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Promoting Sustainable Life Through Global Citizenship-Oriented Educational Approaches: Comparison of Learn–Think–Act Approach-Based and Lecture-Based SDG Instructions on the Development of Students' Sustainability Consciousness

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Abstract

Promoting individuals' sustainability consciousness (SC) is one of the important way of ensuring a sustainable world and finding ways toward a better life. Therefore, the purpose of the present study was to compare the effects of learn–think–act approach-based instruction and lecture-based instruction on the development of sustainability consciousness in students, with the Sustainable Development Goals (SDGs) acting as the subject of the instructions. The research was conducted with 80 seventh-grade students from a state school in Istanbul, Türkiye. While 40 of them were in a class where learn–think–act approach-based SDG instruction was implemented, the other 40 participants were trained with lecture-based SDG instruction for eight weeks. A quasi-experimental research design was followed in the research. The data was collected with the Sustainability Consciousness Questionnaire and obtained before and after SDG instruction. In the data analysis, paired and independent samples *t*-tests were used. The findings revealed that learn–think–act approach-based SDG instruction has a significantly larger effect (d = 1.62, 95% CI) on the development of sustainability consciousness in middle school students compared to lecture-based SDG instruction.

Keywords: sustainable life; global citizenship-oriented educational approach; sustainable development goals (SDGs); sustainability consciousness; learn–think–act approach-based instruction; lecture-based instruction; middle school students

Academic Editor: David González-Gómez

Received: 1 September 2025
Revised: 4 October 2025
Accepted: 7 October 2025
Published: 12 October 2025

Citation: Koçulu, A. Promoting Sustainable Life Through Global Citizenship-Oriented Educational Approaches: Comparison of Learn–Think–Act Approach-Based and Lecture-Based SDG Instructions on the Development of Students' Sustainability Consciousness. *Sustainability* **2025**, *17*, 9026. https://doi.org/10.3390/su17209026

1. Introduction

In today's world, people's choices cause many complex challenges like economic issues (e.g., low income, unemployment, etc.), environmental issues (e.g., climate change, pollution, deforestation, etc.), and social issues (e.g., inequalities, lack of health and well-being, inequality education, etc.) [1–3]. These challenges were also addressed in 2015, with the aim of resolving them through the Sustainable Development Goals (SDGs) by 2030. For humanity to avoid causing these problems and to find solutions for them, it is important to promote sustainability consciousness (SC) in society; developing SC helps promote information- and science-driven engagement with sustainability issues and transform individuals' sustainability choices and decisions regarding complex and unpredictable environmental, social and economic challenges. In other words, people, especially the younger generations, should be raised as individuals with sustainability consciousness to

avoid causing complex challenges, to solve such challenges, and to participate in decision-making processes in a sustainable way, which may contribute to attaining the Sustainable Development Goals (SDGs) [4]. To avoid causing problems and achieve the SDGs, a conscious human factor is needed, as well as a transformation in people's knowledge, attitudes, and behaviors regarding social, economic and environmental dimensions, according to a 2014 UNESCO report [5–10]. Transforming younger students' consciousness, including their knowledge, attitudes, and behaviors, helps contribute to building sustainability literacy in society [11,12]. In this transformation, the learn–think–act approach can play an important role in helping learners acquire knowledge, attitudes, behaviors, skills, and dispositions that are related to becoming global citizens; students can understand complex issues, think critically, and act to solve global issues thanks to this approach. Teachers using the learn–think–act approach in practice contribute to globally competent teaching by developing students' competencies and skills [9]. Therefore, the purpose of the current study was to compare the effects of learn–think–act approach-based and lecture-based SDG instructions on the development of students' sustainability consciousness. Therefore, the research questions (RQs) were as follows:

RQ 1: Does learn–think–act approach-based instruction on the Sustainable Development Goals (SDGs) lead to a statistically significant change in middle school students' sustainability consciousness?
RQ 2: Does lecture-based instruction on the Sustainable Development Goals (SDGs) lead to a statistically significant change in middle school students' sustainability consciousness?
RQ 3: Which instructional method better enhances students' sustainability consciousness, learn–think–act approach-based instruction or lecture-based SDG instruction?

2. Research Framework

2.1. Education for Sustainable Life

Education is one of the powerful tools used to transform society by promoting sustainability consciousness, including sustainable lifestyles, since the world faces huge challenges related to climate change, hunger and public health, as addressed by SDGs. Education ensures well-balanced sustainable development, which takes into consideration the environmental, social, economic and cultural aspects of an advanced quality of life for both today's people and future generations [13–15]. People's educational levels are associated with sustainability consciousness and lifestyles [16]. That is, individuals with higher educational levels tend to act in a more sustainable way, via sustainable energy consumption like conserving electricity, consuming recycled goods, buying energy-saving products, separating their waste, and protecting the environment, as well as contributing to social and economic growth, and other specific environmentally friendly behaviors [17,18].

Education plays a vital role in raising sustainability consciousness and fostering sustainable lifestyles. Addressing today's global challenges through education can drive change toward more peaceful, fair and resilient societies. Learning to change our world to make it more sustainable and viable is quite a challenge, and calls for developing sustainability literacy and consciousness in society [14,19].

2.2. Sustainable Development Goals (SDGs) Instruction in Middle Schools

The Sustainable Development Goals (SDGs) are a global blueprint established by the United Nations (UN) to address local and global challenges, promote the development of our world, and create a sustainable and better future for everyone [3]. The goals were defined in 2015 with the purpose of achieving them by 2030, so we should consider what we can do to help achieve SDGs. As educators, teaching SDG in our classes directly supports the objectives under 'SDG 4: Quality Education'. UNESCO emphasized that education

represents a main strategy in the pursuit of the SDGs, serving as both a key enabler and a goal in itself [20].

There are different ways that educators can approach teaching about the Sustainable Development Goals (SDGs). They can integrate SDGs into their school or class activities, extend current curriculum topics, add specific SDGs units, or make connections to school events and national/global commemorations [21–25]. It is necessary to propose a new educational model that integrates the SDGs in learning by considering the content and pedagogy of education, age-appropriateness and accessibility [20,26].

The important point teachers should pay attention to in the procedure of teaching SDGs is that traditional teaching methods are not sufficient to support a deep consciousness that triggers knowledge, attitudes and behavioral changes. This is because SDGs are multi-dimensional (with highly interactive economic, social and environmental factors included), complex and context-specific [27–29]. Therefore, teachers need a holistic action competence approach that empowers students to solve complex issues and encourages them to take action on local and global challenges linked to the SDGs [19,30–33]. Learner-centered, interdisciplinary, collaborative, transdisciplinary, real-world, and value-based teaching and learning approaches are recommended to equip students with the competencies needed to achieve the Sustainable Development Goals [34–41]. The main outcome of SDG instruction is to engage students in sustainable decision-making and encourage individuals to make responsible choices that shape a sustainable and better future for all of us [20,42–44]. That is, SDG instruction using a holistic action competence approach in the classroom can develop students' knowledge, attitudes and behaviors that enable them to act with awareness of their economic, environmental, and social impacts, both locally and globally [45–52]. SDG instruction is a vital element in fostering sustainability consciousness, as it enables students to become proactive global contributors in solving local and global issues for a more sustainable world [20].

2.2.1. Learn–Think–Act Approach-Based SDG Instruction

The learn–think–act approach is one of the most effective approaches for SDG teaching since it enables a recognition of the relationship among understanding, reflection and action [53]. This approach helps students understand global issues, consider them critically, and take effective action to solve them [53–55]. The learn–think–act approach can enable students to develop the knowledge, attitudes and behaviors needed to become global citizens. Therefore, such an approach can help improve students' sustainability consciousness, including their knowledge, attitudes, and behaviors. Figure 1 shows the learn–think–act approach [53]. SDG teaching through the learn–think–act approach enables students to improve their knowledge, attitudes and behaviors, and to explore sustainable ways of living in order to become responsible global citizens with a high level of sustainability consciousness [56]. Through this approach, teachers can integrate global citizenship education into their instruction, effectively promoting students' consciousness of the world's complex issues and helping them understand their role in creating a more sustainable world [55]. Therefore, this approach was adopted for SDG instruction in this research.

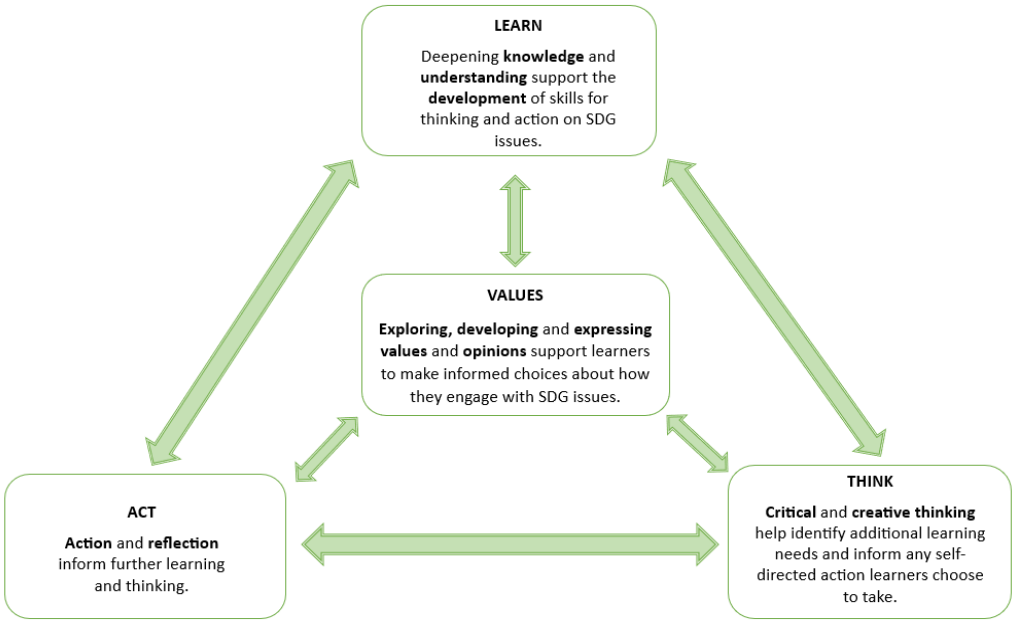

Figure 1. The learn–think–act approach framework [53].

2.2.2. Lecture-Based SDG Instruction

The lecture-based approach is a traditional instructional model. This model is an instructor-centered and content-oriented approach. In this approach, the instructor presents the content verbally, using visual displays (e.g., a projector) or writing surfaces (e.g., a chalkboard). Put differently, traditional lecture-based instruction includes less classroom interaction between the teacher and students, as well as among students themselves [57,58]. Lecture-based instruction is a passive teaching method that is not suitable for teaching practical skills and improving skills at higher learning levels, such as in SDG teaching, which includes complex issues [27–29]. Furthermore, students can forget multidimensional SDG contents soon because they are not active [59]. The traditional lecture-based approach was used in this study for teaching SDGs to students in the control group. In this study, a science teacher used the chalkboard to facilitate the interaction between students and herself [57,58].

2.3. Sustainability Consciousness

Sustainability consciousness is crucial for the welfare of societies all around the world, the preservation of the natural world, economic success, and the integrity of the concept of sustainability itself [60]. Sustainability consciousness (SC) is a vital determinant for developing sustainability literacy and the successful execution of sustainability goals [61]. Ensuring a sustainable future depends on fostering a permanent sense of consciousness among citizens [62]. SC is described as a combination of knowingness, attitudes, and behaviors connected to three dimensions (social, economic and environmental) of sustainable development [63–72]. SC obliges people to transform and cultivate their attitudes in favor of sustainable behaviors [69].

The attainment of the SDGs requires a society with a high level of SC. The transformation of citizens' knowledge, attitudes, and behaviors is a basic component in achieving SDGs [61,73]. Sustainability consciousness (SC) is an anticipated outcome and result of Education for Sustainable Development Goals (ESDG), aimed at fostering a society that embraces sustainable living behaviors [6,64,71,74,75]. ESDG is a learning process that includes decision-making practices, which consider the long-term future of the economy, environment and society and the equality of all communities [76,77]. Moreover, ESDG motivates individuals to cope with complex issues by improving their positive knowledge, attitudes,

and behaviors linked with sustainability, both today and in the future [69,72,78–80]. SDG teaching must be integrated from early childhood education to higher education curricula, as students of all ages should become conscious and feel responsible for designing a better and more sustainable future [54,81–86].

3. Method

3.1. Design

This study aims to evaluate how learn–think–act approach-based instruction versus traditional lecture-based instruction on Sustainable Development Goals (SDGs) influences students' sustainability consciousness. In order to achieve this end, a quasi-experimental research design, as a quantitative research method, was used in the research. This design involves measuring the impacts of independent variables on dependent variables when full experimental control is not possible [87–90]. In the scope of the current research, the 'Sustainability Consciousness Questionnaire (SCQ)' was applied to students in both experimental and control groups as a pretest at the beginning of the course. Then, for 8 weeks, the Sustainable Development Goals (SDGs) were taught to students in experimental group using a learn–think–act-based instructional approach while students in the control group received lecture-based instruction. To examine the effects of both the learn-think-act-based and lecture-based SDG instructions on the development of students' sustainability consciousness, as well as to compare the effects of these instructional approaches, SCQ was administered again as a post-test to students in both the experimental and control groups after SDG instruction.

3.2. Participants

The participants of the present research were seventh grade students from a state school in Istanbul, Türkiye. Their ages were between 13 and 14. All participants had similarly low socio-economic backgrounds. The sample consisted of 80 students enrolled in two different classes. Although there were 92 students in total across the two classes, those who did not attend all sessions were excluded from the study. Participants were included in the research if they took part in the SDG instruction for the eight-week period; otherwise, they were excluded. The participants' distributions in 2 different classes were as follows: 40 students (20 girls and 20 boys) in one class as an experimental group and 40 students (22 girls and 18 boys) in another class as a control group. Since a quasi-experimental research design was employed in the current research, students in one class, the experimental group, received learn–think–act-based SDG instruction, while students in the other class, the control group, were taught using lecture-based SDG instruction. All of the participants were taking the course for the first time and had no pre-knowledge of or experience with the SDGs. The science teacher, who taught the students in two different classes, had ten years of teaching experience and was trained by researchers prior to the SDG implementation. The same science teacher taught students in both classes to ensure the maintaining of internal validity and the minimizing of confounding variables.

3.3. Implementation

At the beginning of the course, the sustainability consciousness of all students in the two classes was measured using the 'Sustainability Consciousness Questionnaire (SCQ)'. Then, the science teacher began implementing the learn–think–act-based SDG instruction in one class, designated as the experimental group, and lecture-based SDG instruction in the other class, designated as the control group. The implementation of SDG instruction continued for eight weeks, including 2–3 lesson hours each week. The science teacher taught all Sustainable Development Goals (SDGs) from SDG1 to SDG17 for eight weeks in

two classes. During the lecture-based SDG instruction, the science teacher gave information about Sustainable Development Goals (SDGs) based on a content-oriented approach. The science teacher used a chalkboard to present theoretical information about SDGs. In this process, students were passive learners, and the interactions between the students and the teacher, and among students themselves, were little. On the other hand, during the learn–think–act-based SDG instruction, teaching that actively engaged students was carried out. In the first part (the 'learn' part) of the course, the science teacher presented theoretical SDG knowledge and showed videos about each SDG to the learners, encouraging them to ask questions. In the second part (the 'think' part) of the course, the students carried out both local- and global-based activities to critically reflect on each SDGs. In the third (the 'act') part, the students discussed how to achieve each SDG, and they watched videos about the solutions of local or global issues all over the world. How the learn–think–act-oriented and lecture-based SDG instructions were implemented can be examined in Table 1. Moreover, Table 2 demonstrates an example of the detailed context of the learn–think–act-oriented SDG instruction (SDG 13: Climate Action). Figures 2 and 3 display photos from the learn–think–act-based and lecture-based SDG instruction, respectively. The learn–think–act-oriented SDG instruction can also be examined in detail in the article by Koçulu and Topçu [82]. At the end of the SDG instruction, the sustainability consciousness of all students in two classes was measured again using the 'Sustainability Consciousness Questionnaire (SCQ)'.

Table 1. The learn–think–act-approach-oriented and lecture-based SDG instructions.

Week	Learn–Think–Act Approach-Based SDG Instruction	Lecture-Based SDG Instruction
	Data collection: 'The Sustainability Consciousness Questionnaire'	
Week 1 (2 lesson hours)	Learn: SD and 17 SDGs Background+Videos Think: Let's achieve sustainable development and Sustainable Development Goals! Act: What can you do for the world we want to live in?	Theoretical Information about SD and 17 SDGs
Week 2 (3 lesson hours)	Learn: SDG 1 Background+Videos Think: The world's resources are not fairly or equally distributed! Act: What can you do to end poverty? + Videos	Theoretical Information about SDG1
	Learn: SDG 2 Background+Videos Think: What's on our plate? Every plate tells people's stories. Act: What can you do for zero hunger? + Videos	Theoretical Information about SDG2
	Learn: SDG 3 Background+Videos Think: A healthy and prosperous life for everyone! Act: What can you do for good health and well-being? + Videos	Theoretical Information about SDG 3
Week 3 (3 lesson hours)	Learn: SDG 4 Background+Videos Think: Quality education can change and transform our world! Act: What can you do for quality education? + Videos	Theoretical Information about SDG4
	Learn: SDG 5 Background+Videos Think: Everybody wins if gender equality exists all around the world! Act: What can you do for gender equality? + Videos	Theoretical Information about SDG5
	Learn: SDG 6 Background+Videos Think: Can you live with dirty water? Clean water for all! Act: What can you do for clean water and sanitation? + Videos	Theoretical Information about SDG6

Table 1. *Cont.*

Week	Learn–Think–Act Approach-Based SDG Instruction	Lecture-Based SDG Instruction
Week 4 (3 lesson hours)	Learn: SDG 7 Background+Videos Think: Let's use renewable energy! Act: What can you do for affordable and clean energy? + Videos	Theoretical Information about SDG7
	Learn: SDG 8 Background+Videos Think: Decent work and economic growth for a better world! Act: What can you do for decent work and economic growth? + Videos	Theoretical Information about SDG8
	Learn: SDG 9 Background+Videos Think: The world's future: industry, innovation, and infrastructure! Act: What can you do for industry, innovation, and infrastructure? + Videos	Theoretical Information about SDG9
Week 5 (3 lesson hours)	Learn: SDG 10 Background+Videos Think: We're not so different each other—let's stand as one! Act: What can you do for reducing inequalities? + Videos	Theoretical Information about SDG10
	Learn: SDG 11 Background+Videos Think: Build a dream city! Eco-friendly homes and sustainable living for everyone! Act: What can you do for sustainable cities and communities? + Videos	Theoretical Information about SDG11
Week 6 (2 lesson hours)	Learn: SDG 12 Background+Videos Think: Reduce, reuse, and recycle for a better life! Understanding the challenge of finite resources. Act: What can you do for responsible consumption and production? + Videos	Theoretical Information about SDG12
	Learn: SDG 13 Background+Videos Think: Climate action: Let's calculate our carbon footprint! Act: What can you do for climate action? + Videos	Theoretical Information about SDG13
Week 7 (2 lesson hours)	Learn: SDG 14 Background+Videos Think: Marine litter— protect life below water! Act: What can you do for life below water? +Videos	Theoretical Information about SDG14
	Learn: SDG 15 Background+Videos Think: Earth: It's everybody's home! The impact of pollution on our planet and our lives. Act: What can you do to protect life on land? +Videos	Theoretical Information about SDG15
Week 8 (2 lesson hours)	Learn: SDG 16 Background+Videos Think: The power of peace, justice, and strong institutions. Act: What can you do for peace, justice, and strong institutions? + Videos	Theoretical Information about SDG16
	Learn: SDG 17 Background+Videos Think: Heroes for change: Global citizens—working together to achieve the Sustainable Development Goals. Act: What can you do in terms of partnerships for the goals? + Videos	Theoretical Information about SDG17
	Data collection: 'The Sustainability Consciousness Questionnaire'	

Table 2. An example section of the learn–think–act-based SDG instruction.

SDG	Learn	Think	Act
	Cognitive learning objective Students explain the concept of climate change	Socio-emotional learning objective Students argue their own role and responsibilities related to climate change	Behavioral learning objective Students propose solutions for climate change
SDG 13—Climate Action	Background **Videos:** Understand SDG 13: Climate Action https://www.youtube.com/watch?v=6YqmEYlg4IY (accessed on 15 April 2025). https://www.youtube.com/watch?v=jhoa3OHivN8 (accessed on 15 April 2025).	Classroom activity: Climate action: Let's calculate our carbon footprint!	Classroom activity: What can you do for climate action? Videos: Take Action on SDG 13: Climate Action https://www.youtube.com/watch?v=b61FPARMsv8 (accessed on 15 April 2025). https://www.youtube.com/watch?v=ugWV-mx5h6o (accessed on 15 April 2025).

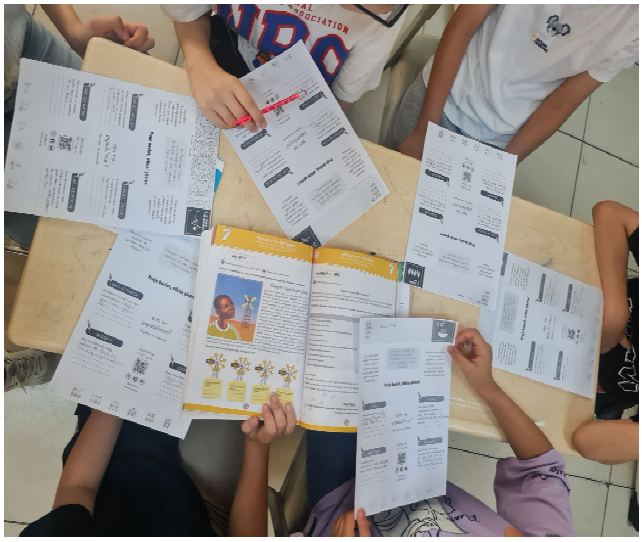

Figure 2. Photo from the learn–think–act-based SDG instruction.

Figure 3. Photo from the lecture-based SDG instruction.

3.4. Data Collection

The data of the present research were collected using the 'Sustainability Consciousness Questionnaire (SCQ)'. The questionnaire was developed by Michalos et al. [91] based on UNESCO's [92] social, environmental, and economic subthemes, and it was later revised by Gericke et al. [93] following UNESCO [10,92] subthemes. Yüksel and Yıldız [94] translated and adapted it into Turkish and used it to detect students' sustainability consciousness level. The questionnaire has 50 items and 3 factors (Knowingness, Attitude, and Behavior). Each factor has 3 subfactors: economic, social, and environmental. The questionnaire utilizes a 5-point Likert scale, with response options spanning from 'strongly agree' to 'strongly disagree'. The 'knowingness' factor includes 19 items, the 'attitude' factor involves 14 items, and the 'behavior' factor consists of 17 items [68]. In addition, the 'economic' sub-factor includes 13 items, the 'social' sub-factor involves 20 items, and the 'environmental' sub-factor consists of 17 items [68]. The items of factors and subfactors of SCQ are presented in Table 3. Furthermore, some items of the SCQ are given in Appendix A. Research has shown that SCQ is useful for determining the impacts of learning interventions with various contexts and designs that address global citizenship [95]. The coefficients of Cronbach's alpha calculated by the developer of the SCQ [68] and the researcher are presented in Table 4. These scores show that the SCQ is a highly reliable questionnaire, confirming internal consistency.

Table 3. Items of factors and subfactors of SCQ.

Factors of SCQ	Sub-Factors of SCQ	Items
Knowingness	Economic	1, 11, 14, 15, 17
	Social	2, 5, 7, 8, 9, 10, 13, 18
	Environmental	3, 4, 6, 12, 16, 19
Attitude	Economic	22, 25, 26, 31
	Social	20, 21, 28, 29, 30, 32
	Environmental	23, 24, 27, 33
Behavior	Economic	39, 42, 44, 49
	Social	37, 38, 46, 47, 48, 50
	Environmental	34, 35, 36, 40, 41, 43, 45

Table 4. Cronbach's alpha values for the SCQ.

SCQ	Values by the Developer	Values for This Study
EnvEcoSoc KAB	0.88	0.95
Env KAB	0.74	0.86
Eco KAB	0.67	0.81
Soc KAB	0.79	0.91
K	0.83	0.90
A	0.74	0.89
B	0.80	0.84

3.5. Data Analysis

The data in this study were analyzed using both paired and independent samples *t*-tests. Prior to performing the paired and independent samples *t*-tests, the necessary assumptions for these parametric analyses were verified. For paired samples *t*-test, the assumptions of dependent observations, continuous data, normality of differences, and no significant outliers in the differences were met. For independent samples *t*-test, the assumptions of the independence of observations, a continuous dependent variable, normality, homogeneity of variances, and no significant outliers were checked. Since the assumptions were met, these types of parametric tests were used in analyzing the data [87]. Firstly, an independent samples *t*-test was used to compare the pre-test scores of students from two different classes, and it was checked whether students' sustainability consciousness levels were similar or not before the SDG instruction. Then, the paired (dependent) samples *t*-test was used to compare the pre-test and post-test scores of the classes. That is, the effects of learn–think–act approach-based and lecture-based SDG instruction on students' sustainability consciousness were tested and measured separately within themselves. Then, an independent samples *t*-test was used again to compare the post-test scores of the two classes so as to determine which approach was more effective in developing sustainability consciousness.

3.6. Ethical Issues

In order to conduct this research, ethical permission was obtained from Yıldız Technical University Ethics Committee. Moreover, informed consent forms involving the voluntariness of students and permission from their parents were collected from all participants. The participants received detailed information about the research process. Additionally, students were informed that participation in the study was voluntary and that they could withdraw at any time. They were also briefed on how their data would be handled to ensure privacy. To maintain anonymity, no personal information or names of the participants were collected or disclosed.

4. Results

In the current research, the effects of learn–think–act approach-based and lecture-based SDG instructions on students' sustainability consciousness were examined and compared. The results are explained in detail under three different headings.

4.1. Results of the Effect of Learn–Think–Act-Approach-Based SDG Instruction on Students' Sustainability Consciousness

In the present study, the effects of learn–think–act approach-based SDG instruction on students' sustainability consciousness were investigated. Tables 5 and 6 present the pre-test and post-test results for the overall scores, factor scores, and sub-factor scores of the Sustainability Consciousness Questionnaire (SCQ). According to the scores, there were statistically significant differences in favor of students' total post-test scores ($t(39) = -5.83$ $p < 0.05$) and post-factor and post sub-factors test scores (Knowingness factor, economic sub-factor—$t(39) = -4{,}125$; social sub-factor—$t(39) = -3.86$; environmental sub-factor—$t(39) = -4.13$, $p < 0.05$) (Attitude factor, economic sub-factor—$t(39) = -3.96$; social sub-factor—$t(39) = -5.30$; environmental sub-factor—$t(39) = -4.61$, $p < 0.05$) (Behavior factor, economic sub-factor—$t(39) = -8.97$; social sub-factor—$t(39) = -5.03$; environmental sub-factor—$t(39) = -5.24$, $p < 0.05$).

Table 5. Descriptive results of students' pre- and post-sustainability consciousness following learn–think–act-based SDG instruction.

Factors of SCQ	Subfactors of SCQ		Mean	N	Std. Deviation
Knowingness	Economic	Pre-test	19.28	40	4.31
		Post-test	22.03	40	2.19
	Social	Pre-test	30.83	40	7.02
		Post-test	35.05	40	3.74
	Environmental	Pre-test	23.35	40	5.16
		Post-test	26.73	40	2.44
Attitude	Economic	Pre-test	16.75	40	3.40
		Post-test	19.08	40	1.10
	Social	Pre-test	22.83	40	5.45
		Post-test	27.20	40	2.56
	Environmental	Pre-test	15.00	40	3.66
		Post-test	17.85	40	2.06
Behavior	Economic	Pre-test	12.53	40	2.59
		Post-test	17.35	40	2.29
	Social	Pre-test	21.43	40	5.28
		Post-test	25.68	40	3.13
	Environmental	Pre-test	25.80	40	5.71
		Post-test	30.28	40	3.71
Total		Pre-test	187.78	40	35.50
		Post-test	218.68	40	16.57

Table 6. Results of paired samples *t*-test for students' pre- and post- sustainability consciousness with learn–think–act-based SDG instruction.

						95% Confidence Interval of the Difference				
Factors of SCQ	Subfactors of SCQ		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	*p*
Knowingness	Economic	Pre-test–Post-test	−2.75	4.22	0.67	−4.10	−1.40	−4.125	39	0.000
	Social	Pre-test–Post-test	−4.23	6.93	1.10	−6.44	−2.01	−3.86	39	0.000
	Environmental	Pre-test–Post-test	−3.38	5.17	0.82	−5.08	−1.72	−4.13	39	0.000
Attitude	Economic	Pre-test–Post-test	−2.33	3.71	0.59	−3.51	−1.14	−3.96	39	0.000
	Social	Pre-test–Post-test	−4.38	5.22	0.83	−6.04	−2.71	−5.30	39	0.000
	Environmental	Pre-test–Post-test	−2.85	3.91	0.62	−4.10	−1.60	−4.61	39	0.000
Behavior	Economic	Pre-test–Post-test	−4.83	3.40	0.54	−5.91	−3.74	−8.97	39	0.000
	Social	Pre-test–Post-test	−4.25	5.35	0.85	−5.96	−2.54	−5.03	39	0.000
	Environmental	Pre-test–Post-test	−4.48	5.40	0.85	−6.20	−2.75	−5.24	39	0.000
Total		Pre-test–Post-test	−30.90	33.55	5.30	−41.63	−20.17	−5.83	39	0.000

In addition, Cohen's d value (effect size) was calculated according to the formula below and found to be 0.92, along with 95% confidence intervals (CI). This means that there

was a large significant difference between students' sustainability consciousness levels before and after the learn–think–act approach-based SDG instruction.

$$\text{Cohen's d} = \frac{\text{Mean}}{\text{Standard Deviation}} = \frac{30.90}{33.55} = 0.92$$

4.2. Results of the Effect of Lecture-Based SDG Instruction on Students' Sustainability Consciousness

In this study, the effect of lecture-based SDG instruction on students' sustainability consciousness was investigated. Tables 7 and 8 display the pre-test and post-test results for the overall, factor, and sub-factor scores from the Sustainability Consciousness Questionnaire (SCQ). The total scores for pre-test and post-test did not show any statistically significant differences (t(39) = −0.102 $p > 0.05$), nor did post-factor and post-sub-factors test scores (Knowingness factor, economic sub-factor—t(39) = −0.35; social sub-factor—t(39) = 0.470; environmental sub-factor—t(39) = −1.05, $p > 0.05$) (Attitude factor, economic sub-factor—t(39) = −0.44; social sub-factor—t(39) = −92; environmental sub-factor—t(39) = −0.32, $p > 0.05$) (Behavior factor, economic sub-factor—t(39) = −0.30; social sub-factor—t(39) = −0.447; environmental sub-factor—t(39) = −0.604, $p > 0.05$).

Table 7. Descriptive results of students' pre- and post-sustainability consciousness with lecture-based SDG instruction.

Factors of SCQ	Subfactors of SCQ		Mean	N	Std. Deviation
Knowingness	Economic	Pre-test	20.33	40	2.29
		Post-test	20.48	40	2.11
	Social	Pre-test	32.78	40	4.07
		Post-test	32.40	40	2.77
	Environmental	Pre-test	24.13	40	3.60
		Post-test	24.83	40	2.33
Attitude	Economic	Pre-test	16.23	40	2.50
		Post-test	16.45	40	2.09
	Social	Pre-test	23.23	40	2.84
		Post-test	23.73	40	3.19
	Environmental	Pre-test	15.28	40	3.26
		Post-test	15.50	40	2.40
Behavior	Economic	Pre-test	11.68	40	2.30
		Post-test	11.83	40	1.78
	Social	Pre-test	21.45	40	4.52
		Post-test	21.85	40	4.07
	Environmental	Pre-test	24.98	40	4.50
		Post-test	25.55	40	4.13
Total		Pre-test	191.68	40	18.28
		Post-test	192.05	40	16.31

Table 8. Results of paired samples *t*-test for students' pre- and post-sustainability consciousness in lecture-based SDG instruction.

						95% Confidence Interval of the Difference				
Factors of SCQ	**Subfactors of SCQ**		**Mean**	**Std. Deviation**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**df**	***p***
Knowingness	Economic	Pre-test–Post-test	−0.15	2.71	0.43	−1.02	0.72	−0.35	39	0.728
	Social	Pre-test–Post-test	−0.38	5.05	0.80	−1.24	1.99	0.470	39	0.641
	Environmental	Pre-test–Post-test	−0.70	4.21	0.67	−2.05	0.65	−1.05	39	0.300
Attitude	Economic	Pre-test–Post-test	−0.23	3.25	0.51	−1.27	0.82	−0.44	39	0.664
	Social	Pre-test–Post-test	−0.50	3.43	0.54	−1.60	0.60	−92	39	0.363
	Environmental	Pre-test–Post-test	−0.23	4.45	0.70	−1.65	1.20	−0.32	39	0.751
Behavior	Economic	Pre-test–Post-test	−0.15	3.16	0.50	−1.16	0.86	−0.30	39	0.766
	Social	Pre-test–Post-test	−0.40	5.67	0.90	−2.21	1.41	−0.447	39	0.658
	Environmental	Pre-test–Post-test	−0.58	6.03	0.95	−2.50	1.35	−0.604	39	0.550
Total		Pre-test–Post-test	−0.3750	23.33	3.69	−7.83	7.08	−0.102	39	0.920

Moreover, the Cohen's d value (effect size) was calculated according to the formula below and found to be 0.02, along with its 95% confidence intervals (CI). That is, there was no significant difference between the scores of the students' sustainability consciousness before and after lecture-based SDG instruction.

$$\text{Cohen's d} = \frac{\text{Mean}}{\text{Standard Deviation}} = \frac{0.3750}{23.33} = 0.02$$

4.3. Results of Comparison of the Effects of Learn–Think–Act-Approach-Based and Lecture-Based SDG Instructions on Students' Sustainability Consciousness

The results show that there were no statistically significant differences among the total pre-test scores of students in the experimental and control groups ($t(78) = -0.618$ $p > 0.05$). This means that the students' levels of sustainability consciousness in the experimental and control group were the same at the beginning of SDG instructions. On the other hand, the findings reveal that the experimental and control classes differed in their post-test scores, that is, there were statistically significant differences in favor of students' post total test scores in the experimental group ($t(78) = 7.243$, $p = 0.000$). That is, the post-test scores of the experimental group in which the learn–think–act-based SDG instruction was used were higher than in the control group following lecture-based instruction. This means that after the learn–think–act-based SDG instruction, students' sustainability consciousness developed significantly. On the contrary, there was no statistically significant change in students' sustainability consciousness after lecture-based SDG instruction (see Tables 9 and 10).

Table 9. Descriptive results of students' pre- and post-sustainability consciousness.

SCQ			**N**	**Mean**	**Std. Deviation**
Total	Pre-test	Experimental Group	40	187.78	35.50
		Control Group	40	191.68	18.28
	Post-test	Experimental Group	40	218.68	16.57
		Control Group	40	192.05	16.31

Table 10. Results of independent samples *t*-test for students' pre- and post-test sustainability consciousness.

					t-Test for Equality of Means					95% Confidence Interval of the Difference	
SCQ			**F**	**Sig.**	**t**	**df**	**Sig. (2-Tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
Total	Pre-test	Equal variances assumed	8.46	0.005	−0.618	78	0.539	−3.90	6.31	−16.47	8.67
		Equal variances not assumed			−0.618	58.315	0.539	−3.90	6.31	−16.54	8.74
	Post-test	Equal variances assumed	0.146	0.703	7.243	78	0.000	26.63	3.68	19.31	33.94
		Equal variances not assumed			7.243	77.981	0.000	26.63	3.68	19.31	33.94

Furthermore, the Cohen's d value (effect size) was calculated according to the formula below, and found to be 1.62, along with its 95% confidence intervals (CI). That is, there was a significantly large difference between the scores of the students' sustainability consciousness after learn–think–act-based and lecture-based SDG instruction.

$$\text{Cohen's d} = \frac{\text{Mean difference} = \text{Mean}_1 - \text{Mean}_2}{\text{Standart Deviation}_{\text{pooled}} = \sqrt{\left(\left(\text{SD}_1{}^2 + \text{SD}_2{}^2\right)/2\right)}} = \frac{218.68 - 192.05}{\sqrt{\left(\left(16.57\right)^2 + \left(16.31\right)^2\right)/2\right)}} = 1.62$$

4.3.1. Results About Knowingness Factor of Sustainability Consciousness

The results show that there were no statistically significant differences among the pre-knowingness factor and sub-factor test scores of students in the experimental and control groups (knowingness factor, t (78) = −1.424; economic sub-factor, t (78) = −1.36; social sub-factor, t (78) = −1.520; environmental sub-factor, t (78) = −0.779 $p > 0.05$). This means that the students' levels of knowledge in the experimental and control groups were similar at the beginning of SDG instructions. After SDG instructions, the findings reveal that the experimental and control classes differed in their post-test scores, that is, there were statistically significant differences in favor of students' post-knowingness factor and post-sub-factor test scores in the experimental group (knowingness factor, t(78) = 4.275; economic sub-factor, t(78) = 3.22; social sub-factor, t(78) = 3.600; environmental sub-factor, t(78) = 3.562, $p < 0.05$). That is, thanks to the learn–think–act-based SDG instruction, students' knowledge developed significantly. On the contrary, there was no statistically significant change in students' knowledge after lecture-based SDG instruction (see Tables 11 and 12).

Table 11. Descriptive results of students' knowingness.

SCQ Subfactors			**N**	**Mean**	**Std. Deviation**
Economic	Pre-test	Experimental Group	40	19.28	4.31
		Control Group	40	20.33	2.29
	Post-test	Experimental Group	40	22.03	2.19
		Control Group	40	20.48	2.11
Social	Pre-test	Experimental Group	40	30.83	7.02
		Control Group	40	32.78	4.07
	Post-test	Experimental Group	40	35.05	3.74
		Control Group	40	32.40	2.77

Table 11. *Cont.*

SCQ Subfactors			N	Mean	Std. Deviation
Environmental	Pre-test	Experimental Group	40	23.35	5.16
		Control Group	40	24.13	3.60
	Post-test	Experimental Group	40	26.73	2.44
		Control Group	40	24.83	2.33
Total Knowingness	Pre-test	Experimental Group	40	73.45	14.90
		Control Group	40	77.23	7.70
	Post-test	Experimental Group	40	83.80	7.30
		Control Group	40	77.70	5.31

Table 12. Results of independent samples *t*-test for students' knowingness.

								t-Test for Equality of Means		95% Confidence Interval of the Difference	
SCQ Subfactors			F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Economic	Pre-test	Equal variances assumed	16.64	0.000	−1.36	78	0.177	−1.05	0.77	−2.59	0.49
		Equal variances not assumed			−1.36	59.43	0.179	−1.05	0.77	−2.59	0.49
	Post-test	Equal variances assumed	0.079	0.779	3.22	78	0.002	1.55	0.48	0.59	2.51
		Equal variances not assumed			3.22	77.90	0.002	1.55	0.48	0.59	2.51
Social	Pre-test	Equal variances assumed	9.36	0.003	−1.520	78	0.133	−1.95	1.28	−4.50	0.60
		Equal variances not assumed			−1.520	62.605	0.133	−1.95	1.28	−4.51	0.61
	Post-test	Equal variances assumed	6.482	0.013	3.600	78	0.001	2.65	0.74	1.18	4.12
		Equal variances not assumed			3.600	71.90	0.001	2.65	0.74	1.18	4.12
Environmental	Pre-test	Equal variances assumed	3.65	0.060	−0.779	78	0.439	−0.78	0.995	−2.76	1.21
		Equal variances not assumed			−0.779	69.72	0.439	−0.78	0.995	−2.76	1.21
	Post-test	Equal variances assumed	0.515	0.475	3.562	78	0.001	1.90	0.53	0.84	2.96
		Equal variances not assumed			3.562	77.84	0.001	1.90	0.53	0.84	2.96
Total Knowingness	Pre-test	Equal variances assumed	11.102	0.001	−1.424	78	0.159	−3.78	2.65	−9.05	1.50
		Equal variances not assumed			−1.424	58.431	0.160	−3.78	2.65	−9.08	1.53
	Post-test	Equal variances assumed	9.964	0.002	4.275	78	0.000	6.10	1.43	3.26	8.94
		Equal variances not assumed			4.275	71.273	0.000	6.10	1.43	3.25	8.95

In addition, Cohen's d value (effect size) was calculated according to the formula below, and found to be 0.96, along with its 95% confidence intervals (CI). That is, there was a significantly large difference between the scores of the students' knowledge after learn–think–act approach-based and lecture-based SDG instruction.

$$\text{Cohen's d} = \frac{\text{Mean difference} = \text{Mean}_1 - \text{Mean}_2}{\text{Standart Deviation}_{\text{pooled}} = \sqrt{\left(\left(\text{SD}_1{}^2 + \text{SD}_2{}^2\right)/2\right)}} = \frac{83.80 - 77.70}{\sqrt{\left(\left(7.30\right)^2 + \left(5.31\right)^2\right)/2\right)}} = 0.96$$

4.3.2. Results About Attitude Factor of Sustainability Consciousness

The findings indicate no statistically significant differences in the pre-attitude factor and sub-factor scores between students in the experimental and control groups (attitudes factor, t(78) = −0.073; economic sub-factor, t(78) = 0.787; social sub-factor, t(78) = −0.412; environmental sub-factor, t(78) = −0.355, $p > 0.05$). This means that the students' attitudes in the experimental and control groups were at similar levels at the beginning of SDG instruction. After SDG instruction, the findings reveal that the experimental and control classes differed in their post-test scores, that is, there were statistically significant differences in favor of students' post-attitudes factor and post-sub-factor test scores in the experimental group (attitude factor, t(78) = 6.87; economic sub-factor, t(78) = 7.043; social sub-factor, t(78) = 5.37; environmental sub-factor, t(78) = 4.71, $p < 0.05$). In other words, thanks to learn–think–act-based SDG instruction, students' attitudes developed significantly. On the contrary, there was no statistically significant changes in students' attitude after lecture-based SDG instruction (see Tables 13 and 14).

Table 13. Descriptive results of students' attitudes.

SCQ Subfactors			N	Mean	Std. Deviation
Economic	Pre-test	Experimental Group	40	16.75	3.40
		Control Group	40	16.23	2.50
	Post-test	Experimental Group	40	19.08	1.10
		Control Group	40	16.45	2.09
Social	Pre-test	Experimental Group	40	22.83	5.45
		Control Group	40	23.23	2.84
	Post-test	Experimental Group	40	27.20	2.56
		Control Group	40	23.73	3.19
Environmental	Pre-test	Experimental Group	40	15.00	3.66
		Control Group	40	15.28	3.26
	Post-test	Experimental Group	40	17.85	2.06
		Control Group	40	15.50	2.40
Total attitude	Pre-test	Experimental Group	40	54.58	11.39
		Control Group	40	54.73	6.09
	Post-test	Experimental Group	40	64.13	4.37
		Control Group	40	55.68	6.44

Table 14. Results of independent samples *t*-test for students' attitude.

					t-Test for Equality of Means					95% Confidence Interval of the Difference	
SCQ Subfactors			F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Economic	Pre-test	Equal variances assumed	1.91	0.171	0.787	78	0.434	0.53	0.67	−0.80	1.85
		Equal variances not assumed			0.787	71.55	0.434	0.53	0.67	−0.81	1.86
	Post-test	Equal variances assumed	16.55	0.000	7.043	78	0.000	2.63	0.37	1.88	3.37
		Equal variances not assumed			7.043	58.96	0.000	2.63	0.37	1.88	3.37

Table 14. *Cont.*

SCQ Subfactors			F	Sig.	t	df	Sig. (2-Tailed)	*t*-Test for Equality of Means: Mean Difference	*t*-Test for Equality of Means: Std. Error Difference	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper
Social	Pre-test	Equal variances assumed	11.91	0.001	−0.412	78	0.682	−0.40	0.97	−2.33	1.53
		Equal variances not assumed			−0.412	58.76	0.682	−0.40	0.97	−2.34	1.54
	Post-test	Equal variances assumed	2.38	0.127	5.37	78	0.000	3.48	0.65	2.19	4.76
		Equal variances not assumed			5.37	74.59	0.000	3.48	0.65	2.19	4.76
Environmental	Pre-test	Equal variances assumed	0.528	0.470	−0.355	78	0.724	−0.28	0.77	−1.82	1.27
		Equal variances not assumed			−0.355	76.98	0.724	−0.28	0.77	−1.82	1.27
	Post-test	Equal variances assumed	0.738	0.393	4.71	78	0.000	2.35	0.50	1.36	3.34
		Equal variances not assumed			4.71	76.25	0.000	2.35	0.50	1.36	3.34
Total attitude	Pre-test	Equal variances assumed	9.238	0.003	−0.073	78	0.942	−0.1500	2.04	−4.21	3.91
		Equal variances not assumed			−0.073	59.622	0.942	−0.1500	2.04	−4.23	3.93
	Post-test	Equal variances assumed	4.697	0.033	6.87	78	0.000	8.45	1.23	5.99	10.90
		Equal variances not assumed			6.87	68.682	0.000	8.45	1.23	5.99	10.91

Furthermore, the Cohen's d value (effect size) was calculated according to the formula below and found to be 1.54, along with its 95% confidence intervals (CI). That is, there was a significantly large difference between the scores of the attitudes of students after learn–think–act-approach-based versus lecture-based SDG instructions.

$$\text{Cohen's d} = \frac{\text{Mean difference} = \text{Mean}_1 - \text{Mean}_2}{\text{Standart Deviation}_{\text{pooled}} = \sqrt{\left(\left(\text{SD}_1{}^2 + \text{SD}_2{}^2\right)/2\right)}} = \frac{64.13 - 55.68}{\sqrt{\left(\left(4.37\right)^2 + \left(6.44\right)^2\right)/2\right)}} = 1.54$$

4.3.3. Results About Behavior Factor of Sustainability Consciousness

The results show that there were no statistically significant differences among the pre-behavior factor and sub-factor test scores of students in the experimental and control groups (behavior factor, t(78) = 0.705; economic sub-factor, t(78) = 1.554; social sub-factor, t(78) = −0.023; environmental sub-factor, t(78) = 0.718, $p > 0.05$). This means that the students' behavior levels in the experimental and control groups were similar at the beginning of SDG instruction. After SDG instruction, the results reveal that the experimental and control classes differed in their post-test scores, that is, there were statistically significant differences in favor of students' post-behavior factor and post-sub-factor test scores in the experimental group (behavior factor, t(78) = 7.380; economic sub-factor, t(78) = 12.03; social sub-factor, t(78) = 4.71; environmental sub-factor, t(78) = 5.38, $p < 0.05$). Put differently, thanks to the learn–think–act-based SDG instruction, students' behaviors developed significantly. On the contrary, there was no statistically significant change in students' behavior after lecture-based SDG instruction (see Tables 15 and 16).

Table 15. Descriptive results of students' behavior.

SCQ Subfactors			N	Mean	Std. Deviation
Economic	Pre-test	Experimental Group	40	12.53	2.59
		Control Group	40	11.68	2.29
	Post-test	Experimental Group	40	17.35	2.29
		Control Group	40	11.83	1.78
Social	Pre-test	Experimental Group	40	21.43	5.28
		Control Group	40	21.45	4.52
	Post-test	Experimental Group	40	25.68	3.13
		Control Group	40	21.85	4.07
Environmental	Pre-test	Experimental Group	40	25.80	5.71
		Control Group	40	24.98	4.50
	Post-test	Experimental Group	40	30.28	3.71
		Control Group	40	25.55	4.13
Total behavior	Pre-test	Experimental Group	40	59.75	11.90
		Control Group	40	58.10	8.80
	Post-test	Experimental Group	40	70.75	6.75
		Control Group	40	59.23	7.21

Table 16. Results of independent samples *t*-tests for students' behavior.

								t-Test for Equality of Means		95% Confidence Interval of the Difference	
SCQ Subfactors			F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Economic	Pre-test	Equal variances assumed	0.054	0.817	1.554	78	0.124	0.85	0.55	−0.24	1.94
		Equal variances not assumed			1.554	76.85	0.124	0.85	0.55	−0.24	1.94
	Post test	Equal variances assumed	6.80	0.011	12.03	78	0.000	5.53	0.46	4.61	6.44
		Equal variances not assumed			12.03	73.51	0.000	5.53	0.46	4.61	6.44
Social	Pre-test	Equal variances assumed	0.964	0.329	−0.023	78	0.982	−0.03	1.10	−2.21	2.16
		Equal variances not assumed			−0.023	76.22	0.982	−0.03	1.10	−2.21	2.16
	Post-test	Equal variances assumed	2.647	0.108	4.71	78	0.000	3.83	0.81	2.21	5.44
		Equal variances not assumed			4.71	73.23	0.000	3.83	0.81	2.21	5.44
Environmental	Pre-test	Equal variances assumed	1.46	0.231	0.718	78	0.475	0.83	1.15	−1.46	3.11
		Equal variances not assumed			0.718	73.93	0.475	0.83	1.15	−1.47	3.12
	Post-test	Equal variances assumed	1.201	0.277	5.38	78	0.000	4.73	0.88	2.98	6.47
		Equal variances not assumed			5.38	77.13	0.000	4.73	0.88	2.98	6.47
Total behavior	Pre-test	Equal variances assumed	1.561	0.215	0.705	78	0.483	1.65	2.34	−3.01	6.31
		Equal variances not assumed			0.705	71.835	0.483	1.65	2.34	−3.02	6.32
	Post-test	Equal variances assumed	0.002	0.965	7.380	78	0.000	11.53	1.56	8.42	14.63
		Equal variances not assumed			7.380	77.677	0.000	11.53	1.56	8.42	14.63

Moreover, the Cohen's d value (effect size) was calculated according to the formula below, and found to be 1.65, along with its 95% confidence intervals (CI). That is, there was a significantly large difference between the scores of the behaviors of students after learn–think–act-approach-based versus lecture-based SDG instruction.

$$\text{Cohen's d} = \frac{\text{Mean difference} = \text{Mean}_1 - \text{Mean}_2}{\text{Standart Deviation}_{\text{pooled}} = \sqrt{\left(\left(\text{SD}_1{}^2 + \text{SD}_2{}^2\right)/2\right)}} = \frac{70.75 - 59.23}{\sqrt{\left(\left(6.75\right)^2 + \left(7.21\right)^2\right)/2\right)}} = 1.65$$

5. Discussion

The purpose of this study was to compare the effects of the learn–think–act approach-based and lecture-based SDG instruction on the progress of students' sustainability consciousness. The findings reveal that the learn–think–act approach-based SDG instruction had significantly large effects on improving students' sustainability consciousness, while the lecture-based SDG instruction had no effect. There are several studies that reveal the impacts of different approaches on students' sustainability consciousness in the current literature. The findings from previous research align with those of the current study. For example, Pauw et al. [71] showed in their study that Education for Sustainable Development can impact students' sustainability consciousness positively. Moreover, the results of another study show that the RADEC (Read Answer Discuss Explain and Create) learning model integrating Education for Sustainable Development is effective for improving sustainability consciousness in students [6]. Zhao et al. [96] indicated in their study that curricular emphasis and instructional practice have a significant effect on three aspects (economic, environmental and social) of students' sustainability consciousness. In another study, researchers showed that sustainability-based education affects students' consciousness of subjective norms, sustainable consumption, attitudes, and perceived behavioral control [97]. Othman et al. [98] revealed in their study that there is a statistically significant difference in the mean scores of sustainability consciousness between participants in the intervention group. Another study indicated that effectively integrating sustainability issues into STEM learning enhances the sustainability consciousness of junior high school students [99]. Kalsoom and Khanam's [100] research showed that empirical investigations into sustainability issues and research-based discussions enhanced preservice teachers' sustainability consciousness. This result highlights the transformative potential of inquiry-based active learning [100]. In another study, Olsson et al. [69] indicated that there was a positive impact of Education for Sustainable Development on the sustainability consciousness of students. The results of Berglund et al.'s [64] study reveal significant differences in sustainability consciousness between students from schools that teach using Education for Sustainable Development and those from regular schools. Another study showed that sustainability pedagogies like problem-based teaching, case studies, discussions and critical incidents enhanced pre-service teachers' SC in online educational settings [101].

All these results show that students' active engagement in sustainability issues helps develop their sustainability consciousness. On the other hand, traditional teaching methods are generally not effective in developing students' sustainability consciousness. The current study also revealed that learn–think–act approach-based SDG instruction, which includes interactive and learner-centered teaching, developed students' sustainability consciousness, while lecture-based SDG instruction had no effect on students' sustainability consciousness. Effective Education for Sustainable Development Goals requires interactive, integrative, learner-centered and action-oriented transformative learning settings [20,31]. Therefore, more integrated teaching approaches and pedagogies are urgently required to help raise students' sustainability consciousness, in order to build a sustainable future [40].

6. Conclusions, Limitations and Future Research

The aim of this study was to examine and compare the impacts of learn–think–act approach-based and lecture-based SDG instructions on the development of students' sustainability consciousness. The findings show that learn–think–act approach-based SDG instruction is one of the more highly effective teaching approaches for fostering sustainability consciousness. This research is important in the context of the current literature because developing sustainability consciousness contributes to the advancing transformation of the sustainability literacy of society. The need to address and readjust society's unsustainable way of living is an indisputable fact [102]. Thanks to this research, it is possible to respond to the need for alternative teaching approaches that promote sustainability consciousness and support social transformation.

On the other hand, the present research has some limitations. One of them is the limited number of participants, which may affect sample representativeness and restrict the generalizability of the findings. Therefore, similar studies could be conducted with larger groups in future research to enhance the generalizability and validity of the results. Moreover, a quasi-experimental research design was used, and this can lead to several disadvantages such as a lack of randomization, internal validity concerns, limited causal inferences, ethical constraints, and generalizability issues. Therefore, future studies can be conducted using experimental research designs. In the current research, *t*-tests are maintained as the primary mode of analysis. This can cause some limitations like a lack of replication, confounding variables, no generalizability, limited statistical power, etc. For example, using only one course per condition (e.g., one course might represent the experimental group and another the control group) can weaken the validity and generalizability of the findings. Any observed differences might be due to the characteristics of the specific courses (e.g., instructor style, student demographics, course content), rather than the experimental condition itself. Therefore, to strengthen the results and interpretations, effect sizes were accompanied with confidence intervals. In this study, only a quantitative research design was employed. Future research can be designed using qualitative or mixed method approaches to obtain in-depth insights into students' sustainability consciousness. The present research presented the results of the effects of learn–think–act-approach-based and lecture-based SDG instructions for 8 weeks. Longer-term follow-up studies to assess students' sustainability consciousness over time can be designed in future research. In spite of these limitations, this research can represent a pioneering effort in revealing the efficacy of learn–think–act-approach-based SDG instruction in advancing students' sustainability consciousness as future shapers of a sustainable world.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional review board (or ethics committee) of Yıldız Technical University (protocol code 20230201893, date of approval 2 February 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved through a "Voluntariness of subjects and informed consent form" and obtained from their parents through a "Child consent form for research purposes" before the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The author declares no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SDGs	Sustainable Development Goals
ESDG	Education for Sustainable Development Goals
SC	Sustainability Consciousness
SCQ	Sustainability Consciousness Questionnaire
CI	Confidence Intervals
Env	Environmental
Eco	Economic
Soc	Social
K	Knowingness
A	Attitudes
B	Behavior
KAB	Knowingness Attitudes Behavior
UNESCO	United Nations Educational, Scientific and Cultural Organization

Appendix A. Some Items of the Sustainability Consciousness Questionnaire (SCQ)

Factors of SCQ	Sub-Factors of SCQ	Items
Knowingness	Economic	1. Economic development is necessary for sustainable development.
	Social	9. Respecting human rights is necessary for sustainable development.
	Environmental	12. Preserving many different natural species is necessary for sustainable development.
Attitude	Economic	26. I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries.
	Social	32.I think that women and men throughout the world must be given the same opportunities for education and employment.
	Environmental	33. I think it is okay that each one of us uses as much water as we want.
Behavior	Economic	42. I often purchase second-hand goods over the internet or in a shop.
	Social	38. I often do things which are not good for my health.
	Environmental	43. I always separate food waste before putting out the rubbish when I have the chance.

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