

Proposing an SDGs education model: integrating design thinking and behavioral science “nudges” for high school students

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Abstract

This study focuses on the development of a creative model of SDGs education that promotes behavior change in upper secondary schools using an approach that combines design thinking and behavioral science nudge methods. The SDGs education for high school students, which utilized design thinking, was used as a case study. Questionnaire surveys of high school students and teachers who participated in the project were conducted. Based on the survey results, a new education model was proposed that can effectively improve SDGs education at the high school level and support educators in this field.

Keywords: design education, design methods, Sustainable Development Goals (SDGs), nudge

1. Introduction

The "2030 Agenda for Sustainable Development," encompassing 17 Sustainable Development Goals (SDGs), was adopted during the 2015 United Nations Summit. In pursuit of achieving the SDGs, diverse approaches by individuals worldwide have been implemented (United Nations, 2023). In the context of high school education, critical thinking, problem-solving skills, communication abilities, and adaptability to the rapid socio-economic changes required for surviving in a global society are essential competencies. However, traditional knowledge-centric educational approaches may prove inadequate in attaining these skills, necessitating the expectation of innovative educational methodologies.

In the 2018 revision of Japan's High School Curriculum Guidelines by the Ministry of Education, Culture, Sports, Science, and Technology, the introduction of the "Comprehensive Exploration Time" is aimed at fostering the development of students' qualities and capabilities. This initiative seeks to encourage students to contemplate their own existence and way of life, facilitating the discovery and resolution of challenges through inquiry-based approaches, and promoting interdisciplinary and comprehensive learning (MEXT, 2018).

However, within the educational landscape amidst the rapid transformations in contemporary societal structures, various complex challenges persist. For instance, a survey, conducted by Recruit Shingaku Soken on high school education reform titled "2018 Active Learning-Type Class Edition," revealed significant challenges in achieving student-driven, dialogic, and profound learning experiences (Recruit, 2021). The survey identified substantial issues in instructional skills, teaching material development, and evaluation methods as crucial components. Students encounter difficulties in delving deeply into societal issues, hindering their ability to generate creative proposals. Furthermore, the current situation indicates that proposed solutions to challenges often remain confined to suggestions for improving problem statements and lack meaningful connections to students' own actions and initiatives.

Based on the aforementioned context, the research aims to develop a new comprehensive educational model that leverages design thinking in high school education to propose innovative solutions for

societal challenges related to the SDGs. Furthermore, the goal is to use behavioral science methodologies to facilitate actions towards resolving these challenges.

2. Objectives

The present study aims to develop an innovative model for promoting behavior change in SDGs education at high schools, utilizing an integrative approach that combines design thinking and behavioral science's nudge techniques. The primary objective is to propose a method for the development of this model. Specifically, the study employs a case study approach, focusing on the SDGs Challenge Project for third-year students at F High School in Fukuoka City. This project utilizes behavioral science nudges within an educational program informed by design thinking principles, with the overarching goal of fostering behavior change. The research seeks to introduce a novel educational model that integrates "design thinking" and "nudges" to enhance SDGs education at the high school level.

3. Theoretical themes

3.1. Design thinking

Design thinking, as proposed by the globally renowned firm IDEO, refers to an innovative methodology aimed at positively transforming society. This approach enables the creative provision of new value to society through imaginative means. It involves the application of designers' sensibilities and techniques, utilizing a human-centered approach to innovation that integrates people's needs, technology, and the market (Brown, 2009).

In the context of this study, the research applies the process of design thinking to high school SDGs classes. Specifically, it involves conducting workshop-style classes based on the processes of "Issue Definition," "Idea Creation," "Evaluation and Improvement," and "Presentation". The study aims to analyze both the process and outcomes of implementing design thinking in the context of high school SDGs education.

3.2. Nudge

Nudge, a behavioral theory introduced by Richard H. Thaler, involves methods aimed at assisting individuals in making better choices for themselves voluntarily (Thaler & Sunstein, 2009). Numerous successful cases of societal implementation through nudging techniques have been observed, as illustrated by the application of insights from behavioral science. In this study, it is hypothesized that the utilization of nudges can facilitate transformative changes in students' behavior toward more desirable directions.

Specifically, drawing upon the EAST framework of nudging, the research proposes a methodology that integrates nudges into educational programs, tools, and support (Team, 2014). It is emphasized that the design of nudges, whilst incorporating relevant elements of EAST depending on the objectives of behavior change, is crucial (Nakamura et al., 2021). The EAST framework suggests four potential courses of action to increase the likelihood of behavior change.

Easy: is to make the target behavior as easy as possible. This can be done in various ways, including harnessing the power of defaults, reducing the hassle factor of taking up a service, or simplifying messages.

Attractive: This is based on the insight that we are more likely to do things our attention is drawn to.

Social: referring to what most others do in a particular situation can effectively encourage people to do the same.

Timely: when they are most likely to be receptive – such as around life events when habits may already be disrupted.

4. SDGs challenge project

This study engaged in a practical exploration to determine whether innovative solutions to societal challenges posed by SDGs could be proposed using design methodologies. Specifically, a collaboration

was established between a university and F High School in 2022. Comprehensive exploratory workshops and classes related to the SDGs were implemented into the school's curriculum. The classes, based on design thinking processes of "Issue Definition," "Idea Creation," "Evaluation and Improvement," and "Presentation" were conducted from April 12 to October 25. The classes included introductory, mid-term, and final presentations (Figure 1) as well.

Prior to the workshops, 301 students were organized into groups of four to six based on their interests, resulting in 56 groups. Twenty-seven high school teachers from various subject areas such as mathematics, language arts, social studies, and physical education, facilitated the SDGs projects. Design methodology was implemented to assess its effectiveness in proposing innovative solutions to societal challenges related to SDGs.




Time	Design Thinking education program	Process	Points	Photos
April	Kick-off	ISSUE DEFINITION		
	Discovering the issues		Discovering issues through familiar realizations	
May	Investigate the issue background		Digging deeper into the issues	
	Final issue identification		Most important issue identification	
June	Developing ideas	IDEA CREATION	Use method cards like KJ method to diffuse ideas	
	Investigation of precedents for solution		Generating fresh ideas	
	Determination of ideas			
	Prototyping		Quick evaluation	
July	Interim presentation	EVALUATION & IMPROVEMENT	Third party evaluation	
	Refinement of ideas		Iterative nature of design process	
Aug.	Summer holiday			
Sept.	Re-prototyping		Iterative nature of design process	
	Final idea			
Oct.	Preparation for presentation	PRESENTATION		
	Final presentation		Self-evaluation & third party evaluation	

Figure 1. SDGs challenge project

This SDG Challenge Project differs from typical high school classes in that it makes use of design thinking. Specific features include:

- The classes are not taught in a one-way knowledge teaching style, but in a workshop style of knowing, thinking, discussing, and expressing. Free ideas and mistakes are welcome in class.
- Classes utilize the distinctive iterative nature design process, where one looks back and makes adjustments as they proceed.
- Solving large social issues of the SDGs entails starting with smaller issues close to home. Educational tools will be created to encourage deeper exploration of the issues.
- Prototyping and utilizing a variety of materials to realise and improve ideas are incorporated in the project.
- A variety of evaluations, including student self-evaluations, teacher evaluations and third-party evaluations are implemented.

5. Background and literature review

In the course of this study, an examination of prior cases revealed that conventional education, which leans heavily on knowledge-centric approaches, proves insufficient for fostering individuals capable of

addressing complex societal issues such as the SDGs (Dorst, 2015). This underscores the need for educational methods that enhance students' autonomy and proactivity. Simultaneously, there has been a growing interest in recent years in approaches to SDGs employing the power of "design," a field that aligns with the researchers' expertise (Dorst, 2015).

While the United Nations Decade of Education for Sustainable Development (UNDESD) has provided proposals and guidelines for education related to sustainable development, it acknowledges the difficulty and challenges in practical implementation for diverse populations, given that these guidelines are not universally enforceable rules (Martin et al., 2008).

Within domestic cases in Japan, SDGs education projects targeting high school students have been critiqued for lacking a thorough exploration of issues, emphasizing the need for reinforcing proactive issue recognition (Kikusawa, 2021). It is also noted that initiatives and support from educators, particularly in subjects where teachers specialize, are crucial for deepening students' learning and insights (Jinnouchi, 2021). Additionally, the implementation of inquiry-based education focusing on SDGs suggests the necessity of establishing an environment, including appropriate evaluation methods, effective allocation of teachers, and securing dedicated activity time, as well as providing information to facilitate inquiry activities (Sugio & Miyaguni, 2020).

Moreover, challenges have been identified in the design of processes within SDGs talent education, indicating a need for refinement in this aspect (Takahashi et al., 2021). The realization of methods for implementing SDGs education programs still faces numerous challenges (Zhang et al., 2023). A pilot design program as a form of general education in the Japanese high school education was created to enhance awareness of SDGs, develop twenty-first century competencies (21CC) and social-emotional learning (SEL), as well as assess current SDGs education (Loh et al. 2020). From the pilot program, it became evident that addressing the complex societal challenges posed by SDGs requires more creative design methodologies. While instances of design methodologies exist, there is a lack of research examples focusing on a comprehensive educational model that is both creative and conducive to behavior change.

Therefore, the objective of this study is to propose an innovative model for SDGs education in high schools, utilizing an integrative approach that combines design thinking and behavioral science's nudge techniques. By incorporating design thinking into the educational program along with nudges, the research aims to explore changes in students' mindsets, attitudes, and behaviors. Additionally, it seeks to facilitate the development of more creative problem-solving methods and build the capacity for students to envision their own dreams for the future. This integrative approach aims to go beyond individual methodologies and create a holistic educational model that fosters innovation and behavioral transformation in the context of SDGs education at the high school level.

6. Surveys

To evaluate the impact of the design methodology, surveys were conducted after the completion of the classes. A total of 301 senior high school students and 27 teachers who were involved in the project participated in the survey. The data collected from these surveys form the basis of analysis for the study's findings and proposals.

6.1. Questionnaire survey of students and discussion

The following questions relevant to this study were extracted and presented below (Figure 2):

1. After this class, has your awareness of the SDGs changed? (5-point scale from "increased" to "did not change")
2. Did this lesson provide you with an opportunity to learn about sustainability issues around you? (5-point scale from "yes" to "no")
3. Did this course enable you to learn about ways in which you, as an individual, can contribute to the sustainability of society and the environment? (5-point scale from "learned" to "did not learn")
4. Do you believe that you can contribute to the Sustainable Development Goals (SDGs) with your own capabilities? (5-point scale from "I think so" to "do not think so")

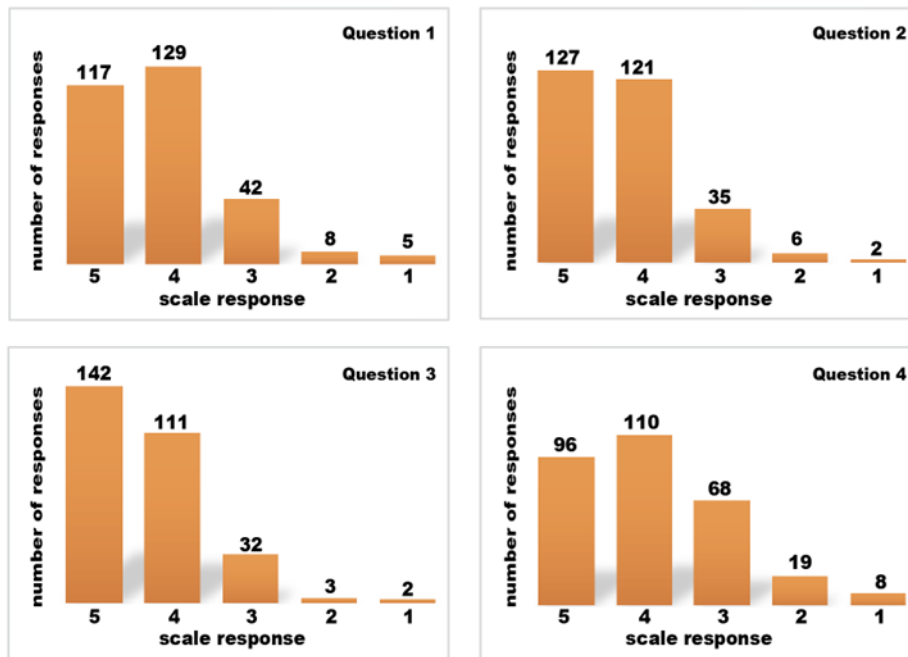


Figure 2. Students' questionnaire survey result

The response of students who felt their awareness of SDGs changed as a result of the project was at 82%, with 39% reporting their awareness increased greatly. The number of students who felt the project provided them the opportunity to learn about sustainability issues was at 82%, with 42% of the students evaluating the project as highly educational and only 3% finding it not educational. Eighty-four percent of students reported that they learned how they can contribute to social and environmental sustainability after the project. Lastly, 68% of the students reported that they can contribute to the SDGs with their own capabilities.

Students' survey responses were also gathered through text mining (Figure 3), and the results are organized in descending order of scores. The scores reflect the "importance" of each word. Notably, for students, nouns such as SDGs, environmental issues, ideation; the verbs know, think, discuss, deepen; as well as adjectives such as difficult and deep; were identified as significant. The term "deep" appeared frequently in both verb and adjective forms.



Figure 3. Students' responses illustrative model

In design thinking, delving deeply into issues is crucial, and the findings from text mining show that students in this class were conscious of creating a social impact by exploring familiar issues in depth. Based on the survey results from 301 students, it is evident that over 80% of the students feel that their awareness of SDGs significantly increased through the SDGs project. They perceived the opportunity to become informed about sustainability issues in their surroundings and learned about ways to contribute to the preservation of society and the environment. However, it is noteworthy that only 68% of students believe they can contribute to the SDGs with their own capabilities, a percentage lower than other aspects. While there has been improvement in knowledge and awareness, it appears that one-third of the students have not translated this enhanced understanding into actionable contributions or a deeper exploration of knowledge.

6.2. Questionnaire survey and discussion of teachers in charge

To validate the effectiveness of the design methodology, a post-class survey on student evaluations was conducted with the instructors. The assessment criteria for confirming the learning achievements of third-year high school students included three items: "Knowledge and Skills," "Thinking Skills, Judgment, and Expression," and "Attitude toward Learning and Personality." "Knowledge and Skills" assesses the ability to collect information in tasks and utilize it for problem-solving. "Thinking Skills, Judgment, and Expression" assesses the ability to clarify tasks and understand and define the situation of the task. "Attitude toward Learning and Personality" assesses the ability to learn with various perspectives, maintaining fairness.

The survey was conducted with 27 teachers, and 22 responses were received. The following relevant questionnaire items related to this study were extracted, utilizing a five-point scale ranging from "Not Achieved" to "Achieved." (Figure 4)

1. How much do you think you have achieved in terms of "knowledge and skills?"
2. How much do you think you have achieved in "thinking, judgement, and expression?"
3. How far do you think you have achieved regarding "capacity to learn/personality?"

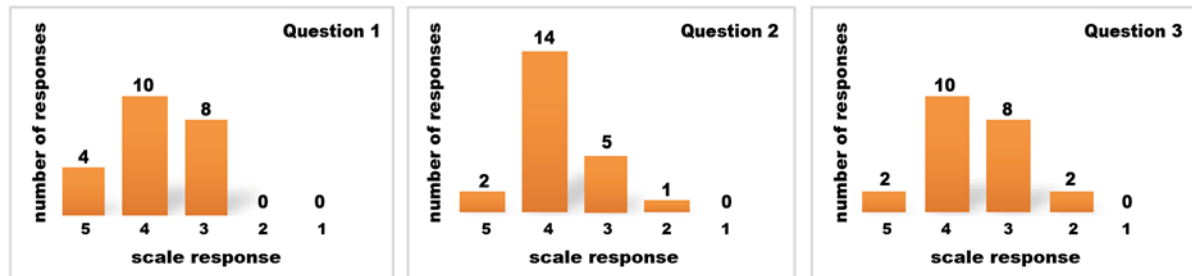


Figure 4. Students' response text mining result

Among the 22 teachers, 14 responded that they had achieved "Knowledge and Skills." Specifically, four teachers reported achieving it to a high degree, while 10 teachers assessed their achievement as moderate. Positive feedback included a reported increase in knowledge through research and a deepened understanding in identifying social and local issues. Teachers also reported that students' presentation skills, research skills, and information absorption capacity improved, along with their receptiveness to the SDGs project. Teachers also felt peer learning was enhanced through observing the varying research approaches of student groups. Some concerns teachers expressed were feeling that the knowledge gained was superficial and the reliability of online sources for information was questionable. Teachers also reported challenges in research and conducting interviews with the actual target audience.

For "Thinking Skills, Judgment, and Expression," 16 teachers indicated that they had achieved much in this area. Teachers attributed this self-assessment to the abilities of the students; all student groups were able to create prototypes, not just slides or posters, which led to understandable presentations of their achievements. Teachers reported that summarizing and presenting materials allowed students to learn methods of self-expression and develop their thinking. Teachers observed that students tackled unknown and unclear aspects, took steps together, discussed, and responsibly communicated. Despite limited

materials, students persevered in exploring possible ideas. However, despite achieving thinking skills, judgment, and expression, some teachers expressed concerns about task awareness, such as individual differences in group discussion contributions, students' inability to logically connect topics, and a lack of persuasiveness regarding implementation feasibility.

For the last question, 12 teachers responded that they had achieved "Attitude toward Learning and Personality." Teachers reported enthusiasm when generating unique ideas and having a clear purpose with an openness to learn after completing the various workshops. They reported favorable attitudes of team members when actively contemplating, questioning, and exploring the direction of work. They also felt they and the students had an increased awareness of societal issues as the learning progressed. However, despite achieving attitude toward learning and personality, some teachers expressed concerns about the lack of enthusiasm in some students. They also reported a difficulty in evaluating the aspect of "personality."

Based on the teachers' survey results, the teachers in charge provided a positive evaluation of the overall education of the SDGs project from the perspectives of "Knowledge and Skills," "Thinking Skills, Judgment, and Expression," and "Attitude toward Learning and Personality." However, it was simultaneously noted that there were challenges regarding the depth of learning, and the motivation and actions needed to move on to the next step.

Looking at the results of both student and teacher surveys as a whole, there was evidence of learning in terms of knowledge, and improvement in abilities such as thinking and expression. However, it became apparent that the SDGs project has not translated into behavioral changes for students. While there was positive feedback regarding the educational aspects of the SDGs project, there are challenges in terms of the depth of learning, and the translation of knowledge and skills into meaningful actions for the students.

7. Proposal of integrating design thinking and "nudges"

This study addresses the first research question by asserting that within high school education, the design methodology in SDGs education can propose innovative solutions to societal issues outlined by the SDGs. However, for the second research question—how to actively form behaviors towards problem-solving by developing an innovative educational model for addressing societal issues—clear answers have not yet been identified.

In this context, we propose a hypothesis that by leveraging nudges, students can transform their behavior in the desired direction. Specifically, we aim to employ the EAST (Easy, Attractive, Social, Timely) framework and provide a checklist (Figure 5) for each educational process to facilitate this transformation. In this SDGs education that utilizes design thinking, the objective for solving big social issues is to start with smaller, more accessible issues. Therefore, it is not enough to just integrate EAST into education programs, but also to comprehensively develop educational tools and educational support systems that also aim to incorporate EAST.

This checklist was developed by reflecting on SDG education programs, educational tools, and support systems that utilize design thinking for high school students in 2022. The checklist also incorporates behavioral science nudges for students to move forward with SDG actions, rather than ending with problem-solving proposals. We would like to do the checklist in a cycle of research, refinement, and implementation to ensure its validity and completeness, as follows:

- Based on the EAST checklist, a survey will be conducted among the teachers in charge to determine to what extent they have achieved the educational programs, tools, and support systems so far.
- Based on the results of the survey, a plan will be developed to improve programs, tools, and support structures using the EAST perspective.
- New SDG Challenge projects will implement the improved programs, tools, and support structures.
- A survey will be conducted on the achievement of the new SDG Challenge Project's programs, tools, and support structures based on the EAST checklist.
- Results of the survey before and after the implementation of EAST will be compared to validate and improve the checklist.

EAST	EASY	ATTRACTIVE	SOCIAL	TIMELY
Education Program	<ul style="list-style-type: none"> <input type="checkbox"/> Is the education program easy to understand? <input type="checkbox"/> Is there an overall picture and detailed content of the education program? <input type="checkbox"/> Are the included examples easy to understand? 	<ul style="list-style-type: none"> <input type="checkbox"/> Is there a mechanism for evaluating educational achievement? <input type="checkbox"/> Is there a forum for teachers to provide feedback? <input type="checkbox"/> Is there a mechanism for teachers to interact with each other simultaneously? <input type="checkbox"/> Is praise given after student activities? <input type="checkbox"/> Are there opportunities to present educational achievements? 	<ul style="list-style-type: none"> <input type="checkbox"/> Are the social issues of interest to the students being addressed? <input type="checkbox"/> Is there an examination of issues from a social and historical perspective? <input type="checkbox"/> Are there opportunities for educational outcomes to be made available to society? 	<ul style="list-style-type: none"> <input type="checkbox"/> Is there a preliminary explanation of the overall program? <input type="checkbox"/> Is there a detailed content briefing before the class? <input type="checkbox"/> Is there a system for taking feedback from teachers and students immediately after the educational program? <input type="checkbox"/> Is there a system in place to update the educational program?
Education Tool	<ul style="list-style-type: none"> <input type="checkbox"/> Is the content of the textbook easy to understand? <input type="checkbox"/> Are the explanations on the worksheets easy to understand? <input type="checkbox"/> Are the expressions and messages on the question cards easy to understand? 	<ul style="list-style-type: none"> <input type="checkbox"/> Have you included illustrations in your textbooks that are easy for students to understand? <input type="checkbox"/> Have you considered the design quality of the textbooks? <input type="checkbox"/> Are the tools well designed? <input type="checkbox"/> Have easy-to-understand educational materials such as videos been prepared? <input type="checkbox"/> Can the tools be provided free of charge? 	<ul style="list-style-type: none"> <input type="checkbox"/> Are you making use of government education support tools? <input type="checkbox"/> Are other educators' educational tools used effectively? <input type="checkbox"/> Are there external assessment tools as well as internal school assessment tools? 	<ul style="list-style-type: none"> <input type="checkbox"/> Are the necessary tools available? <input type="checkbox"/> When new tools are needed, can teachers create them? <input type="checkbox"/> Are the tools ready in class?
Support System	<ul style="list-style-type: none"> <input type="checkbox"/> Is there a support system where interested parties can join at any time? <input type="checkbox"/> Is the support platform easy to access? <input type="checkbox"/> Is there a platform for teachers to interact with each other? 	<ul style="list-style-type: none"> <input type="checkbox"/> Has the system been designed to facilitate the participation of external supporters? <input type="checkbox"/> Can a registration system be established for external supporters? 	<ul style="list-style-type: none"> <input type="checkbox"/> Are there third-party evaluations outside the school? <input type="checkbox"/> Are there social supporters? 	<ul style="list-style-type: none"> <input type="checkbox"/> Are teachers able to respond immediately when students have problems? <input type="checkbox"/> Do teachers have an immediate support system in place when there is a problem?

Figure 5. Students' response text mining result

Ultimately the results of this research will be made public and provide society with universal knowledge on SDGs education for high school students.

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