greater number of respondents belonged to grade 9, as they were still young and were not given an exclusive device by parents due to various factors. One main factor that may have affected the ownership pattern can be the income level of parents of these children studying in government schools in India.

Those who owned more than two devices, that is about 32% of respondents, almost all belonged to private schools.

Number of devices owned. Devices can be smart phones, tablets, laptops, personal computers. 207 responses



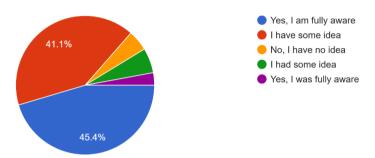
Awareness of energy consumption impact of everyday online activities

While about 46% of the participants claimed that they are fully aware about the impact of online activities like uploading files, streaming videos and sending emails on energy consumption, there were also 41% of respondents who had some idea of the same. Hence it may be concluded that most of the participants (about 87%) from both the countries were aware about the energy consumption of common online activities.

A digital carbon emission or footprint⁵ refers to the environmental impact of digital technologies and activities. This includes the energy consumption, greenhouse gas emissions associated with using devices, data centres, and accessing online services. It encompasses factors such as electricity usage by data centres, manufacturing and disposal of electronic devices, and emissions from internet infrastructure.

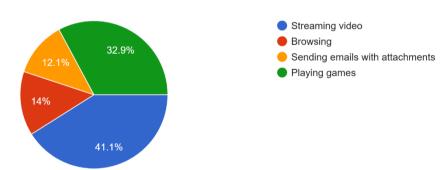
Are you aware that everyday online activities like uploading files, streaming videos, and sending emails consume energy and contribute to digital carbon emissions?

207 responses



On the question aimed at assessing the awareness of the participants regarding which digital activities cause the greatest level of emission – 41% of the participants were of the opinion that streaming videos causes highest level of emissions and energy consumption. About 33% of the participants viewed playing videos as the activity having highest impact on environment. Sending emails with large attachments was viewed as having highest energy consumption by 12% of the respondents and 14% of the respondents felt that browsing

Which digital activities cause more emissions? 207 responses



"Organizations and individuals are increasingly focusing on reducing their digital carbon footprint. They are adopting energy-efficient technologies, optimizing data centre operations, and promoting sustainable practices in digital consumption and production." ⁵

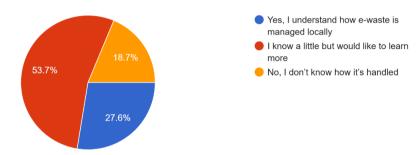
Awareness of disposal of electronic waste

Most study participants had some idea of how electronic waste like old laptops, phones, batteries are collected, processed or recycled. But close to 19% of the participants did not have an idea how e-waste is collected or recycled. While greater number of participants from Singapore had an idea about this, due to the greater amount of government efforts in this regard, most of the participants who were unaware were from India. This is reflective of the fact that the National Environmental Agency of Singapore undertakes periodic collection drives which are closer to the residents. This plays a huge role in not just generating greater awareness, but also makes more residents participate in the collection drive and make it more accessible to them.

In Delhi, the challenge of e-waste is particularly acute. As Delhi generates 152000 metric tonnes of e-waste every year, due to its high population density, quite a lot of it ends up in informal recycling sectors or landfills, where it's not treated properly and contributes to generation of excessive pollution and environmental degradation. According to some estimates⁶, it results in losses of around \$57 billion worth of valuable and critical metals, without considering the huge environmental cost which is extremely difficult to estimate.

Are you aware of how electronic waste (e-waste)—like old phones, laptops, or batteries—is collected, processed, or recycled in your area or country?

203 responses



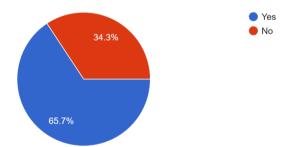
The survey results point to the need for a greater role and responsibility of the state and central government that can create greater awareness amongst the population. The state government can work towards creating greater awareness and opportunities by including the importance of sustainability in the school curriculum. When the subject of e-waste disposal is introduced in the curriculum, it will positively affect the behaviour of not just school going kids but also their family members.

Awareness of carbon emissions of online activities

Though two-thirds of respondents were aware of the impact of video gaming using electronic devices on emission of greenhouse gases, they had little idea about the extent of the same.

Did you know that one hour of video gaming—depending on the device and energy source—can produce measurable greenhouse gas emissions?

207 responses

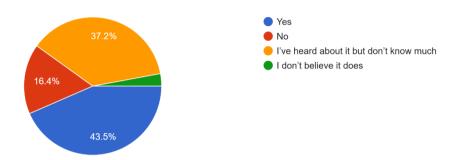


Similarly, about 80% of students had an idea about the emission of greenhouse gases due to use of AI tools like chatbots, chatgpt, copilot, etc – but around half of these just had a vague idea about it. It was observed that in general there is a little awareness of the negative impact of excessive use of digital devices on the environment.

Moreover, about 17% of the students had no awareness about the same. Most of the students who lacked awareness belonged to the sub-group of young high-schoolers, namely grade 9 and 10 students; and some who belonged to the public/government school system. This can be attributed to the fact that many students attending government schools in India belong to low income group, and have family members who had limited access to education. This gets depicted in their overall low levels of awareness about many important aspects of life.

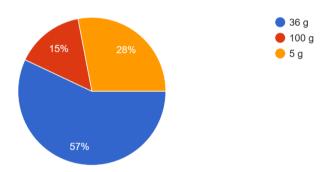
Did you know that using AI tools (such as chatbots, image generators, or recommendation engines) consumes energy and contributes to CO2 emissions?

207 responses



A majority, 57% of respondents, gave the response that standard definition streaming for one hour leads to 36 grams of carbon emissions. This depicts a good level of awareness in high schoolers. While a significant number of respondents, 28%, underestimated the emissions to be just 5 grams. It may be concluded that majority of respondents had an idea about the negative impact of video streaming.

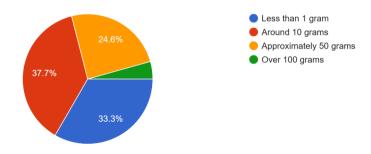
Provide approximate carbon values per hour of streaming 207 responses



The awareness in high schoolers regarding the environmental cost of asking a simple AI prompt isn't high. While one-third of participants were close to the actual cost of less than one gram of emissions, many have no knowledge about the same and largely overestimated it. About one in twenty-five respondents believed the environmental cost to be over 100 grams.

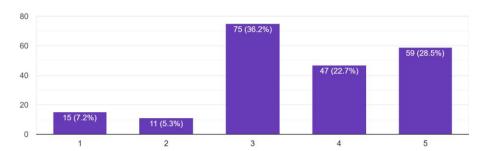
How much carbon dioxide (CO2) is approximately emitted when an AI model answers a single prompt?

207 responses



Do you believe that digital carbon emission is more harmful relative to other activities. Five star indicates highest significance.

207 responses



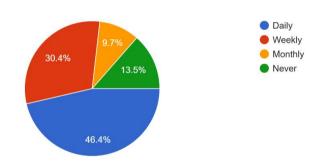
Of all the respondents, 59 students were of the view that digital pollution is more harmful than other forms of pollution. There is no evidence about the same.

Behaviour around consumption of digital content and devices

A vast majority of respondents are regular consumers of HD video streaming. About 46% of respondents claimed that they stream HD videos on their devices on a daily basis, another 30% of respondents use it weekly. Only 13% of respondents have claimed to have never used the service on their mobile devices. Upon analysis it was found that most of these 13% of respondents were from grade 9, and had limited data availability or greater parental controls on their devices.

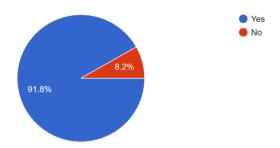
How often do you stream HD video?

207 responses



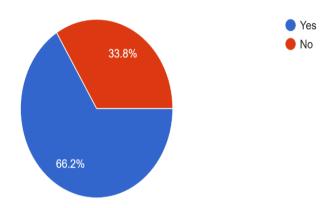
A vast majority of respondents, about 92%, said they keep their devices for longer than two years. Only 8% of high schoolers said that they change their devices before 2 years. The reason behind this is most likely difference in income profile of their parents, which allows them to spend greater amount of money on digital devices and latest technology.

Do you keep using your devices longer than 2 years? 207 responses



About two-thirds of respondents claimed that they reduce the video resolution to save energy/data, while one-third of respondents did not do that. This comes from all backgrounds, such behaviour relies more on awareness of the environmental cost and also from the awareness of higher monetary cost in terms of data usage.

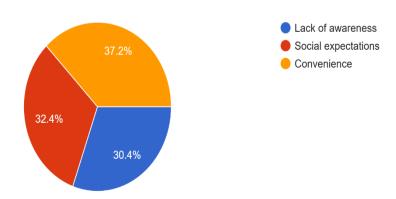
Digital minimalism: Do you reduce video resolution to save energy/data? 207 responses



More than one-third of high schoolers were not willing to reduce the HD resolution of data streaming due to convenience. Another one-third cited social expectations like staying up to date on social media as a reason for not being able to reduce digital usage. While lack of awareness accounted for about 32% of respondents.

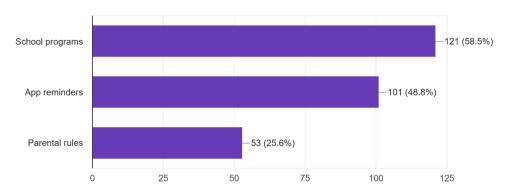
What stops you from reducing digital usage?

207 responses



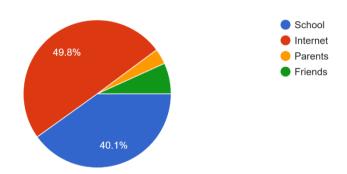
Since most high schoolers display an addiction for their electronic devices, they also acknowledge the fact that they cannot control their consumption of content and games without external intervention. Majority of respondents (58.5%) believed the school programs can help them alter their habits and help reduce their digital carbon footprints, while about half of the respondents felt that app reminders can play an important role. As the respondents chose multiple options, many believed that a combination of school programs, app reminders and parental rules can be used collectively to help them reduce their digital consumption and hence emissions.

What would help you reduce your digital carbon footprint? 207 responses



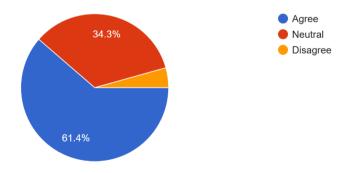
Almost half of the participants gained awareness regarding environmental impact of consumption of digital devices from internet, while 40% of respondents learnt about the same from school.

Where did you learn about digital environmental impact? 207 responses



A little under two-thirds of respondents showed willingness to adopt changes in their habits like switching to low-resolution streaming. This shows willingness to adapt to the changes when this demographic is made aware of the impact of their consumption habits.

Are you willing to adopt behavior changes like low-resolution streaming? 207 responses



Discussion

The level of awareness of the respondents is mixed from both the countries, yet promising. As Singapore is ahead of India, in terms of environmental awareness and government policy implementation as a significant number of Singapore students report being "fully aware" of digital carbon emissions and e-waste issues, especially in Grades 11 and 12. However, still some students in Singapore fall into the "I have some idea" or "I've heard about it but don't know much" categories—indicating room for deeper conceptual understanding. This can be done by implementing even greater changes in the curriculum where it is explicitly taught. Even those who have an idea about digital emissions, few take effort to adopt digital minimalism, due to various social and behavioural factors like convenience and social expectations.

Students provided a range of carbon values for streaming and Al usage—from 5g to over 100g per hour—suggesting lack of standardized knowledge. This presents an opportunity to teach them about digital product's lifecycle analysis and data centre energy consumption. Students also recognised the role of educational institutions in terms of helping them correct certain behavioural practices. This suggests that structured interventions can be highly effective and should be implemented. There may be an initial resistance from the students, but they would adopt the changes when the purpose is made clear to them. Educators can also reinforce the idea of recycling and refurbishing digital devices by undertaking specific programs like lessons on repair culture and circular economy principles can be integrated into the curriculum. This will help enhance the acceptability of using older devices, as many times young demographic is influenced by demonstrative effects of consumption. Modules on digital carbon footprints, e-waste, and energy use can be integrated into ICT, Business Management, and Environmental Systems courses. Integrating digital sustainability into the curriculum will benefit society and environment. Student led programs of repairing and refurbishing old devices can be beneficial.

Creating school-wide initiatives where students can track and reduce their screen time or emissions for a week or fortnight. Incentives may be offered for participation and reflection, linking it to CAS in the IBDP curriculum or service learning. Including sustainability criteria in tech purchasing decisions for labs and classrooms can reinforce the behaviour amongst students.

Government's effort to mandate Carbon Labelling for Digital Services can help influence the behaviour across demographics. Advocacy/pressure groups can also influence the social media and entertainment platforms (e.g., YouTube, Netflix, AI tools) to display estimated carbon emissions per hour of use. This information and transparency can empower students to make informed choices.

Singapore's Ministry of Education (MOE) has integrated sustainability principles into its EdTech strategy, including energy-efficient infrastructure and promoting digital minimalism in classrooms. Schools are encouraged to use cloud-based platforms with lower energy footprints. Teachers' active participation in encouraging students towards digital minimalism can be quite fruitful. Educational institutions follow strict guidelines for purchasing energy-efficient devices and services. Vendors are required to meet sustainability benchmarks, like offering e-waste takeback programs and lifecycle carbon disclosures. Secondary and post-secondary students engage with modules on digital carbon footprints, Al energy use, and ethical tech consumption. These are often integrated into subjects like Computing, Geography, and Environmental Science.

Though India's National Education Policy (NEP) 2020 promotes digital literacy and environmental awareness, but digital sustainability and awareness is far behind that in India. There are few procurement policies for energy-efficient educational tech. Handful of school-level initiatives are present that link digital behaviour to climate impact. However, India is strengthening ties with Singapore to learn from its tech and education models—so there's real potential for these practices to be adapted in India soon.

Unlike Singapore's centralized education system where MOE has a direct control over policies and practices followed in schools, India's policies vary widely across states and boards. Since there is no unified mandate for integrating digital sustainability into curricula or procurement standards, most schools will not be spending time and money on awareness creation amongst the pupils. Most schools and institutions prioritize cost over sustainability when purchasing tech, both in public and private sector. Furthermore, e-waste takeback programs and lifecycle carbon disclosures are rare in public domain.

Students may not perceive digital habits as environmentally impactful, especially when convenience is prioritized. Without visible consequences or incentives, behaviour change is slow.

National Environment Policy 2020 encourages environmental awareness and digital literacy. NGOs and private schools are developing sustainability modules with guidance from NEP.

Partnerships with countries like Singapore could accelerate adoption of best practices and national curriculum should be integrated to include efforts across boards and states. Policy to encourage school-based labs where students can develop low-carbon tech solutions or assess the suitability of behavioural nudges.

Use apps or school platforms to track and reward low-impact digital habits (e.g., SD streaming, reduced screen time), gamifying the strategy to reduce digital consumption. House competitions or awarding badges to build awareness and engagement of students can be beneficial to attain the goals of creating awareness.

Hosting workshops for parents on responsible tech use and device longevity, encouraging community repair cafés and e-waste drives led by students will also create awareness and participation across diverse sections of society.

Public Awareness Campaigns have shown to generate traction in Singapore. Campaigns and competitions can be launched in MRT stations, malls, and social media—designed and led by students—to raise awareness of digital emissions.

Conclusion

The study reveals that most participants, whether it's Singapore or India, demonstrate some awareness regarding sustainability and environmental cost of digital consumption. The high schoolers are willing to make behavioural changes when made aware about the environmental cost of digital consumption. Government initiatives, school programs and parental guidance can play a significant role in fostering eco-conscious habits. Behavioural nudges like reminders, incentives or apps like "Recyclenation" can prove effective in encouraging action. These findings underscore the importance of education targeted to create greater awareness and appreciation of recycling, reducing consumption; community support through availability of recycling programs and accessible infrastructure in promoting sustainable digital habits. The research presented valuable insights which can be utilised by policymakers to device policies and nudges around desirable behaviour and sustainable digital habits, reducing environmental impact in an increasingly tech-driven world.

The study has its limitations due to limited number of respondents and comparing two countries and can be extended to undertake analysis of behaviour of many other diverse demographics as well as can be extended in other countries too.

References

- 1. Altin, A., S. Tecer, L. Tecer, S. Altin, and B. F. Kahraman. "Environmental Awareness Level of Secondary School Students: A Case Study in Balıkesir (Türkiye)." *Procedia Social and Behavioral Sciences*, vol. 141, 2014, pp. 1208–1214.
- 2. Brzyskiewicz, Samuel, Oliver McGarr, and Rachel Lenihan. "Critically Reflecting on the Human and Environmental Costs of Digital Technology Use in Education: Considering the Role of Leadership and School Culture." *Irish Educational Studies*, 2025, pp. 1–20. https://doi.org/10.1080/03323315.2025.2479439.
- 3. dela Peña, Pauline Nicole, M. Macale, and Nico N. Largo. "Environmental Awareness and Pro-Environmental Behaviors of High School Students in Los Baños, Laguna." *Journal of Nature Studies*, vol. 17, no. 1, 2018, pp. 56–67.
- 4. Hajj-Hassan, Mira, Rawad Chaker, and Anne-Marie Cederqvist. "Environmental Education: A Systematic Review on the Use of Digital Tools for Fostering Sustainability Awareness." Sustainability, vol. 16, no. 9, 2024, article 3733. https://doi.org/10.3390/su16093733.
- 5. Madya, Abdullah. "The Relationship of School Students' Environmental Knowledge, Attitude, Behavior, and Awareness toward the Environment: A Systematic Review." *International Journal of Academic Research in Progressive Education and Development*, vol. 12, no. 1, Jan. 2023, pp. 432–447. https://doi.org/10.6007/IJARPED/v12-i1/15707.
- 6. Nam, A. H., and S. Lee. "Students as Partners: Implementation of Climate Change Education within the Harvard Graduate School of Education." *Education and Climate Change: The Role of Universities*, 2021, pp. 153–180.

- 7. Nusche, D., M. Fuster Rabella, and S. Lauterbach. "Rethinking Education in the Context of Climate Change: Leverage Points for Transformative Change." *OECD Education Working Papers*, no. 307, OECD Publishing, 2024. https://doi.org/10.1787/f14c8a81-en.
- 8. Shengjergji, Luzai, Mills, Nostrand, Cermakova, and Kucirkova. *Environmental Impact of EdTech: The Hidden Costs of Digital Learning*. UiS Scholarly Publishing Services, 2024.
- 9. Van Huu, Dat, Phuong Tran Thu, Duong Do Vinh, and Tran Thanh. "Digital Transformation and Its Impact on Environmental Awareness and Green Consumption Among Students." *E3S Web of Conferences*, vol. 559, Jan. 2024, article 03009. https://doi.org/10.1051/e3sconf/202455903009.
- Walker, C., et al. "Tomorrow's Leaders and Today's Agents of Change? Children, Sustainability Education and Environmental Governance." *Children and Society*, vol. 31, no. 1, 2017, pp. 72– 83.

Citations

- 11. Focuskeeper glossary
- 12. Singapore teenagers spend nearly 8.5 hours a day on screens: CNA-IPS survey CNA
- 13. What is Digital Carbon Footprint? Effects and Mitigation
- 14. Australian social media ban on under-16s approved by parliament
- 15. What is Digital Carbon Footprint? Effects and Mitigation
- 16. http://timesofindia.indiatimes.com/articleshow/121775326.cms?utm_source=contentofinterest&u tm medium=text&utm campaign=cppst
- 18. Our Digital Carbon Footprint: What's the Environmental Impact of the Online World? Digital for Good | RESET.ORG.

