



The Effect of Realistic Edutech-Based Consumer Education on Sustainable Behavior and Consumer Citizenship Competency in Female High School Students

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ABSTRACT

Introduction. The problem and the aim of the study. Although the 2022 South Korean national curriculum revision emphasizes digital competencies and education for sustainable development (ESD), there is a lack of empirically validated programs that integrate these components in secondary education. This study aims develop and evaluate an innovative educational program that leverages realistic Edutech to promote sustainable consumption among high school students in South Korea.

Research methods. The participants consisted of a total of 87 students, with 50 assigned to the experimental group and 37 to the control group. Surveys measuring sustainable consumption behavior and consumer citizenship competency were administered to all participants. For data analysis, SPSS Win Version 21.0 was used. A t-test was conducted to verify the homogeneity between the experimental and control groups. To evaluate the effectiveness of the program, ANCOVA (Analysis of Covariance) and paired t-tests were performed on both groups.

Results. To evaluate the effectiveness of the program, an analysis of covariance (ANCOVA) was conducted using pre-test scores as covariates to compare post-test scores between the experimental and control groups. After controlling for pre-intervention scores on sustainable consumption behavior, the estimated post-test mean was 4.009 for the experimental group and 3.611 for the control group, showing a statistically significant difference ($F = 7.747$, $p < .01$). A comparison of pre- and post-test scores also confirmed the program's effectiveness. In the experimental group, sustainable consumption behavior significantly improved from 3.204 to 3.939 ($p < .001$), while the control group showed a smaller but statistically significant increase from 3.464 to 3.706 ($p < .05$). Regarding consumer citizenship competency, the experimental group showed a significant improvement from 3.160 to 3.460 ($p < .001$), whereas the control group's score slightly decreased from 3.730 to 3.622, which was not statistically significant ($p > .05$).

Conclusion. These results suggest that the Realistic Edutech-based Sustainable Consumption Education Program had a positive effect on both sustainable consumption behavior and consumer citizenship competency among female high school students.

KEYWORDS

realistic edutech, consumer education, sustainable behavior, consumer citizenship competency, female high school student

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INTRODUCTION

The national curriculum in South Korea was revised in 2022 and is scheduled for implementation in general high schools starting with first-year students in 2025. The revision focuses on cultivating the competencies essential for addressing future societal challenges, such as digital transformation and climate change, as well as on strengthening personalized learning for learners [1]. The curriculum addresses the need for education that supports the development of digital competencies to navigate the rapidly changing and uncertain future driven by advancements in artificial intelligence technologies. Particularly in the context of the COVID-19 pandemic, the increased use of hybrid (online-offline) classes using educational technologies (Edtech), alongside the redesign of future-oriented teaching, learning, and evaluation systems, highlighted the need for curricular flexibility, which has been reflected in the revised framework [2].

Furthermore, the revised curriculum incorporates the growing demand for education for sustainable development (ESD) to address climate change and other environmental challenges, reflecting values such as respect for life, sustainability, and ecological sensitivity. The World Commission on Environment and Development (WCED), in its 1987 report, defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [3]. ESD refers to an educational approach that equips students with the principles, knowledge, skills, values, and attitudes to address global challenges, such as climate change, environmental issues, biodiversity loss, poverty, and inequality across all stages of education [4].

In 2015, the 70th UN General Assembly adopted the "Transforming Our World: The 2030 Agenda for Sustainable Development," which outlines 17 Sustainable Development Goals (SDGs) and 169 targets [5]. Le Blanc's [6] network indicated that SDG 12 (sustainable consumption and production), SDG 10 (reduced inequalities), SDG 1 (no poverty), and SDG 4 (quality education) are central to the SDG network. This highlights ESD's crucial role in achieving the SDGs by shaping awareness and attitudes toward sustainable consumption, production, inequality reduction, and poverty eradication, and global citizenship education.

Research on sustainable consumption has largely focused on predicting consumers' behavioral intentions based on their attitudes and awareness. However, an attitude-behavior gap exists, particularly in ethical actions such as sustainable consumption [7]. Therefore, fostering sustainable consumption requires focusing not only on shifts in awareness and attitudes but also on enabling behavioral change. Key factors influencing sustainable consumption behavior include self-efficacy, social-influence, and social media participation. In particular, individuals who believe their actions can positively impact sustainability and who possess high self-efficacy are more likely to engage in behaviors that enhance the quality of life, protect the environment, and consider the well-being of future generations [8]. According to Sickinger [9], various socializing agents—such as parents, peers, and social media—play a pivotal role in shaping the knowledge, attitudes, and behaviors related to sustainable consumption among Generation Z (born between 1997 and 2013). This supports the findings of Hong and Seo [10], who observed that adolescents' sustainable consumption behaviors are strengthened when social media engagement interacts with their confidence in their own influence. As a vital platform for influencing consumer behavior change, social media fosters a sense of social connectedness and can positively influence sustainable consumption [11; 12]. In this context, consumers are organically motivated to create and share content related to sustainable consumption, facilitating the acquisition of knowledge in the process. This dynamic emphasizes the importance of social networks, alongside psychological factors, in promoting sustainable consumption behaviors [13].

Moreover, sustainable consumption involves transforming values and attitudes associated with unsustainable lifestyles into sustainable practices, aiming to improve students' value systems and practical abilities to act sustainably [14; 15]. Fostering consumer citizenship competencies for sustainable consumption necessitates educating students about their roles as effective consumer citizens, equipping them with the knowledge, attitudes, and actions essential for responsible consumption [16]. Consumer citizenship emphasizes the role and identity of consumers not only in economic terms but also as citizens contributing to the common good [17].

Consumer citizenship competency encompasses several sub-competencies, such as consumer financial literacy, consumer transaction competence, and the ability to act as a consumer citizen.

These competencies are further categorized into knowledge, attitudes, and practices, which are interconnected, though not necessarily at the same level [18]. Research suggests that consumer education has a positive influence on the development of these competencies, thereby promoting sustainable consumption [19; 20].

Existing research on sustainable consumer education has primarily focused on university students and adults. However, there is a growing need for sustainable consumption education, specifically targeting high school students, who represent the future generation of sustainable consumers. Therefore, there is a pressing need to develop consumer education programs for this population and to assess their effectiveness in fostering consumer citizenship competencies.

In Korea's current educational landscape, there has been a growing interest in utilizing digital technologies—commonly referred to as Edutech, which combines education and technology – to enhance educational services. Edutech serves as a tool for enabling personalized learning, addressing learning gaps, enhancing communication among school stakeholders, and boosting academic engagement. Among various EdTech applications, immersive content utilizing cutting-edge technologies such as virtual reality (VR), augmented reality (AR), mixed reality (MR), and artificial intelligence (AI) has gained significant attention. While early realistic edutech content was costly and challenging to produce and implement, recent technological advancements have simplified content creation using tools accessible on smartphones or tablets, thereby enhancing educational effectiveness [21]. Existing research has extensively explored the use of realistic edutech in areas like Korean language education, spatial design, and nursing education [22; 23], however, research examining the effectiveness of realistic edutech in sustainable education remains limited.

Therefore, this study examines the effect of realistic edutech-based sustainable consumer education programs on sustainable consumption behavior and consumer citizenship competency among female high school students, using a nonequivalent control group design. The research objectives are as follows: (1) Develop a realistic edutech-based sustainable consumer education program for high school students. (2) Examine the effect of the program on students' sustainable consumption behavior. (3) Examine the effect of the program on students' consumer citizenship competency.

This program is expected to develop students' consumer citizenship competencies and encourage their participation in public welfare activities as responsible consumers, thereby promoting sustainable consumption behaviors.

MATERIALS AND METHODS

Realistic Edutech-based Sustainable Consumption Education Program

The development of content for sustainable consumer education focused on the environmental, social, and economic dimensions [24]. An analysis of Korean school consumer education content [25] was conducted, centered on identifying key content in Figure 1.

In organizing the program, the study drew upon Park's [24] framework, categorizing the content according to environmental, social, and economic domains based on the concept of sustainable consumption, and developed programs applicable to Korea's home economics education [26]. Realistic content was created for 16 sessions. The environmental component included topics such as environmentally friendly purchases, eco-friendly labels, food mileage, eco-friendly use, and eco-friendly disposal. The social component included human rights protection, fair treatment, and guarantee of labor rights. The economic component included responsible consumption, sustainable corporate product purchase, sharing economy, and cooperative consumption. Finally, teaching and learning guidelines were developed by reorganizing the core concepts of sustainable consumption: purchase, use, disposal, and practice.

Following the development of the education program, its content validity was evaluated by experts in field education, consumer education, and sustainable development education (professors and researchers). The Content Validity Ratio (CVR), calculated using Lowshe's [27] formula, was applied to evaluate the educational program's composition, its relevance to students' real lives, and the applicability of its content in Figure 2.

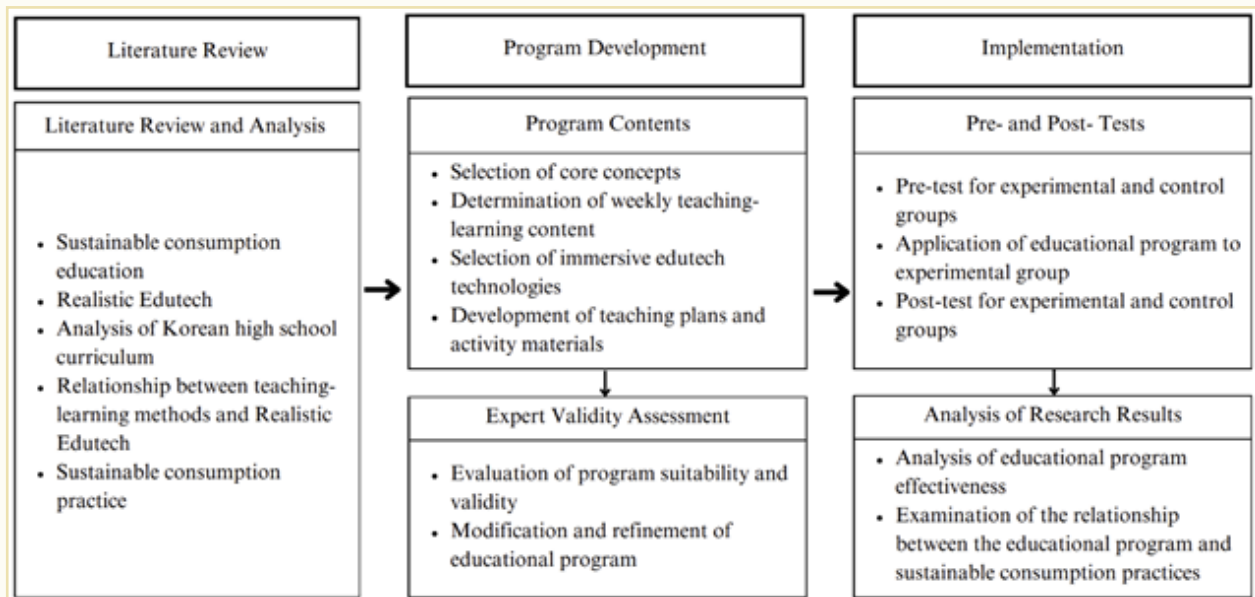


Figure 1 Research Flow Chart

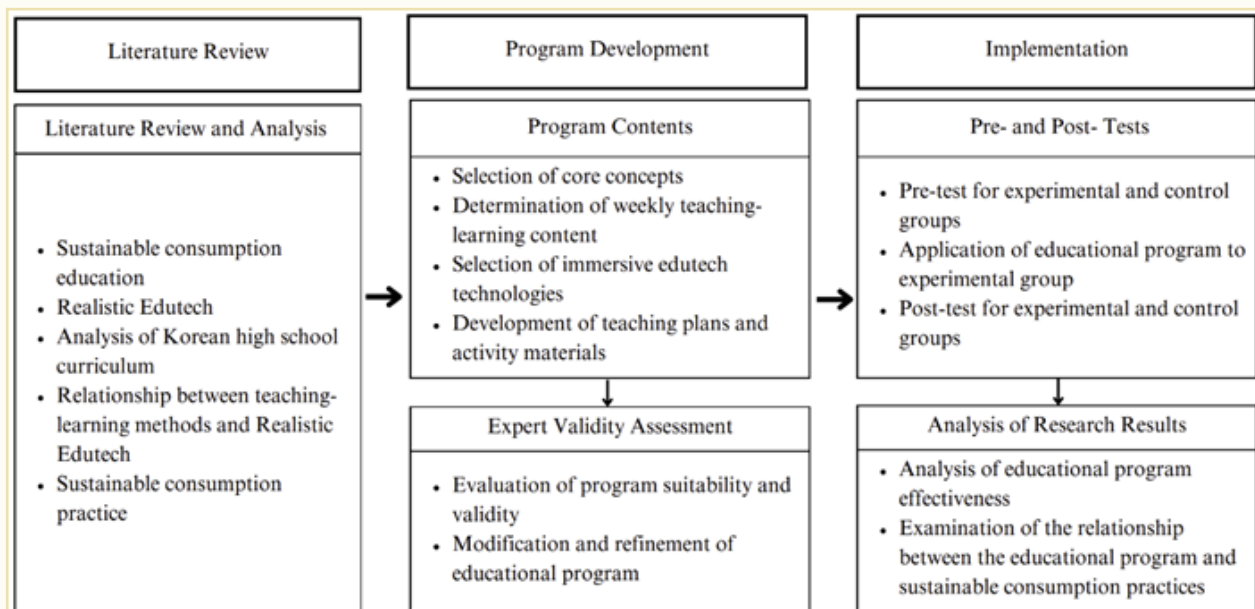


Figure 2 Procedure of Program Development

The CVR for each item ranges from -1 to 1, where a value of 1 indicates that all evaluators rate an item as essential. The CVR for this education program ranged from 0.75 to 1, indicating that more than half of experts deemed the program content as suitable.

Education Program subjects

The target population of this study was high school students in Korea. The experimental group comprised 50 first-year high school female students from Sangju, a city in Korea, while the control group comprised 37 first-year high school students from a metropolitan area. To control for potential differences in program effectiveness resulting from grade and gender, participation was limited to first-year high school female students. The study was conducted after obtaining approval from the Gyeongbuk National Bioethics Committee (IRB, 2024-0336) for student recruitment, preliminary survey, program implementation, and post-survey. The pre-survey was conducted from August 30 to September 13, 2024, and the post-survey was conducted (using Google Forms) from December 16 to December 30, 2024.

The education program consisted of 16 sessions conducted from September 27 to December 13, 2024. The experimental group consisted of 50 students who expressed interest in participating in the sustainable consumer education program and obtained parental consent. The control group comprised 37 students from other schools (enrolled in family studies classes) who agreed to participate and obtained parental consent.

Development procedure of educational program

To develop the education program, the contents were derived from the sustainable consumption education classification system and the revised 2022 curriculum for school consumer education. As the educational program utilizes realistic edutech, it was jointly developed by a subject teacher and a researcher for students enrolled in family studies or consumer education courses. The developed program was implemented by eight middle and high school teachers. The assessment used a 5-point Likert scale (1: not valid at all, 2: not valid, 3: normal, 4: valid, 5: very valid), and the content validity ratio (CVR) and coefficient of variation (CV) were calculated to provide basic information about the questions. The survey was conducted as both a pre-test and a post-test for high school students, focusing on the Sustainable Consumption Behavior and Youth Consumer Competency Level Scale, developed by the Korean Consumer Agency [26].

The program consists of 16 lessons, with its core concepts structured around five key topics: sustainability, eco-friendly purchase, eco-friendly usage, eco-friendly disposal, consumption environment, and sustainable consumption practices. The program content is organized into three domains: environmental sustainability (EN), social sustainability (SO), and economic sustainability (EC). Content within the environmental sustainability (EN) domain included eco-friendly labels, green purchasing, food mileage, local food, eco-friendly disposal, recycling, separate collection, environmental issues, and waste management. The social sustainability (SO) domain covered sustainable development, sustainable development goals, fair trade (human rights), ethical consumption, and environmental conservation practices. The Economic Sustainability (EC) domain consisted of the sharing economy, climate and economic inequality, and sustainable consumption practices.

Program Implementation

The program was conducted over 16 sessions with 50 first-year students at S High School in Gyeongsangbuk-do, South Korea. The classes were held during the school's home school hours. Students used tablet PCs, and the edtech tools utilized included YouTube, realistic VR, quiz and problem-solving apps, Google Maps, Google Earth, Padlet, online fair trade stores, Tridis, ChatGPT, music AI (SUNO), and a design platform. For web-based and application-based programs, students logged in during class time. Figure 3 depicts the activities for each class period.

Method of verify the effectiveness of program

This study employed a nonequivalent pretest-posttest experimental design, a type of quasi-experimental design (Table 1).

Table 1

Experimental Design

Group	Before program	Program	After program
G1	O1	X	O2
G2	O3	-	O4
G1: Experimental group, G2: Control group, O1, O3: Pre test, X: Experimental treatment, O2, O4: Post test			

The independent variable was the realistic edutech-based sustainable consumer education program, and the dependent variables were the sustainable consumption awareness and consumer citizenship competency of high school students. The experimental group completed a pre-test before the first session and a post-test after completing the 16-session program. The control group completed the pre-test and post-test at the same time periods as the experimental group.

Evaluation Tool

The sustainable consumption behavior was measured using a 33-item, 5-point Likert scale proposed by Park [24], with responses ranging from 'not at all' (1) to 'very much so' (5). Higher scores indicate higher levels of sustainable consumption behavior. The scale demonstrated excellent reliability, with Cronbach's α values ranging from .957 to .981 across both experimental and control groups at both pre-test and post-test.

Consumer citizenship competency was assessed using the Korean Consumer Agency's (2022) Youth Consumer Competency Level Scale. The scale consists of 7 questions on consumer knowledge, 7 questions on consumer attitudes, and 7 questions on consumer behavior, each with 2 sub-factors—claiming rights and accepting responsibilities. This 21-item, 5-point Likert scale ranges from "not at all" (1) to "very much so" (5), with higher scores indicating greater consumer citizenship competency. The Cronbach's α values ranged from .733 to .949 across the experimental and control groups at both the pre-test and post-test.

Analysis Method

Data analysis was performed using SPSS Win Version 21.0. First, the study used independent samples t-tests to examine the homogeneity between the experimental and control groups. Second, to assess program effectiveness, analysis of covariance (ANCOVA) and paired t-tests were applied to both groups.

RESULTS

Test of homogeneity between the experimental and control groups

To test the homogeneity between the experimental and control groups, a t-test was conducted. As shown in Table 2, the difference between the two groups was not significant. For sustainable consumption behavior, the control group exhibited a higher level than the experimental group; however, the difference was not statistically significant ($t = -1.793$, $p > .05$), indicating homogeneity for this variable.

However, a significant difference was found between the experimental and control groups in the case of consumer citizenship competency. The control group demonstrated statistically significantly higher consumer citizenship competency ($t = -2.475$, $p < .05$), indicating that homogeneity was not established.

Table 2

Homogeneity Test for the Experimental Group and Control Group

		N	M	S.D.	t	p
Sustainable consumption behavior	Experimental group	50	3.204	.675	-1.793	.070
	Control group	37	3.464	.661		
Consumer citizenship competencies	Experimental group	50	3.160	.650	-2.475	.017
	Control group	37	3.730	1.283		

Therefore, to evaluate the program's effectiveness, an analysis of covariance (ANCOVA) was conducted to compare post-test scores between the two groups, with pre-test scores serving as a covariate. This approach was chosen because the homogeneity test indicated that the sustainable consumption behavior was homogeneous between the experimental and the control groups; however, there was a difference in mean scores. Moreover, a significant difference was found between the two groups in consumer citizenship competency. Therefore, ANCOVA, a statistical method that controls for pre-test scores and compares post-test scores, was applied.

Validate the effectiveness of your program

ANCOVA was conducted using SPSS version 21 to test the differences in post-test sustainable consumption behavior scores between the experimental group and the control group, controlling for pre-test scores. The analysis revealed that the experimental group demonstrated a higher post-test score (mean of 3.939) than the control group (mean of 3.706). Levene's test for equality of variances was not significant, indicating that the variance between the two groups was statistically equal and the assumption was satisfied ($F=.040$, $p>.05$).

After controlling for pre-test scores, the estimated post-test sustainable consumption behavior scores were 4.009 for the experimental group and 3.611 for the control group. This difference between the groups was statistically significant ($F=7.747$, $p<.01$) (Table 3).

Table 3

Differences in Post-Sustainable Consumption Behavior between Groups

	N	Post-sustainable consumption behavior		After controlling for pre-score, post-sustainable consumption behavior	
		M	S.D.	M	S.E.
Experimental group	50	3.939	.721	4.009	.092
Control group	37	3.706	.833	3.611	.108
Levene's test for equality of error variances					
F		Df1		Df2	
.040		1		85	
Test for between object effects					
		Type III Sum of Squares	Mean Square	F	P
Modified model		16.490	8.245	19.683	.000
Preliminary sustainable consumption behavior		15.337	15.337	36.614	.000
Experimental-Control group		3.245	3.245	7.747	.007
Error		35.187	.419		
Modified total		51.677			

Next, the program's effectiveness was examined by comparing pre- and post-test scores for sustainable consumption behavior (Table 4).

For the experimental group, the pre-test score was 3.204, which increased to 3.939 after the program, a statistically significant improvement (paired $t=-6.723$, $p<.001$). Similarly, the control group demonstrated a statistically significant improvement from a pre-test score of 3.464 to a post-test score of 3.706 (paired $t=-2.657$, $p<.05$).

Therefore, it can be concluded that the realistic edutech-based sustainable consumer education program had a positive effect on high school students' sustainable consumption behavior.

Table 4

Validation of Pre-Post Difference in Sustainable Consumption Behavior

		N	M	S.D.	paired t	p
Sustainable consumption behavior	Pre-Test	50	3.204	.675	-6.723	.000
	Post-Test	50	3.939	.721		
Consumer citizenship competencies	Pre-Test	37	3.464	.661	-2.657	.012
	Post-Test	37	3.706	.834		

Consumer Citizenship Competencies

ANCOVA was applied using SPSS version 21.0 to test for differences in post-test scores of the experimental and control groups, controlling for pre-test scores. The analysis revealed that the control group (mean of 3.622) demonstrated a higher post-test score than the experimental group (mean of 3.460). Levene's test for equality of variances was not significant, confirming the equality of variance between the two groups ($F=3.194$, $p>.05$).

After controlling for the pre-test scores, the estimated post-consumer citizenship competency scores were 3.528 for the experimental group and 3.529 for the control group. The difference between the two groups was not statistically significant ($F=.000$, $p>.05$) (Table 5).

Table 5

Difference in Post-Test Consumer Citizenship Competencies Between Groups

		N	M	S.D.	paired t	p
Sustainable consumption behavior	Pre-Test	50	3.160	.650	-3.280	.002
	Post-Test	50	3.460	.676		
Consumer citizenship competencies	Pre-Test	37	3.730	1.283	.487	.629
	Post-Test	37	3.622	.893		

The program's effectiveness was confirmed through a pre-post comparative analysis (Table 6). For the experimental group, the pre-test score for consumer citizenship competency was 3.160, which increased to 3.460 after the program, a statistically significant improvement (paired $t=-3.280$, $p<.0101$). In contrast, for the control group, the pre-test score was 3.730, and the post-test score was 3.622, a decrease that was not statistically significant (paired $t=-.487$, $p>.05$).

Table 6

Consumer Citizenship Competency Pre-Post Difference Validation

	N	Post-sustainable consumption behavior		After controlling for pre-score, post-sustainable consumption behavior	
		M	S.D.	M	S.E.
Experimental group	50	3.460	.676	3.528	.105
Control group	37	3.622	.893	3.529	.123
Levene's test for equality of error variances					
F		Df1		Df2	p
3.194		1		85	.077

Test of between objects effect				
	Type III Sum of Squares	Mean Square	F	P
Modified model	6.903	3.451	6.475	.002
Preliminary consumer citizenship competencies	41.283	41.283	77.448	.000
Experimental -control group	.000	.000	.000	.994
Error	44.776	.533		
Modified total	51.678			

Therefore, it can be concluded that the realistic edutech-based sustainable consumer education program had a positive influence on high school students' consumer citizenship competencies.

Participants emphasized that sustainable consumption is important for future generations, environmental protection, eco-friendliness, and fair trade. In addition, they expressed that realistic edutech-based sustainable consumption education helped them learn new and valuable knowledge. They also noted that the content was easy to understand and expressed satisfaction with learning through digital devices and online platforms. Regarding the challenges, students reported experiencing network instability, issues with accessing online sites, and difficulties using digital devices. Nevertheless, most students expressed satisfaction with their participation in the program.

DISCUSSION

This study investigated the effectiveness of an immersive, edutech-based sustainable consumer education program on the sustainable consumption behaviors of high school students. Building on prior research, the educational content was developed based on Park's [24] taxonomy of sustainable consumer education and the content elements of the 2022 revised school consumer education curriculum [26]. Theoretical and field experts were consulted on the educational content, and the final program was revised based on their feedback regarding the strengths and limitations of using edutech prior to its implementation with high school students. To assess the program's effectiveness, a non-equivalent pre-post experimental design, a quasi-experimental research design, was used. The study yielded several key findings.

First, the homogeneity of the experimental and control groups was assessed: perceptions of sustainable consumption behaviors showed no significant difference between the two groups at the pre-test, confirming the homogeneity.

Second, the effect of the experiential edutech-based sustainable consumer education program on sustainable consumption behavior was found to be significant.

Third, the realistic edutech-based sustainable consumer education program had a significant effect on improving consumer citizenship competency. The difference in pre- and post-scores between the experimental and control groups was not significant; however, the pre-post comparison revealed that the experimental group's consumer citizenship competency improved after the program, while the control group's competency decreased. This finding is consistent with research indicating an association between consumer citizenship competency and sustainable consumerism and the positive effect of consumer education on fostering this competency [19;20]. Therefore, continued efforts are necessary to enhance students' consumer citizenship competency through targeted educational programs [28].

CONCLUSION

As this study focused on high school students, a quasi-experimental design was chosen rather than a pure experimental design. Since the experimental group had lower sustainable consumption behavior scores than the control group in the pretest, the educational program was administered to the experimental group. Moreover, since the program's effectiveness was demonstrated, the same program will be offered to the control group to improve their sustainable consumption behavior. This study is significant in that it confirms sustainability can be achieved through education [28].

Nevertheless, a quasi-experimental design shares similarities with the control group pretest design in a pure experimental setup but differs in that it does not randomly assign participants to the experimental and control groups. This design was used to measure the pre- and post-test scores in an educational setting where the random assignment was difficult to apply. It is also important to note that the study was limited to Korean female students, precluding the identification of potential differences by gender. However, gender is known to influence environmental attitudes and behaviors [29]. Previous studies have shown contradictory findings regarding gender and sustainable consumption: while some suggest that men engage more actively in sustainable consumption through moral identity [30], others indicate that women exhibit stronger intentions toward green consumption and purchase eco-friendly products more frequently [31]. Therefore, future research should investigate sustainable consumption behaviors among Korean male and female high school students.

Therefore, future studies should employ a pure experimental design that randomly assigns participants to experimental and control groups within the same school and analyze the effectiveness of educational programs by gender, region, and other relevant variables.

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