Using Design Thinking as a Tool to Promote Education for Sustainability

Harveen Kaur Singh
School of Life Skills & Communication, Singapore Polytechnic
Harveen_Kaur_SINGH@SP.EDU.SG

Lee Foo Koon
Singapore Polytechnic International
Frank_Lee@SPI.EDU.SG

ABSTRACT
In our pursuit for a sustainable future, education will play a pivotal role in promoting awareness and driving the correct action to support the cause. This paper features the reasons Singapore Polytechnic (SP) integrated Design Thinking (DT) principles into the pedagogy of the Learning Express (LeX) Programme, which is a module catered to Education for Sustainable Development (ESD) and our investigative study in measuring its success. By utilizing the human-centered principles and process of DT – empathy, ideation, prototyping and testing— in the pedagogy for LeX, SP aims to create an impactful learning experience that not only equips students with the knowledge needed to address environmental challenges innovatively, but also fosters a pro-active mindset in championing sustainability.

INTRODUCTION
The Learning Express (LeX) Programme is a capstone project within the Common Core Curriculum (CCC) in Singapore Polytechnic. The CCC is a mandatory course of studies for all students from Singapore Polytechnic (SP) and is designed with the aim to equip students with the skill sets to manage life and work in a disruptive world that is ever-changing.

A total of 10 modules are designed for students to engage in critical analysis of real-world issues, foster empathy towards local and global communities, and empower them to utilize their acquired skills to catalyze positive transformations, in turn, enabling them to play a part in contributing to a more sustainable Singapore and world (Singapore Polytechnic, n.d.). The 10 modules are namely:

1. Thinking Critically about the UNSDGs
2. Data Fluency
3. Artificial Intelligence & its Impact
4. Persuasive Communication with Data Storytelling
5. Problem Solving with Creative & Computational Thinking
6. Digital Communication for Impact
7. Collaboration in the Digital Age
8. Effective Writing for the Workplace
9. Personal Branding & Career Agility
10. Sustainable Innovation Project (The Learning Express (LeX) programme)

LeX allows students to apply the knowledge, skills and abilities acquired from the other 9 CCC modules to work in multidisciplinary groups, addressing issues mapped to the Sustainable Development Goals (SDGs) within the ASEAN, China and India (ACI) region. Using the DT process, SP students collaborate with students from overseas partner institutions on sustainable innovation projects that are real-life challenges faced by local users in the ACI region.

Together with their project mates from the global communities, over the course of 12 days, students on LeX will co-create purposeful and sustainable solutions for the communities and industries, while gaining socio-cultural-economic understanding, environmental awareness and empathy for the global communities through the DT project work experience.

Adopting the principles of DT on the programme, students are taught the importance of knowledge of the users in designing effective and applicable solutions. LeX requires students to prepare and conduct extensive observation and in-depth interviews with users for analysis to identify user beliefs, values, behavioral patterns, challenges, pain points and critical needs, which form the basis of insights that guide students in achieving their design goals.

Through this experience, students acquire empathy for the real-life challenges faced by the global communities and a deeper appreciation of the complexities in SDG issues. The DT process is used to facilitate a deeper comprehension and connection of students to SDGs, leading to more effective learning and a stronger commitment to the cause of SDGs.

LITERATURE REVIEW

Education for Sustainable Development (ESD) is a response by UNESCO to address the issue of sustainable development, which involves the interplay of environmental, social and economic concerns (Pauw et al., 2015). It is a participatory approach to teaching and learning that aims to empower learners of all ages with the knowledge, skills, values, and attitudes needed to achieve the SDGs, enabling them to address interconnected global challenges like climate change, loss of biodiversity, unsustainable use of resources, and inequality (UNESCO, 2017). It is education for social transformation, with the aim to create more sustainable societies (Cheah, Lim, & Chao, 2022). The learning should continue beyond the programme to prepare students to find solutions for the challenges of today and the future (Cheah, Lim, & Chao, 2022).

The end goal of ESD is, through a facilitated learning process, to develop students who can comprehend the world critically based on their own observations and take proactive steps towards sustainability. This aligns with the vision of Singapore Polytechnic's CCC, where through such learning, students will develop the abilities to make sound choices to navigate future complexities and uncertainties; and become active participants in building a more sustainable world, able to tackle real and relevant issues (Cheah, Lim, & Chao, 2022).

According to Boeve-de-Pauw, Olsson and Berglund's (2015), ESD is characterized by these two conceptual features:

1. **Holism**: Its content focuses on the interactions amongst the economic, social, and environmental dimensions of sustainable development issues, considering their past, present, and future repercussions while keeping in mind of their local, regional and global contexts.
2. **Pluralism**: Its pedagogy is modelled to appreciate and involve various perspectives, beliefs and values when addressing sustainable development issues, eventually imbuing the students to reflect deeper rather than to develop "right" sets of answers and responses.

Content and instructional design in LeX follow the aim of incorporating these 2 concept features of ESD to achieve an educational approach that is both comprehensive (Holism) and inclusive (Pluralism) in preparing students to tackle complex and multifaceted sustainability challenges effectively.

To achieve this end, SP has adopted the Design Thinking methodology as anchor pedagogy in LeX. The DT process as practiced in LeX allows students an opportunity to:

1. Explore and learn deeply about global communities and industries (fosters empathy & social/ global awareness) and the importance of knowing user intimately to design applicable solutions.
2. Understand complex real-world problems linked to the context of SDGs and the essential process of iterative intervention to constantly improve solutions over time to meet the evolving needs of different stakeholders.
3. Appreciate diversity of perspectives from project participants of different backgrounds and the power of collaborative work in solving problems.

There is apparent compatibility and alignment to the conceptual features in ESDs and provided below is an investigative study that was conducted to assess its effectiveness.

METHODOLOGY

The following is our investigative attempt to assess the impact of LeX, and consequently the influence of DT on LeX, in achieving ESD learning outcomes.

Semi-structured interviews were conducted with one student and one facilitator. The interviews aimed to gain deeper insights to validate how LeX has helped in ESD. A part-structured interview approach (Hobson & Townsend, 2010) was chosen, combining closed and open-ended questions, allowing deviations for richer insights. Tomlinson's (1989) hierarchical focusing technique minimized interviewer influence while achieving coverage objectives. Two hierarchical-focusing sets were developed, one for students (Image 1) and one for facilitators (Image 2), enabling comprehensive data collection on LeX and ESD.

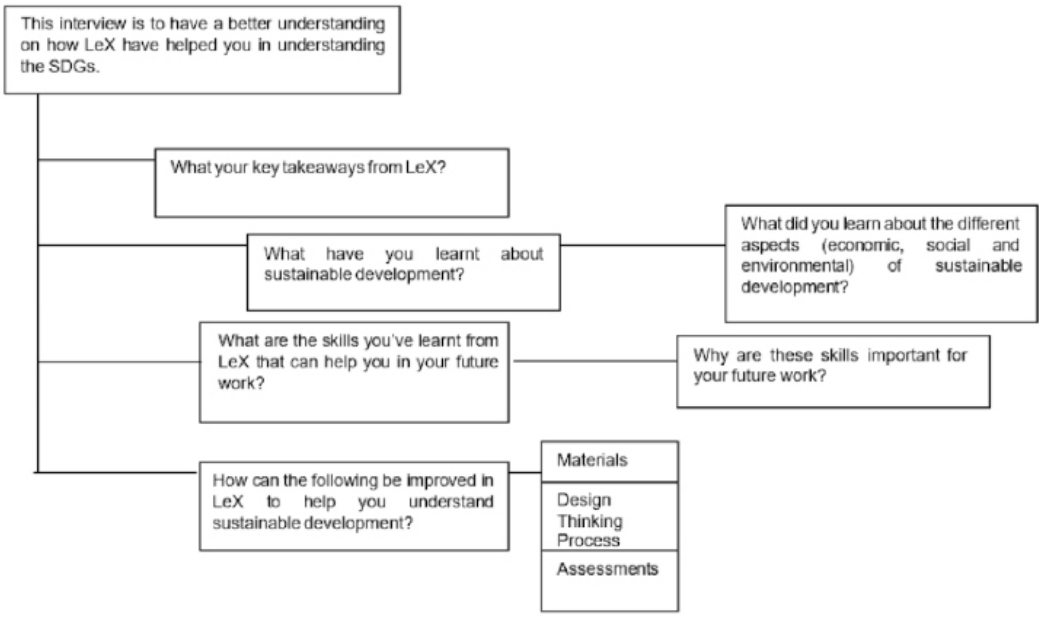

Image 1 Hierarchical- Focusing Flowchart for Student Interview.
(Source: Singh & Koon, 2024)

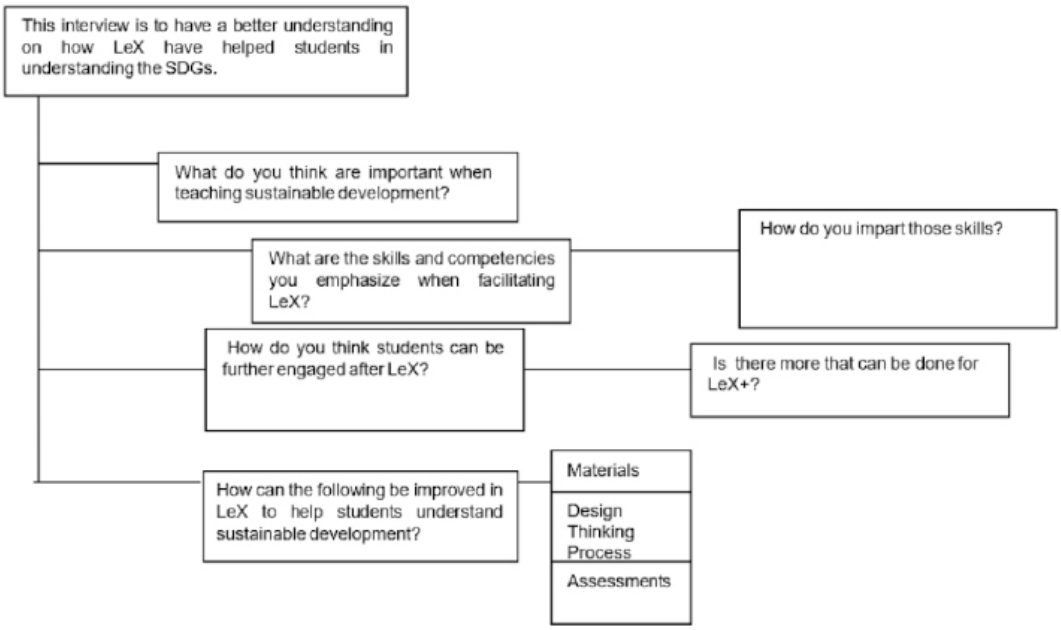

Image 2 Hierarchical- Focusing Flowchart for Facilitator Interview.
(Source: Singh & Koon, 2024)

The interviews lasted approximately 45-60 minutes each and were recorded with consent, then transcribed verbatim. The transcripts underwent thematic analysis using an inductive coding approach recommended by Braun and Clarke (2006). Initial codes were generated by carefully reading the data line-by-line. These codes were then collated into potential themes through an iterative process of analysis.

RESULT & DISCUSSION

Understanding Learning Express (LeX) Programme

Learning Express by Singapore Polytechnic is a **multi-national, multicultural, multi- disciplinary** programme that addresses local complex problems in complex settings rather than simplified problems in isolation. It involves students in activities that address local needs while developing their academic skills and commitment to the community. SP is using Design Thinking Framework in doing LeX Programme, which consist of 4 phase: Sense and Sensibility, Empathy, Ideation and Prototype, as shown in the image below:

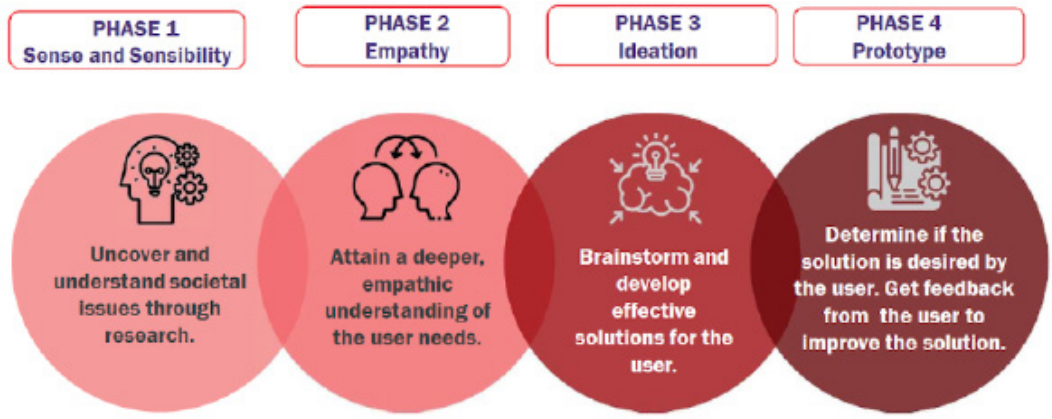

Image 3 SP's Design Thinking Framework in LeX. (Source: Singh & Koon, 2024)

Phase 1: Sense and Sensibility

Sense and Sensibility aimed to uncover and understand societal issues through research. In this stage students were asked to do self-directed learning about the projects, focusing on economics, environment, society and culture and research using secondary resources (i.e.: credible internet sources, books and journals, newspapers, documentaries, social media) before the program begin. Skills to enable them to achieve these phase goals are research skills and tools to streamline research process (i.e.: S(ocial) P(hysycal) I(dentity) C(ommunication) E(motion)).

Phase 2: Empathy

In the Empathy stage, the LeX participant attains a deeper emphatic understanding of the user needs. It will use in-depths interviews, observation study, data mining and persona creation (see image below). Skills to enable them to achieve this phase goals are effective interview techniques, observation tools, data mining and analysis to acquire useful insights and deeper user needs and constructing persona of user community from a holistic understanding.

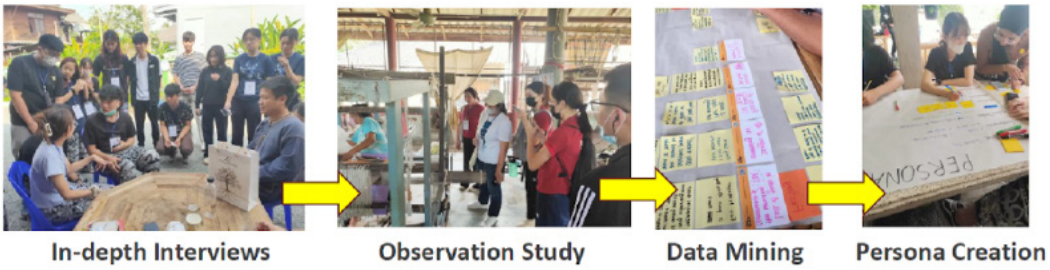

Image 4 Empathy stage. (Source: Singh & Koon, 2024)

Phase 3: Ideation

In this stage, the data gathered from the previous stage will be brainstormed and developed into effective solutions for the user. While doing the brainstorming and synthesizing ideas, there are three considerations for the solutions ideation that intersect each other: desirability, feasibility and viability to ensure innovation (see image below). Skills to enable the participant to achieve this phase goals are brainstorming techniques to encourage divergent thinking and framework to identify and validate values in ideas for synthesis into concept.

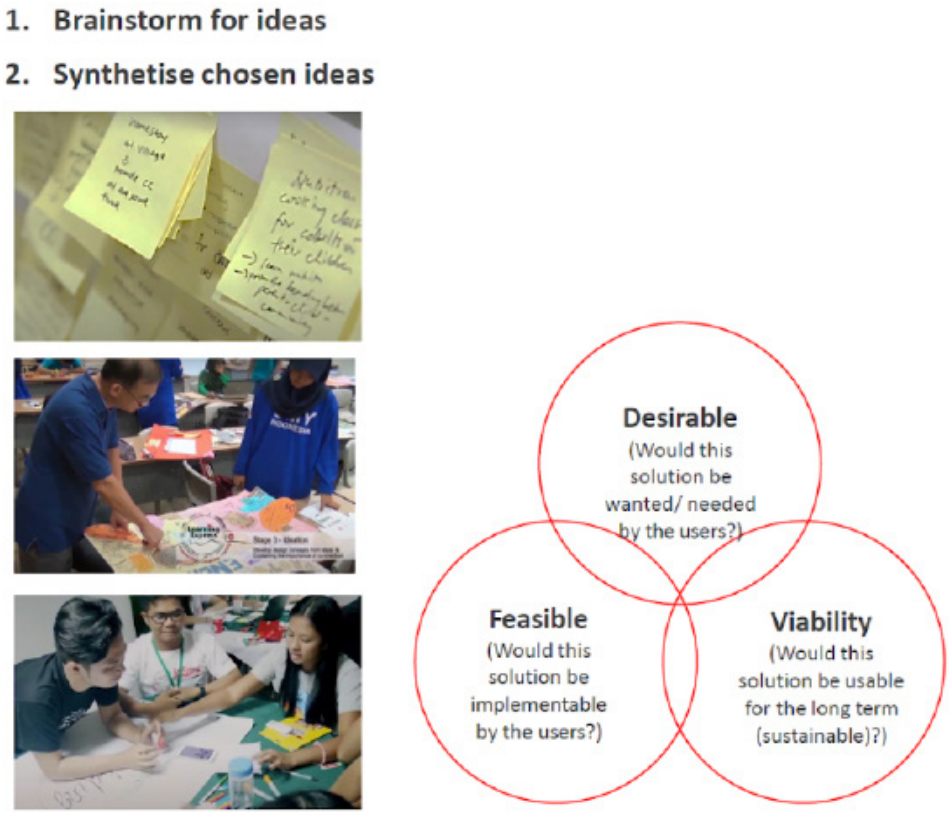

Image 5 Ideation stage. (Source: Singh & Koon, 2024)

Phase 4: Prototyping

As the name suggested, prototyping is when ideation materializes into prototypes. It will determine if the solution is desired by the user, by getting feedback from the

user to improve and refine the solution. Skills to enable the participant to achieve this phase goals are how to create low-res prototype to test concept and detect flaws, acquiring user feedback with prototype to improve concept, and adopting iterative mindset and approach to design.

Image 6 Prototyping stage. (Source: Singh & Koon, 2024)

As stated above, LeX Programme aimed for students to acquire empathy for the real-life challenges faced by the global communities and a deeper appreciation of the complexities in SDG issues. The DT Framework also gives a deeper comprehension and connection of to the SDGs, where eventually leads to more effective learning and a stronger commitment to the cause of SDGs. The salt-wheel project in Ho Chi Minh, Vietnam 2017 that producing prototype for low-cost human-powered device that makes salt transportation less laborious for the salt-industry worker is an example of this, as it responded to SDG 3 (good health and well-being), 8 (decent work and economic growth) and 9 (industry innovation and infrastructure) (see image below).

Image 7 Prototyping stage. (Source: Singh & Koon, 2024)

Key themes of LeX Programme relation to Education for Sustainable Development (ESD)

The interviews with a student and facilitator involved in the LeX programme revealed several key themes related to the Education for Sustainable Development (ESD)

in LeX. These themes are presented below, supported by relevant excerpts from the interviewees.

Theme 1: Baseline Knowledge on Interplay of Social, Economic and Environmental Factors

Both the facilitator and student shared that students who have gone on LeX have a baseline understanding of the interplay between social, environmental, and economic factors based on the projects they worked on. This makes it easier for them when they embark on projects in *LeX+ *(*LeX+ is an SP initiative to co-develop LeX projects with relevant stakeholders for real-world usage and implementation)*. However, the student mentioned that she saw the interplay only when students from other teams were sharing their projects.

Student: *"I have seen like the other teams focus on different issues... We (the LeX team the student was in) focused on the business side, instead of the environment and social… It helps in my LeX+ project as I still able to think back like the villagers' challenges when they are farming… also the challenges they had to face when they need to market the product because the farmers over there don't really know how to market. They usually sell through a middleman. I was able to share this with my friends who have not gone on this project."*

Facilitator (quoting an example): *"Students will question why we use a certain material - for example, plastic. The reason why we use it is because that particular community has a lot of plastic waste and so it is a readily accessible material. Students would know if they have gone on the LeX trip and seen the amount of plastic waste in the community."*

Nonetheless, in both scenarios, the student and facilitator emphasized that students would only delve deeper into the interplay of the three factors when embarking on LeX+.

Theme 2: Deep Understanding from Different Perspectives

In both interviews, the theme of collaborating with partner universities and conducting empathy studies with the community was highlighted. Both the student and facilitator highlighted that perspectives from different stakeholders are crucial in the project.

Student: *"They (the partner university) also invite professors and researchers to share the talks with us… there was this female professor, she shared what are the different types of Kencur (the product) that are used, like different ways that they can process the Kencur there's also the part that I think… they did bring us to the factory but they split us into different groups so I wasn't there to experience the factory tour… through our interviews (with the villagers), we found that the value of Kencur is decreasing because of lower demand."*

Facilitator: *"When the students present our prototype solution, there's only one man representing the teacher… it might not actually be the users as well, which*

defeat the purpose because you need the user … by chance the man was one of the teachers. But it's different because the man is not blind (for context, the end-users are blind)."

The facilitator shared that at times, students do not get to receive feedback from the users themselves when sharing their initial solutions, which is crucial in the DT process. Therefore, consolidating the perspectives of different stakeholders during the interview stage is important so students understand the issue on a deeper level. This also exposes students to the reality where there is a project deviation when one is not able to have access to the ideal stakeholders and how to circumvent roadblocks like these to still meet their goals.

Theme 3: Building Connections

The student particularly highlighted this theme several times, especially when sharing the biggest takeaway from LeX, as encapsulated in the quote below:

"The opportunity to make new connections with people from overseas because LeX allows us to go overseas to work with people from different countries and this allows me to build new connections… I also still keep in touch with my Indonesian friends because I need Kencur powder to analyze (for LeX+) so I reach out to them if they could pre-order the powder and send some over to me…"

The interviews revealed that students possess a baseline understanding of holism (the interplay between social, economic, and environmental elements) within the Sustainable Development Goals (SDGs).

This understanding is evident even when students are not directly working on projects but are exposed to the projects undertaken by their classmates. This baseline knowledge is derived from the sharing of students working on different projects, highlighting the importance of ensuring students work on a variety of projects to receive a comprehensive understanding of the interplay between social, economic, and environmental elements. This also highlights the importance of the role of facilitators to facilitate peer learning across teams working on various aspects of the same issues, so that students are able to appreciate the complexity and synergy of holism of a local issue faced in the community.

The appreciation of different perspectives is noticeable in LeX too, as revealed in the interviews, where it was shared that considering perspectives from various stakeholders is crucial in creating prototype solutions. However, as emphasized by the facilitator, it is essential for facilitators to elucidate the perspectives of different stakeholders when conducting interviews, ensuring that students understand the merits of each stakeholder's feedback when they present prototype solutions.

CONCLUSION

From the investigative exercise above, it is evident that adopting DT as pedagogy in LeX has curated a learning experience for students to elevate their baseline

understanding on the intricacies of relationship between society, culture, economics and environment in fomenting issues related to sustainable development.

DT, being a user-centered approach in Design, which emphasizes on empathy and the iterative learning and problem-solving process has established an effective framework to engage education for sustainable development and achieve the conceptual outcomes as outlined in Boeve-de-Pauw, Olsson and Berglund's (2015) to be holistic and pluralistic.

In summary, we believe the learning of students are reinforced in these areas through the practice of DT:

1. Empathy: Students develop a deeper appreciation for different perspectives and knowledge of how and why certain issues/ problems are more 'wicked' and challenging to resolve. This empathy for the global communities and resonance with SDGs may also increase their commitment to play a pro-active part in supporting the SDGs.
2. Problem-Solving: DT has provided students a structured approach to solving complex problems – defining problems, brainstorming creative solutions, prototyping, and iterating based on feedback.
3. Real World Application: Students engage real-world issues that expose them to the interplay between social, economic, and environmental elements. The students develop solutions for these problems using DT, which gives them an opportunity to contribute to SDGs.
4. Collaboration: Students learn the importance of sharing knowledge and leveraging on the strengths of one another to enhance their output in creative work, and appreciating diverse perspectives and the power of collaborative work in solving problems.
5. Iterative Learning: Students learn the importance of constant feedback and development of solutions in problem solving, as the issues in SDGs can be very complex.

Overall, the integration of DT into LeX is attributable to helping the programme achieve its ESD goals, by scaffolding the learning experience of students to become empathetic and Design- enabled citizens of the world, who might be better prepared and equipped to contribute to our sustainable future.

REFERENCES

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

Cheah, S.-M., Lim, L. Y., & Chao, Y. C. (2022). In *2022 18th International CDIO Conference* (pp. 104–115).

Hobson, A. J., & Townsend, A. (2010). Chapter 14. In *Interviewing as Educational Research Method(s)* (pp. 223–238). essay, Chippenham, Wiltshire: Continuum International Publishing Group.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning*

and development (2nd ed.). Upper Saddle River, NJ: Pearson Education.

Pauw, J., Gericke, N., Olsson, D., & Berglund, T. (2015). The effectiveness of education for Sustainable Development. *Sustainability*, *7*(11), 15693–15717. doi:https://doi.org/10.3390/su71115693.

Salun, M., & Zaslavska, K. (2024). Strategies for resilience in a dynamic world: From Vuca to Bani. *Socratic Lectures 10 - Part I*. doi:10.55295/psl.2024.i23

Seelig, T. and Kelley, D., 2015. Design Thinking for Educators: A Framework for Creativity and Innovation in the Classroom. Stanford, CA: Stanford University d.school.

Singapore Polytechnic International. (n.d.). SPI supports Singapore Polytechnic (SP) in its internationalisation strategies and prepares SP learners to be life-ready, work-ready and world- ready. Retrieved from https://www.spi.edu.sg/student-programmes/

Singapore Polytechnic. (n.d.). SP Common Core Curriculum. Retrieved from https://www.sp.edu.sg/sp/education/common-core-curriculum/about-the-ccc

Tomlinson, P. (1989). Having it both ways: Hierarchical focusing as research interview method. *British Educational Research Journal*, *15*(2), 155–176. doi:10.1080/0141192890150205.

UNESCO. (2017). *Education for Sustainable Development Goals: Learning Objectives*. *UNESCO*. Paris. Retrieved from https://doi.org/10.54675/CGBA9153