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Sustainable interior design learning during the Covid-19 era: From theory into practice

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The three pillars of sustainability, social, environmental and economic developments, are global trends in education. The emergence of the COVID-19 pandemic is a critical indication of nature's resistance. Developing a sustainable interior design learning approach is not a prerequisite for a sustainable education perspective but may bring solutions to environmental concerns. Therefore, developing a curriculum for teaching green interior design is vital for SID. This study proposes a curriculum framework for teaching sustainable interior design from theory to practice based on sustainability theory and green interior rating standards. Students must consider Covid-19 based on WHO and LEED green rating standards for their design project. A study was conducted to examine the learning processes and outcomes of students. This study offers a new perspective on the development of sustainable interior design in education.

Key words: Sustainable interior design, Covid-19 era, sustainable design education, case study.

INTRODUCTION

Sustainability is a holistic assessment of the economy, society and environment to approach the United Nations Sustainable Development Goals (SDGs) by 2030 (UNO, 2015). Interior design education is now more than just teaching design theories and aesthetics; instead, instructors should lead students to enhance and inspire knowledge and skill of creative sustainability from their broad expertise. With the growing awareness of environmental sustainability among interior design scholars, interior design education programs need to be updated and established to allow for transferring green environmental contextualisation into the elements of internal spaces (Celadyn, 2017). The COVID-19 pandemic altered people's lives, including their way of life, and significantly impacted education and employment. People were forced to spend much time indoors; hence, they know how important environmental health and sustainability are (Zaher, 2020). SID education can use the pandemic experience to develop an innovative green interior curriculum.

Sustainable development in education

Education for Sustainable Development (ESD) is becoming more widely recognised worldwide as an

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essential component of quality teaching and learning for sustainable development. The United Nations declared 2005-2014 as the Decade of ESD (UNESCO, 2005). The goal of ESD is to achieve the SDG framework in five aspects: policy, learning environments, building capacities of educators, and youth and local-level action (UNESCO, 2019). The initiative aimed at educating for a more sustainable future.

Sustainable interior design curriculum framework

Interior design includes the design stage-space planning, interior design, and interior integration and the construction stage-the furnishing of ceilings, walls and floor and technical work for water, electricity, etc. In other words, the interior design contains two complementary levels – aesthetics and practice (Chou et al., 2021).On this basis, the SID curriculum focuses on green innovation of interior space of a structure to satisfy lifestyles behaviour and health standards, as well as to fulfil architectural aims and the internal orientation and development of activities without harming the environment (Celadyn, 2017). According to the US Green Building Council (USGBC), Leadership in Energy and Environmental Design (LEED) (USGBC, 2020) for green interior design and construction rating system, "ID+C" defines "interior design and construction". Therefore, regards to SID education, the learning scope includes green concepts and sustainable construction practises, from theory to practice. Currently, LEED is included in the SID curriculum, and students are encouraged to develop their design concepts by following this international interior design rating system. In addition, the COVID-19 epidemic affected education and business activities and altered all aspects of people's lives. As a result of the COVID-19 epidemic, people are becoming more aware of indoor environment quality. World Health Organisation (WHO) announced the infection prevention standards for residences, public areas, and commercial spaces. Several architects and designers have embedded green interior standards and combined WHO policies in their architecture and interior design cases (Zaher, 2020). Therefore, in terms of the development of SID education, the WHO standard is also critical to secure people's health and promote sustainable development. By incorporating virus prevention measures into the design curriculum, students can learn about the importance of taking precautions to prevent the spread of the virus and apply these measures in their design projects. Moreover, such education can help to promote responsible citizenship and community health, which are crucial in the current global context. The purpose of the research is to: formulate a SID curriculum framework from theory to practice based on SID theory, the WHO infection prevention policy and LEED green interior rating standard for leading students in developing their design projects; examine the students' learning processes and outcomes based on SID theory; and identify the prospects for green interior design education.

LITERATURE REVIEW

In this chapter, the research reviewed SID theory in the structure of development orientation for formulating the teaching and learning framework.

SID theory

The United Nations (1987) indicated that people could ensure their needs are met through sustainable development and contribute to a sustainable future. The green design considers consequences during production, construction and disposal and the impacts on the environment and people's health throughout the operation. Therefore, instructors can guide students to apply SID knowledge and skills in the design process to achieve sustainable development. Promoting green education has become a critical concern in the Covid-19 era.

Scholars (Chou et al., 2021; Kusumarini, 2011) asserted that SID includes three pillars of sustainability; economic interior, social interior, and economical interior, including the internal and external environment (within the scope of the building).The SID theory aims to develop a sustainable interior space by balancing people's health, indoor environment quality, and resource waste reduction.

Theoretical framework of SID curricular

The SID consists of three pillars-Internal Environmental Interior, Internal Social Interior and Internal Economic Interior. The SID curricular framework focuses on these three internal aspects based on SID theory as follows (Table 1):

1. Environmental Interior of LEED standards: students need to choose and decide the best design strategies with the design standards of LEED and WHO.
2. Social Interior of LEED standards: students must consider communication and integration between users and the indoor environment with the design standards of LEED and WHO.
3. Economic Interior: Benefits from design decisions with LEED and WHO design standards.

METHODOLOGY

Case study

Dhurakij Pundit University (DPU), one of the leading international

Table 1. Theoretical framework of SID curricular.

SID three-pillars	Internal environmental interior	Internal social interior	Internal economic interior
Dimensions	Indoor environment	People	Profit
Theoretical dimensions	Design decisions for the interior environment	Social relationships between people and indoor space	Benefits from design decisions
Items of LEED green interiors for hospitality spaces	Materials and resources; indoor environmental quality; innovation	Integrative Process; location and transportation; regional priority	Water efficiency; energy and atmosphere
Items of Design Strategies for Covid-19 Prevention: Technical and Maintenance Services	Water disinfection; dishwashing and laundry equipment; ventilation and air conditioning; dispensers; waste management	Communication	Benefit from practicing design strategies

Source: Author

and private schools, is accredited by the Ministry of Higher Education, Science, Research and Innovation of the Thai government body in Thailand. The Creative Design programme of the university adopts sustainable development and green innovation curriculums to align with the goal of ESD. This study conducted a case study method to examine the phenomena within its context for insight into illustrating, comparing, assessing and understanding unique aspects of a research objective. The target population is a group of third-year undergraduate students Creative Design program at the university. The registration procedures for the third-year undergraduate Creative Design program typically involve several steps. First, students must have completed the prerequisite courses for the program, typically in their first and second years of study, including art, interior design, management, graphic design and product design. Once they have met these requirements, they can apply for admission to the course. Many students in this program are interested in pursuing careers in design or related fields, and are eager to develop their skills and knowledge to prepare for the workforce. The number of students from the third-year undergraduate Creative Design programme is 18-two dropped out, and one took a similar class before. Therefore, a group of 15 students was selected as a sample who attended the “Spatial Theory and Composition” design course. Students were required to develop a semester design project and present their project at the end of the semester. The course includes the fundamentals of environmental sustainability, design theories and methods.

SID curricular framework

The project brief requested students to design a green service apartment while keeping the Covid 19 environment in mind. As shown in Figure 1, the SID curricular framework includes expert validation and three phases for students to develop the green project. The expert validation research method was carried out by using a validation procedure that relies on the modified Delphi expert consensus for reviewing six categories of Learning of Outcome Assessments (LOA). In this research, five faculty members of the design department with over ten years of teaching experience were invited to examine six categories based on the standards of LEED and WHO (Table 1). According to scholars, a consensus ratio is reached between 51% and 80% of the agreement by experts in terms of Delph's content validation (Eubank et al., 2016). After two rounds of review by experts, the consensus ratio was more than 80% of the experts’ agreement (Lin, 2015). All experts agreed with the six categories of LOA.

Phase 1: The students participated in group discussions and shared their understanding of green interior design based on the three pillars of SID sustainability. Collaborative learning helps students build their skills and creative thinking of SID. While designing, the students were encouraged to explore SID for further discussion.
Phase 2: In the practice stage, students explored their green design based on international green interior rating standards, considering Covid-19management in the accommodation sector (WHO, 2021). Students engaged in individual discussions with the instructors to develop their green concept effectively.
Phase 3: Finally conclusion stage, students presented their green service apartment design concepts. The evaluation of students’ learning outcomes was based on the SID theory, green rating standards and the design strategies considering Covid-19infection prevention.

Students were required to carefully follow the LEED green interior and WHO standards to create their design concepts. The evaluation of learning outcomes was categorised into four levels: 1=poor (0-1 green items), 2=average (2-3 green items), 3=good (3-4 green items), and 4=excellent (above five green items). In terms of the reliability of phase 1 and Phase 3, the value of Coefficient Alpha was $\alpha = 0.81$ and 0.84. According to scholars, the Coefficient Alpha of 0.80 and above is better (Cronbach, 1951).

RESULTS AND DISCUSSION

Students’ learning outcome assessment

The results and discussions on the student's learning outcomes are as follows:

1. LOA of LEED Green Interiors: As shown in Table 2, in phase 1, the highest score is “Economic Interior of LEED standards” (M=2.00, SD=0.00). Most students understood how to conserve resources, particularly water and energy. In phase 3, the “Environmental interior of LEED standards” (M=3.20, SD=0.56) scored the greatest among all the standards.
2. LOA of WHO standards: As shown in Table 2, in phase 1, The lowest score was "Economic Interior of WHO

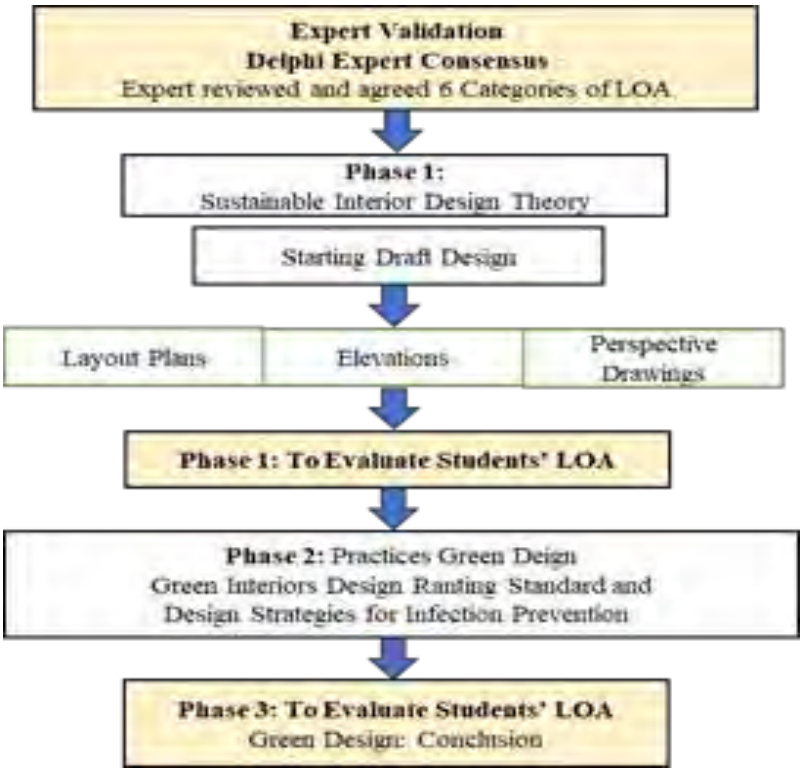

Figure 1. SID curricular framework.
Source: Author

Table 2. Descriptive statistics of students' design project score.

	SID 3 Pillars	N	Minimum	Maximum	Mean	Std. Deviation
Phase 1	1. Environmental Interior of LEED standards	15	1	2	1.67	0.49
	2. Environmental Interior of WHO standards	15	1	2	1.80	0.41
	3. Social Interior LEED standards	15	1	2	1.80	0.41
	4. Social Interior of WHO standards	15	1	2	1.87	0.35
	5. Economic Interior of LEED standards	15	2	2	2.00	0.00
	6. Economic Interior of WHO standards	15	1	2	1.27	0.46
Phase 3	1. Environmental Interior of LEED standards	15	2	4	3.20	0.56
	2. Environmental Interior of WHO standards	15	2	3	2.13	0.35
	3. Social Interior of LEED standards	15	2	3	2.40	0.51
	4. Social Interior of WHO standards	15	2	3	2.53	0.52
	5. Economic Interior of LEED standards	15	2	3	2.47	0.52
	6. Economic Interior of WHO standards	15	2	3	2.20	0.

Source: Author

standards" was the lowest score (M=2.13, SD=0.35).

3. Comparison of LOAs of LEED Green Interiors and WHO standards: Regarding the indoor environment, LEED and WHO standards have a similar concept-design for human health. Therefore, combining these two standards to develop design concepts could be a solution to improve students' perceptions.

4. Comparison of Phase 1 and Phase 3: As shown in Tables 3 and 4, the results of paired sample t-test showed that the score in phase 3 (M=2.51, SD=0.35)increased compared to phase 1 (M=1.73, SD=0.24), $t(14)=12.08$, p-value ≤ 0.05. In phase 3,

Table 3. Paired samples statistics of students' design project score.

	SID 3 Pillars	Mean	N	Std. Deviation	Std. error mean
Pair 1	Phase 1 Overall standards	1.73	15	0.24	0.06
	Phase 3 Overall standards	2.51	15	0.35	0.09

Source: Author

Table 4. Paired samples test of students' design project score.

		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. deviation	Std. error mean	95% Confidence interval of the difference				
					Lower	Upper			
Pair 1	Phase 1 Overall standards– Phase 3 Overall standards	-0.78	0.25	0.06	-0.92	-0.64	-12.08	14	0.000

Source: Author

Figure 2. Student's Design Project-Green service apartment with garden.
Source: Fine and Applied Arts Program, DPU.

students implemented green design strategies in their design projects after the design courses. The students tried combining aesthetics with functional aspects of green design standards. For example, when selecting the paints, some students considered toxic emissions and anti-virus or chose lighter shades to increase daylight reflection. In terms of management, some chose smart home systems to monitor water and energy consumption and a reservation system for social distancing and security.

Students' green design project evaluation

In this green design project, two students excel among their peers (Figures 2 and 3). The design approaches are as follows:

1. Environmental interiors strategies: 3R design strategies-recycling, reusing and reducing the material for the ceiling, wall flooring and furniture; the large operable windows designed to promote daylight and ventilation; separating the interior public areas (living room and dining room) and private areas (bedroom) at different floors; segregation of operational and domestic waste.
2. Social interiors Strategies: providing disinfection and cleaning supplies at the entrance; installing UV water filters, air filters and UV lighting for anti-virus and air quality; providing a bicycle lane.
3. Economic Interior Strategies: Indoor Environmental Quality- Using air filters and UV lighting for anti-virus and air quality; water-efficient equipment and reusing grey water; installing solar energy systems on the roof and light sensors for energy savings.

Summary of SID learning outcomes

Based on the findings of the study, strategies for

Figure 3. Student's Design Project-Green service apartment with skylight window and blinds.
Source: Creative Design Program, DPU.

expanding green interior design education are as follows:

1. Environmental Aspect: As indicated in Table 2, most students are interested in expanding their design knowledge to create a healthy, eco-friendly interior environment. Scholars propose that the core value of SID development is balanced social, economic, and environmental development. Some green policies and education will fail if SID focuses on environmental development without social and economic support. Green innovation can be a solution for the holistic development of SID in three dimensions: resource reuse and recycling to preserve the environment, the use of eco-friendly materials free of harmful components to protect people's health, and the use of fewer resources or energy during production processes to gain green benefits.
2. Social Aspect: Green design management has been a significant priority in the Covid-19 era to improve the relationship between people and the environment and enhance human health. Transdisciplinary learning, since it integrates several curricula, could be a method to enable students to integrate knowledge from various disciplines to develop a better understanding of the actual world. By cooperating with design firms, educators can assist students in developing design and business management models for a more authentic learning experience.
3. Economic Aspect: Developing SID in the real world has always required understanding the sustainable economy. Future courses will include real-world case studies and seminars with managers and experts to help students build a new perspective on green business. Students must understand how to use scarce natural resources wisely to advance SID and realise greener benefits.

In summary, as a result of the coronavirus epidemic, people are becoming more conscious of how human activities impact the environment. The pandemic has highlighted the need for healthy and sustainable design solutions that prioritise human health and well-being. SID education can play a crucial role in this by equipping students with the knowledge and skills to create healthier and more sustainable indoor environments. This includes understanding the principles of sustainable design, such as using renewable materials, minimising waste, and reducing energy consumption. It also involves incorporating biophilic design principles, such as incorporating natural light and greenery into indoor spaces, which have been shown to improve mental health and cognitive function. Moreover, SID education can also help students stay informed about the latest trends and technologies in sustainable design, such as the use of intelligent home systems and passive design strategies. By understanding and implementing these strategies, students can help create indoor environments that are healthier, more energy-efficient, and cost-effective.

Conclusion

SID education has become integral to the sustainable age. Ruff and Olson (2009) asserted that design educators are responsible for building the foundation for sustainability. While students embrace the knowledge, educators must also lead them to sustainable real-world project practises based on the theory. SID education can rebuild and raise awareness of the environmental effects of the COVID-19 pandemic so that eco-friendly products can be used to create a healthy indoor

environment (Zaher, 2020). SID is the highest guiding concept for policy execution in interior design education that includes "designaesthetics" to create a positive living quality and "practical design" applying green environmental standards and reducing environmental impact.

The research developed a SID curriculum framework based on SID theory. In terms of future curricula, SID practice relies on collaboration with design firms or associations to bridge the gap between learning and reality. In addition, universities can provide graduates and designers with continuing education regarding SID. This is because SID is becoming increasingly important in design industries and can have a significant impact on the environment, health, and sustainability of our communities. Overall, providing SID education can benefit both students and universities by preparing students for the evolving job market, contributing to the sustainability of our communities, and promoting a culture of environmental responsibility.

CONFLICT OF INTERESTS

The author has not declared any conflict of interest.

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