2023-10-10

Teaching Sustainability Through A Role-Play Case Study Of E-Scooter Use On College Campuses

Shruti MEHTA
George Mason University, United States of America, smehta23@gmu.edu

Ashish HINGLE
George Mason University, United States of America, ahingle2@gmu.edu

Aditya JOHRI
George Mason University, United States of America, johri@gmu.edu

Teaching Sustainability through a role-play case study of e-scooters on college campuses

S Mehta
George Mason University
Fairfax, USA
0009-0004-0928-8677

A Hingle
George Mason University
Fairfax, USA
0000-0002-6178-1256

A Johri[1]
George Mason University
Fairfax, USA
0000-0001-9018-757

Conference Key Areas*: Embedding Sustainability and Ethics in the Curriculum*

Keywords*: Role-play case studies, Sustainability ethics, Research study*

ABSTRACT

Sustainability has developed into a pressing concern across disciplinary domains, and the need for teaching sustainability concepts to students has grown significantly. In this paper, we present a research study that assessed undergraduate students' understanding of sustainability after participating in a case study discussion. We

[1] *Corresponding Author*

A Johri

johri@gmu.edu

designed and implemented a role-play case study of e-scooters on a college campus. The case facilitated “near transfer,” as it focused on an issue most students have personally experienced. Furthermore, the role-play component simulated a real-world context and allowed students to take different perspectives related to the topic, resulting in a discussion of social, political, economic, and technical factors related to sustainability. The case study was implemented with 38 students. Course readings and pre-case study assignments were used by students to prepare for the role-play. Students participated in groups of 6-7 participants in student-led discussions. To evaluate the development of perspectives, we undertook a thematic analysis of the pre- and post-assignment questions using a framework derived from Transformative Learning Theory (TLT). Findings show that students developed a holistic view of sustainability by co-constructing decisions related to the case study presented. The role-play case study and role descriptions are presented in the Appendix.

1 INTRODUCTION

1.1 Background

The idea of sustainability has evolved from a purely environmental concern to a more multi-disciplinary challenge that requires a thorough understanding of socio-economic, political, ethical, justice, and equity implications (Bennett et.al 2019; Kidd 1992). Furthermore, as digitization has increased across all aspects of society, sustainability has also become intertwined with progress in computing technologies. The complexity of sustainability tends to be difficult for students to understand, and a largely linear or lecture-based form of teaching about sustainability is only marginally effective (Joslyn 2017; Van Wynsberghe 2022).

1.2 Study Aims and Research Questions

This study assessed how a role-play case study on the use of e-scooters on college campuses helped expand students’ understanding of the concept of sustainability (Johri and Hingle 2022; Hess and Brightman 2017; Maier, Baron and Mclaughlan 2007). We adopted transformational learning theory to analyze the outcomes of the intervention. Specifically, the study explored: 1) Does role-play simulation lead to transformative learning about sustainability; and 2) How do students’ experience of e-scooters on college campuses and discussions with peers transform perspectives about sustainability?

2 LITERATURE REVIEW

2.1 Toward a holistic point of view on sustainability and teaching sustainability

According to Kidd (1992), the earliest definitions of sustainability were in environmental terms. The primary narrative was the overconsumption of natural resources in light of urbanization and its effect on the earth’s carrying capacities. Over time, this viewpoint was widened, and sustainability was defined in terms of three pillars, i.e., the environment, the economy, and the society (Cuello Nieto and Neotropica 1997; Johri and Hingle 2022; Maier, Baron and Mclaughlan 2007). The Stockholm Conference in

1972 added the idea of ‘wellbeing’ for developed and developing nations to the definition (United Nations Foundation 2023). The Millennium Development Goals in 2000 and, recently, the Sustainable Development Goals (SDG) have further widened the scope with seventeen goals ranging from poverty and climate change to prosperity (WHO 2018). This new holistic approach to sustainability extends the three pillars of economic, social, and biological spheres to include institutions, governance, ethical aspects, and equity for all (Blewitt 2008; Caetano and Felgueiras 2019; Casañ, Alier and Llorens 2021; Maier, Baron and Mclaughlan 2007; McGill University 2023).

As the definition of sustainability has evolved to become multi-disciplinary, it has become increasingly complex. Studies point out that students find it difficult to understand the idea of sustainability(Feng 2012; Maier, Baron and Mclaughlan 2007; Salas-Zapata and Ortiz-Muñoz 2018; Steiner and Posch 2006). Consequently, instructors within engineering have developed and implemented different approaches to teach sustainability. For instance, Jeon and Amekudzi (2005) used a project-based approach that focuses on engaging stakeholders and encourages decision-making through consensus. An infrastructure component has also been used to guide class discussions (Maier, Baron and Mclaughlan 2007). The system’s approach model that addresses five components, i.e., socio/cultural, environmental, economic, technical, and individual, has also been employed (Pappas 2012). Overall, there is consensus that a productive way to address sustainability in classrooms is to build on students’ previous personal and professional experiences and encourage them to address real-life problems collectively (Caetano and Felgueiras 2019). Such a pedagogy is supported by Mezirow’s Transformative Learning Theory (TLT) (Mezirow 1991).

2.2 Transformative Learning Theory for teaching holistic ideas of sustainability

According to Mezirow’s TLT, learners evaluate past ideas and experiences as they get new information. This drives a shift in their worldview, making room for newer insights. Transformative learning occurs in phases, starting with a ‘disorienting dilemma’ when a learner finds conflicting ideas to past beliefs. This leads to the phase of self-examination, followed by a critical assessment of the assumptions formed as learners take on new roles. The focus of transformative learning is either on ‘instrumental learning’ that involves ‘task-oriented problem solving’ or on ‘communicative learning’ that explains how learners express intentions, values, and morals (Mezirow 1991; WGU 2020). TLT has also been adopted for teaching-learning of sustainability in engineering classrooms (Sipos, Battisti and Grimm 2008; Van Wynsberghe 2022).

Joslyn (2017) adopted Mezirow’s TLT to assess engineering students’ development of humanistic perspectives and suggested three evolving phases or stages of learning. The *engineering point of view* pointed out the presence of technocentric and positivist mindsets, the *new point of view* marked an intermediary step, and the *transformed point of view* reflected an understanding of the social nature of engineering.

One pedagogical device for teaching toward transformative learning is role-play scenarios (Johri and Hingle 2022). Role-play scenarios allow learners to work on real-world problems and scenarios as well as discuss and change perspectives through peer interaction (Johri 2021). The construction of role-plays and their implementation can be designed to provide the necessary scaffolding for students to learn complex topics and, especially, to work on problems that have no single and simple answer. Role-plays also provide a means to bring contexts with which students are familiar into the discussion, facilitating "near transfer" of learning, i.e., transfer of knowledge across similar or familiar contexts (Perkins and Gavriel 1992).

3 METHODOLOGY

3.1 Context and Participants

The role-play on using e-scooters was implemented in the College of Engineering and Computing at a large public university in the USA [see Appendix A & B for the scenarios, roles, and assessments]. The topics for the course included global economic history, global development, AI algorithms and fairness, and IT ethics. The objective of the course was to guide students toward developing a nuanced and contextual understanding of the design, implementation, and use of information technology.

The research study, approved by the Institutional Review Board (IRB), was undertaken with 38 undergraduate students majoring in technology courses (computer networking, information technology, cybersecurity) who participated in discussion groups of 6-7. All students completed pre- and post-class assignments. For this paper, assignment responses from consenting students were analyzed to understand sustainability concepts and changes in perspectives triggered due to the role-play.

3.2 Using role-play scenarios to transform students' understanding of sustainability

3.3.1 The role-play case study on e-scooters on college campuses

E-scooters are motorized stand-up scooters powered using a small electric engine. As a means of micro-mobility, e-scooters are being used as a convenient alternative to traditional gas-powered vehicles or public transportation. Over the past few years, e-scooters have become convenient for college students. However, recently college administrators are banning these scooters and other electric equipment due to safety concerns (Eggert 2020). The real impact and utility of e-scooters are also being contested. While some argue that e-scooters offer less pollution and cheaper mobility solutions, others point out the shorter lifespans of the scooters and issues with their disposal (Sipos and Battisti 2008). Since the issue and context of e-scooter use relate to students' own experiences on campus, a case study was designed to develop perspectives on sustainability. A central dilemma of allowing or banning e-scooters was presented. The case study uses a multi-stakeholder approach, where the roles are

mapped to represent political, social, economic, technical, environmental, and ethical viewpoints. This helped learners empathize with distinct viewpoints pertaining to a real-life issue through discussion.

Pre-class readings based on a broad framework that considered political, environmental, societal, and other factors were provided to aid students' understanding of sustainability and assist in efficiently playing their parts for the role-play. These readings discussed different concerns, such as accessibility, regulation, and ethics, along with socio-economic and environmental issues (Casañ, Alier and Llorens 2020; DCosta 2010). Pre-class homework was assigned, prompting students to think about the dilemma and their ideas on sustainability and to familiarize themselves with the perspectives of all stakeholders. A post-class assignment with questions followed the role-play scenario and asked students about their recommendation, the group dynamics, lessons learned about sustainability, and changes in their perspectives.

3.4 Assessing students' learning

Student learning was assessed qualitatively using thematic analysis of pre- and post-class assessment responses. Themes were drawn inductively and deductively using concepts from Transformative Learning Theory (Braun and Clark 2012). Data were coded by two coders and checked for inter-coder reliability.

3.4.1 Changes in perspectives

Responses to pre- and post-class assignments were analyzed for change in perspective about sustainability. Based on TLT and Joslyn's (2017) classification of the three phases of perspective change among engineering students, changes in perspectives of students were thematically coded for learning in three phases as defined in Table 1.

Table 1. Exploring Students' ideas through Transformative Learning Framework

Points of view on sustainability (Guided by Transformative Learning Theory)	***Ideas Demonstrated***
Environmental points of view	Students mention only 'environmental' ideas.
Extended points of view	Students mention technical, economic or social dimensions of sustainability.
Holistic point of view	Students mention most of the political, social, technical, economic, ethical and regulatory aspects of sustainability.

3.4.2 Insights and "Aha-moment": E-scooters are "not as sustainable as [they] seem."

Coders analyzed responses to explore the insight or "aha-moment" - a sudden comprehension that helps reinterpret a solution. In working through the case and guiding questions, insights result from restructuring the elements in a situation or problem. Corresponding with the first phase of transformative learning, insights present a disorienting dilemma where learners find out the inaccuracy of their past beliefs

(Kounios and Beeman 2009). These “trigger events” act as catalysts for transformations and critical reflections (Mezirow 1991; WGU 2020). Responses were analyzed and coded for observed insights regarding sustainability.

3.4.3 “Near-Transfer” of Learning

“Transfer of learning” is interpreted as applying prior learning and experiences in novel contexts. According to TLT, as students begin to self-examine past beliefs, they think about previous experiences. The role-play scenario simulates the application of prior knowledge in a significantly similar context. This leads to “near-transfer” learning as students bring in their past ideas and transfer them to learn new ideas and perspectives (Perkins and Gavriel 1992). As the case study is based on a college campus, students’ everyday encounters with e-scooters, both the convenience and issues they present, are explored. Responses to pre- and post-assignments were coded for near-transfer.

4 RESULTS

4.1 Students were able to develop an extended and holistic point of view of sustainability

Forty-two percent of students demonstrated an understanding of sustainability beyond environmental terms (Fig.1). Students successfully formed connections between multiple perspectives presented and demonstrated a broadened point of view.

“Sustainability, I discovered, entails understanding and safeguarding the interconnected linkages between the environment, culture, and economy.” – Student 1

“*There are aspects of health, economic growth, and social wellbeing, data and public tools associated with sustainability*.” – Student 2

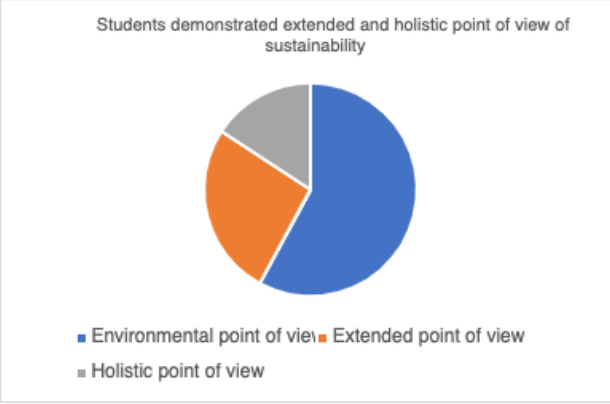

Fig. 1. Students demonstrated an extended and holistic point of view of sustainability.

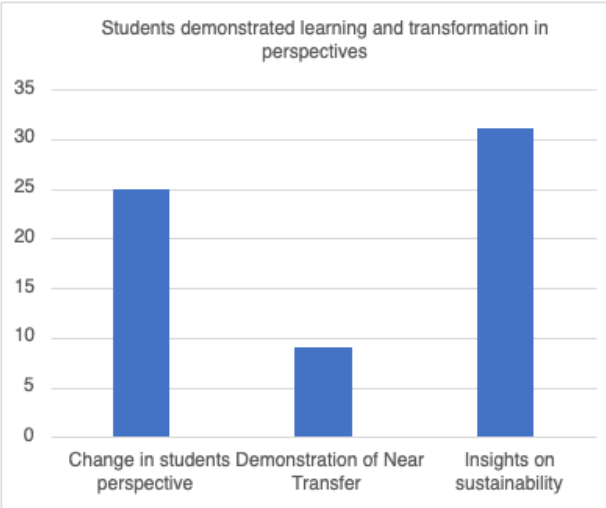

Fig. 2. Students’ perspectives changed with new insights.

4.2 Role-play simulation transformed students' perspectives and facilitated learning about sustainability.

Of 38 students, 81.5% reported a change in perspectives around sustainability. As students co-constructed knowledge with their peers, their understanding of sustainability broadened (Fig 2). The role-play allowed an improved understanding of an infrastructural decision to allow or ban e-scooters on campus. Students were able to evaluate the long-term impact of this decision. It should be noted that students demonstrated one or more changes in perspectives, near-transfer, and insights about sustainability that indicated learning and transformation of perspectives.

"*During the discussion, while I was listening to other group members, my perspective did change because I was able to create more ideas in my mind and was able to understand the idea of sustainability based on what others were saying*." - Student 3

"Yes, my perspective has changed because an e-scooter is not as environmentally friendly as I had initially expected. Although individual e-scooters are not very harmful to the environment, the biggest impact on greenhouse gas emissions comes from the resources and the businesses that work every day to locate all the scooters, recharge them, and return them." - Student 4

Table 2. Students point of view on sustainability changes in three phases

Theme	*Number of students*	*Example*
Environmental point of view	22	*"I learned that e-scooters are not completely eco-friendly but are better than fuel vehicles."*
Extended point of view	10	"*To decide whether to use an e-scooter or not, we need to consider the following factors – the carbon footprint, the cost of production, and the resources used for operation."*
Holistic point of view	6	*"Sustainability is a process. We need to think of social, economic, environmental, and wellbeing factors to design sustainable artificial intelligence systems."*

4.2.1 Students were able to demonstrate a 'near-transfer' of their own experiences with e-scooters and expand understanding about sustainability

Students were able to relate their own experiences of using e-scooters on campus to the case study, and they grappled with dilemmas around the personal convenience of using e-scooters and accidents or accessibility issues in the community at large.

It was interesting to note how students used the name of their own university instead of the one mentioned in the case study while responding to decisions during the role-play.

"As someone who lives on campus, I understand the use of scooters since [student's university] campus is so huge, but, I do believe they should not be used as I have almost been hit by the scooters and their riders because they were riding on the sidewalks and it does make me quite nervous to walk on sidewalks now." Student 5

4.2.2 Students were surprised to learn that the batteries used in e-scooters were not as environmentally friendly as they had assumed

Electric scooters are often considered "sustainable and eco-friendly" options that avoid fossil fuel consumption and help decrease CO2 emissions. However, issues like human rights violations, circulation accidents with pedestrians, and lack of end-of-life recycling processes are not addressed in the popular narrative around e-scooters (Rabino-Neira 2019). Most students were surprised to find out that batteries used in e-scooters have a short life and cause long-term environmental pollution. This finding also helped look beyond the often perceived "sustainable nature" of e-scooters.

"*I learned that even with things that would, in theory, highly support sustainability, it turns out that is not the case. Such as with batteries for the device and studies on them. They were not as environmentally friendly as we may think." - Student 6*

"My perspective changed, because initially, I was only focused on whether a product's operations were actively polluting, rather than its entire lifecycle." Student 7

Table 3: Students' perspectives changed and influenced learning

Theme	*Occurrences*	*Example*
Change in students' perspective	25	*"My perspective did change. Earlier, I supported implementation of these scooters but did not think of other conditions that come with it."*
Demonstration of 'Near Transfer'	9	*"I agree with the resolution because we have scooters at our university as well and I can see the convenience behind them."*
Insights on sustainability	31	*"I had no idea that e-scooters were not the most environment-friendly alternatives."*

5 DISCUSSION AND LIMITATIONS

In this paper, we present a study that assessed whether role-play case studies can provide students with a more holistic understanding of sustainability and, specifically, allow them to learn from each other's perspectives. Toward this end, we developed a case study with which students could identify and have some experience. We found that, overall, students displayed evidence of both holistic thinking about sustainability and perspectival thinking. Consistent with TLT, students' understanding of sustainability varies from a simpler, in this case, environmental view toward a more integrative view that considers other factors. Students also demonstrated near-transfer of the case study to their own institution. This study suggests a role-play approach's effectiveness in teaching a complex topic, such as sustainability.

The study presented here has certain limitations. We only report on a single course offering, and only students from technology majors participated in this study. It will be useful to expand to other disciplines to learn how those with a different domain knowledge address the scenario. It is also difficult to compare accurately what aspect of the scenario changed students' perspective and what role the readings played compared to peer influence. Students' deeper insights into sustainability can be better

assessed through other methods, such as interviews. Finally, the study looks at a single role-play; long-term changes in students' perspectives have not been studied. Future work might use different role-plays in varied contexts around the theme of sustainability.

6 ACKNOWLEDGMENTS

This work was partly supported by U.S. NSF Awards# 204863, 1937950, 1939105; USDA/NIFA Award#2021-67021-35329. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding agencies.

REFERENCES

Bennett, Nathan J., Jessica Blythe, Andrés M. Cisneros-Montemayor, Gerald G. Singh, and U. Rashid Sumaila.2019. “Just Transformations to Sustainability.” *Sustainability* 11, no.14 (July):3881. https://doi.org/10.3390/su11143881

Blewitt, John .2008. *Understanding Sustainable Development*. London.Earthscan

Braun, Virginia and Clarke, Victoria. 2012. “Thematic analysis”. In *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological*, edited by H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher, 57–71. American Psychological Association. https://doi.org/10.1037/13620-004

Caetano, Nídia & Felgueiras, Manuel .2019. “Sustainable development in higher education: different teaching & learning approaches”. In Proceedings of the Seventh International Conference on *Technological Ecosystems for Enhancing Multiculturality* (TEEM'19)., New York, NY, USA, 469–472. Association for Computing Machinery .https://doi.org/10.1145/3362789.3362950

Casañ, Maria Jose,Alier,Marc, Llorens,Ariandna.2021. “A Collaborative Learning Activity to Analyze the Sustainability of an Innovation Using PESTLE”. S*ustainability*,1*3, no 16*8756. https:// doi.org/10.3390/su13168756

Casañ, Maria Jose, Alier,Marc and Llorens, Ariadna.2020. "Teaching Ethics and Sustainability to Informatics Engineering Students, An Almost 30 Years’ Experience" *Sustainability* 12, no. 14: 5499. https://doi.org/10.3390/su12145499

Cuello Nieto,Cesar and Neotropica, Fundacion .1997. “Towards a Holistic Approach to Ideal of Sustainability” *PHIL & TECH* 2:2 (Winter), 41-48

Dcosta, Amanda.2010. “A Review of PESTLE Analysis History and Application—BrightHub Project Management”.Brighthubpm. https://www.brighthubpm.com/project-planning/100279-pestle-analysis-history-and-application/.

Eggert, Anthony.2020. “E is for Environment, Unpacking the benefits of e-scooters.” Forbes.com https://www.forbes.com/sites/anthonyeggert/2020/03/05/e-is-for-environment-unpacking-the-benefits-of-e-scooters/?sh=6567918161c3

Feng, Ling .2012. “Teacher and student responses to interdisciplinary aspects of sustainability education: what do we really know?”, *Environmental Education Research*18 no.1, 31-43, DOI: 10.1080/13504622.2011.574209

Hess, Justin, Strobel, L. J., Brightman, Andrew. O. 2017. “The Development of Empathic Perspective-Taking in an Engineering Ethics Course”. *Journal of Engineering Education* 106, no 4, 534-563. https://doi.org/10.1002/jee.20175

Jeon, Christy Mihyeon and Amekudzi, Adjo.2005. “Addressing Sustainability in Transportation Systems: Definitions, Indicators, and Metrics” *Journal of Infrastructure Systems* 11, No. 1(March) doi:10.1061/(ASCE)1076-0342(2005)11:1(31)

Johri, Aditya .2021. “Students develop situated learning with online role-plays*”* SEFI https://www.sefi.be/2021/04/12/students-develop-situated-insights-with-online-roleplays/.

Johri, Aditya & Hingle, Ashish .2022. “Learning to Link Micro, Meso, and Macro Ethical Concerns Through Role-Play Discussions” *IEEE Frontiers in Education Conference (FIE)*, Uppsala, Sweden,1-8, IEEE doi: 10.1109/FIE56618.2022.996256.

Joslyn, Cole Hatfield .2017. *Exploring Transforming Learning Pedagogies to Teach Human-Centred Design: A Collaborative Action Research Approach: Dissertation* Purdue University.ProQuest

Kidd, Charles V. 1992. "The evolution of sustainability." *Journal of Agricultural and Environmental Ethics* 5,1-26.doi: https://doi.org/10.1007/BF01965413

Kounios, John & Beeman, Mark. 2009. “The Aha! Moment: The Cognitive Neuroscience of Insight.” *Current Directions in Psychological Science* 18. 210-216. 10.1111/j.1467-8721.2009.01638.x.

Maier, Holger; Baron, Judi and Mclaughlan, Rob .2007. “Using Online Roleplay Simulations for Teaching Sustainability Principles to Engineering Students.” *International Journal of Engineering Education* 23,no. 6 1162-1171.

McGill University “What is Sustainability?” McGill Sustainability.Accessed Jun19,2023. https://www.mcgill.ca/sustainability/files/sustainability/what-is-sustainability.pdf.

Mezirow, Jack .1991. *Transforming Dimensions of Adult Learning.* San Francisco: Jossey-Bass Publishers.

Pappas, Eric .2012. “A New Systems Approach to Sustainability: University Responsibility for Teaching Sustainability in Contexts”. *Journal of Sustainability Education* 3*,* (March),1-21.

Perkins, David N. and Gavriel Salomon.1992. Transfer of Learning, *International Encyclopaedia of Education*, Second Edition. Oxford, England: Pergamon Press.

Rabino-Neira,Maria. 2019*.“* E-scooters and human rights: What are the ethical dilemmas in their supply chain and in consumers’ wellbeing?” University of Auckland.thebigq.org https://www.thebigq.org/2019/11/20/e-scooters-and-human-rights-what-are-the-ethical-dilemmas-in-their-supply-chain-and-in-consumers-wellbeing/

Salas-Zapata,Walter Alfredo and Ortiz-Muñoz,Sara Milena .2018. “Analysis of meanings of the concept of sustainability”, *Sustainable Development* 27,no.1,153-161.https://doi.org/10.1002/sd.1885

Sipos, Yona ,Battisti, Thomas and Grimm, Kurt.2008. “Achieving transformative sustainability learning: engaging head, hands and heart”. *International Journal of Sustainability in Higher Education 9,* no.1,68-86, https://doi.org/10.1108/14676370810842193

Steiner, Gerald, and Alfred Posch.2006. “Higher education for sustainability by means of transdisciplinary case studies: an innovative approach for solving complex, real-world problems.” *Journal of Cleaner Production* 14, no. 9, 877–90, https://doi.org/10.1016/j.jclepro.2005.11.054.

United Nations Foundation “Sustainable Development Goals” *https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=CjwKCAjwjMiiBhA4EiwAZe6jQ4y70OarbPoCkmFwBocN1WLhjpcuxwNsMrIjKaWFjkmU8UAz9x_tGxoCk1cQAvD_BwE .* Accessed May 3,2023

Van Wynsberghe, Rob .2022. “Education for Sustainability, Transformational Learning Time and the Individual <–> Collective Dialectic.”*Frontiers in Education.*Vol 7 (May). https://doi.org/10.3389/feduc.2022.838388

WGU.2020. “What is the transformative learning theory?” ,Western Governors University, https://www.wgu.edu/blog/what-transformative-learning-theory2007.html

WHO .2018. “Millennium Development Goals”. https://www.who.int/news-room/fact-sheets/detail/millennium-development-goals-(mdgs)#:~:text=The%20United%20Nations%20Millennium%20Declaration,are%20derived%20from%20this%20Declaration.

Appendix –A E-Scooter Case Study

E-Scooter Case Study

Eva Walker recently started reporting on-campus traffic issues for the student newspaper. She would have preferred to do more human-interest stories, but as a new member of the staff who had just moved from intern to full-time, she was happy to get whatever opportunity she could. Eva was a double major in journalism and creative writing, and this was her dream on-campus job. She also realized that, even though many stories at first didn't appear to her as though she would be interested in them, as she dug deeper she eventually found an angle with which she could strongly relate.

One weekday morning, Eva was working on yet another story on parking woes when Amina Ali, one of the editorial staff members, texted her to say that there had been an accident on campus; she just passed it at the intersection of the library and the recreation building, and it might be worth covering. Eva was at the library, and within no time, reached the spot of the accident.

When Eva arrived, a patrol car, an ambulance, and a fire engine were all present at the scene, and near the accident site, an e-scooter lay smashed into a tree. The rider, it looked like, was sitting in the ambulance and was being treated by the medical staff. A little further down, Eva noticed the police speaking to a young woman in a wheelchair. Although Eva's first instinct was to try to talk to the police or the medical staff to ascertain what had happened, she realized this probably wasn't the best moment and she would have to wait until later for the official version of the event.

She looked around and saw a group of four students leaning against a wall with drinks in their hands. A couple of them were vaping. Eva thought that they looked like they had been here for a while, and she walked over to ask them what had happened. From the account they gave her, it appeared as if the e-scooter rider was coming around the bend at some speed, saw the woman in the wheelchair a little too late to ride past her, and, to avoid hitting her, leapt off his e-scooter and let the vehicle hit the tree. Things happened very quickly and no one was exactly sure about the sequence of events, but this was the rough story she got.

Later, she called the police department on campus and was able to speak with one of the officers to get an official account. The story was very similar to what she already knew. She did find out that nobody was seriously hurt and that the only injuries were to the e-scooter rider and were taken care of at the scene by the medical staff. When she asked about who was to blame or if any legal action was expected, she was told that there were no laws around the use of helmet or speeding for e-scooters yet and that she should reach out later for more information. Eva wrote up what she had so far, sent it over to the editorial staff, and called it a day.

As she was walking back to the dorm that evening, her attention was drawn to the large number of e-scooters parked near the library. As she crossed the central campus, she noticed even more e-scooters lying about the intersections, and there was a litter of them

around the dorm. She wondered why she hadn't noticed them before. Her attention was drawn today, she thought, because of the accident and also because she saw a good Samaritan remove an e-scooter from the sidewalk, as it was blocking the path of one of the self-driving food delivery robots. It's a sign, Eva thought, this is what she needs to look for more in her next article, the use of e-scooters on campus.

Eva recognized that, to write a balanced and informative article, as she had been taught to do, she would have to look at many different aspects of the use of e-scooters as well as look broadly at mobility on campus and the use of battery powered vehicles. She had also recently seen e-bikes on campus and, in addition to the food delivery robots, service robots in one of the buildings that she assumed was either delivering paperwork or mail. The accident had also made her realize that, when it came to mobility, accessibility was something that never crossed her mind but that she now understood was an important consideration. She hoped to learn more about it as her research progressed.

As background research for the article, Eva started reading up on articles and studies published about e-scooters, e-bikes, and urban mobility and came across a range of concerns that had been raised beyond accessibility. First, there were reports that e-scooters are not as environmentally friendly as many service providers had made them out to be. This is related to the production of the battery as well as the short lifespan of the vehicles, and as of yet, there has been no procedure implemented to reuse them[2]. Second, there were reports of littering, where e-scooters are often left on sidewalks and other places where they restrict movement of other vehicles, pedestrians, and in particular, those in wheelchairs[3]. Finally, it was also clear from the reports that accidents and injuries have increased due to e-scooters, especially since many riders do not wear safety gear and are often careless, even inebriated, as there were little to no regulations[4]. When she approached her editor with an outline for an article, she was advised to do some more reporting by talking with people who could shed more light on the issue.

After some research, Eva shortlisted the following experts across fields related to e-scooters for an interview, and once she spoke with them, she realized that it would help her if she could get them to have a dialogue and respond to some of the questions that were raised by other experts. Therefore, she decided to conduct a focus group with them so that she achieved her goal of a balanced article and did not misrepresent any expert's point of view.

1. **Bryan Avery is co-founder and Chief Technology Officer (CTO) of RideBy, an e-scooter company.** RideBy is one of the options available on campus. Born in a small town, Bryan used to ride his bicycle everywhere while growing up, and for him, founding and leading an e-scooter company provided a chance to merge his interests in personal transportation and new forms of energy. He was a chemical engineer by

[2] https://www.smartcitiesdive.com/news/reduce-reuse-rescoot-a-look-at-e-scooters-long-term-sustainability/558691/

[3] https://wtop.com/dc/2021/09/upcoming-dc-law-aims-to-stop-e-scooters-from-littering-sidewalks/

[4] https://www.safetyandhealthmagazine.com/articles/21536-weekend-drinking-a-factor-in-many-e-scooter-injuries-researchers-say

training, and at a time when most of his friends ended up working for big oil companies, Bryan decided to work on alternative fuels and found himself developing expertise and experience with batteries. For most of the software- and mobile device-related development, RideBy outsourced the work and utilized ready-to-configure systems that were available. By only keeping the core device and battery functionality in-house, they could focus on delivering a much stronger product. Overall, he is quite happy with the success of RideBy so far and can't help but extol the difference it can make for the environment.

2. **Abiola Abrams is a professor of transportation engineering and an expert on mobility systems**. Her work combines systems engineering, computer science, and data analytics. Her recent research is on urban mobility and micro-mobility services, particularly e-bikes. In her research, Dr. Abrams has looked at a host of topics related to e-bikes, many of which are also applicable to e-scooters, including the optimization of hubs for availability, common path patterns of users, subscription use models, and the e-waste and end of lifecycle for these vehicles. Increasingly, she has become concerned about the abuse of some of these services, especially in cities that attract a lot of tourists, and about the rough use of the vehicles, so much so that many do not even last for a month. In a new project, she is investigating the effect of e-vehicles on the environment and has found that there is mixed evidence for how much difference battery-operated vehicles will actually make for climate change compared to vehicles that use fossil fuels.

3. **Marco Rodrigues works as Transportation Director for the local county government where the university is based.** As part of a recent bilateral international exchange, he got the opportunity to spend time in different cities in Germany to learn about local transportation. He realized very quickly that local transportation was very different in Germany; residents had a range of public, shared options that were missing in the United States. However, he also realized that e-mobility services were being considered across both countries. He investigated this further and found that Germany waited until it could pass some regulations before allowing e-mobility operators to offer services; helmets were mandatory on e-scooters and e-bikes, and riders had to purchase a nominal insurance policy. He also learned that there were strict rules around the sharing of data generated by the vehicles as well as the apps used by riders.

4. **Judy Whitehouse is Director of Infrastructure and Sustainability** on campus and responsible for planning the long-term development of the campus from a space perspective, but also increasingly from a sustainability dimension. As the number of students has increased, so has the need for more infrastructure, including classrooms and dorms. This has also resulted in greater distances to be traveled on campus. Judy regards e-mobility options as a necessary component of campus life and has been a strong supporter for them. Lately, she has been called into meetings with safety and emergency management people discussing the issue of increased accidents on campus and the littering of e-vehicles across the campus. Not only is it bad for living on campus, but it is also bad optics. A recent photo featured in the campus newspaper

was a stark reminder of just how bad the optics can be. She is further divided on the use of e-scooters due to misgivings about the sustainability of battery use, as new research suggests that manufacturing batteries and disposing them are extremely harmful for the environment.

5. **Aaron Schneider heads Campus Mobility, a student interest group focused on autonomous vehicles development and use**. The group members come from different majors and are interested in both the technical dimensions of mobile solutions and the policy issues surrounding their implementation. Aaron himself is a computer science student with interests in data science, and with some of his fellow members from the policy school, he has been analyzing a range of mobility-related datasets that are publicly available online. Of these, the data on accidents is quite glaring, as the number of accidents in which e-scooters are involved has gone up significantly. Aaron and his friends were intrigued by their findings and approached some of the companies to see if they would share data, but they were disappointed when they could not get access. Although the companies said it was due to privacy reasons, Aaron was not too convinced by that argument. He was also denied access to any internal reports about usage patterns of accidents. Ideally, he would have liked to know what algorithms were used for optimizing delivery and access, but he knew he was not going to get that information.

6. **Sarah Johnson is the Head of Accessibility Service**s on campus and is responsible for both technology- and infrastructure-related support for students, faculty, and staff. The growth of the physical campus and the range of technological offerings has significantly increased the workload for her office, and they are really strained in terms of people and expertise. The emphasis from the university leadership is largely on web and IT accessibility, as teaching and other services are shifting quickly online, but Sarah realizes that there is still an acute need to provide physical and mobility support to many members of the community. Although all the new buildings are up to code in terms of accessibility, there is still work to be done both for the older buildings and especially for mobility. Campus beautification does not always go along with access. She is also worried about access to devices, as taking part in any campus activity requires not just a computer, but also access to mobile devices that are out of reach economically for many and not easy to use.

To help get the dialogues started and based on her prior conversation with the group, Eva has prepared some initial questions [these can be used as discussion prompts]:

1. From your perspective, what do you see as the biggest pros of using e-vehicles, especially e-scooters on campus?
2. From your perspective, what do you see as the biggest downside of using e-vehicles, especially e-scooters on campus?
3. Can you confidently say that e-scooters are an environmentally friendly option?
4. What current accessibility accommodations would be impacted by the use of e-vehicles, and what new, potential accessibility accommodations might arise from increased use of e-vehicles?

5. Would we be better off waiting for more regulations to come before deploying these vehicles on campus and, if so, what should those regulations look like?
6. Should we use automatic regulation of speed on the vehicle based on where it is and/or inform authorities if it is violated?
7. Can we control where it can go or penalize if not put back?
8. What guidelines do you recommend for e-scooter usage on campus?

Appendix –B Pre/Post assignment questions

Pre-assignment questions:

1. From your perspective, should Eva write in favor of e-scooters on campus or against their use; why/why not? What are some issues she will need to keep in mind while writing her article?
2. From your perspective, what sustainability considerations should influence the decision to use e-scooters or not?
3. From the perspective of each of these roles, what would you recommend to Eva Walker and why?

Post-assignment questions:

1. What recommendation did your group reach following the discussion, and what criteria were considered?
2. Was the recommendation agreed to by all or did one person have more influence? Why? Do you personally agree with the solution reached? Why/Why not? Any comments on how your group approached the case?
3. What did you learn about sustainability as part of this role-play discussion? Did your perspective change?