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The impact of training on digital citizenship skills in developing students' attitudes towards sustainable development at the university level

Safar Bakheet Almudara
Department of Educational Sciences, Prince Sattam Bin Abdulaziz University, Saudi Arabia
Mohamed Mahmoud El-Gammal
Department of Islamic studies, Hamad Bin Khalifa University
Maiada Hasan Ali
Department of English, Al-Iraqia University, Iraq
Mohamed Sayed Abdellatif*
Department of Psychology, Prince Sattam Bin Abdulaziz University, Saudi Arabia/ Department of Educational Psychology, Al-Azhar University, Egypt.
Adel Ibrahim Abdullah Elshazly
Department of Curriculum and Teaching Methods, King Faisal University in Al-Ahsa, Saudi Arabia
Sherif Ahmed Ibrahim
Department of Educational Technology, University of Bisha, Saudi Arabia
Anwar Hammad Al-Rashidi
Department of Psychology, Prince Sattam Bin Abdulaziz University, Saudi Arabia.
* **Corresponding author:** m.heby@psau.edu.sa
https://orcid.org/0000-0002-2212-5256

Abstract
The research aimed to investigate the impact of training on digital citizenship skills in developing attitudes toward sustainable development among university students. The study involved 25 first-year students from Prince Sattam bin Abdulaziz University, including 13 Medical Sciences College students in the experimental group and 12 Engineering College students in the control group. The researchers administered the following tools: the training program and the Sustainable Development Attitude Scale. A quasi-experimental design was employed, and data were analyzed statistically using the Mann-Whitney and Wilcoxon tests. The research results revealed statistically significant differences between the mean ranks of the scores of individuals in the experimental and control groups on the Sustainable Development Attitude Scale after the implementation of the program in favor of the experimental group. Additionally, statistically significant differences were found between the mean ranks of the scores of individuals in the experimental group on the Sustainable Development Attitude Scale in the pre-test and post-test measures in favor of the post-test. However, no statistically significant differences were found between the mean ranks of the scores of the experimental group on the Sustainable Development Attitude Scale in the post-test and follow-up measures (after one month). The researchers provided a comprehensive discussion of the study variables: attitudes towards sustainable development and its components, as well as the training program based on digital citizenship skills in the current study. Furthermore, the researchers presented some recommendations and proposed further research.

Keywords: attitudes, digital citizenship skills, sustainable development, training program, university students.

Public Interest Statement

The research examines how teaching digital citizenship skills to university students fosters sustainable development attitudes, aligning with global goals like the SDGs and Vision 2030. It shows a positive impact on students' environmental stewardship and social responsibility but emphasizes the need for ongoing reinforcement. Integrating digital citizenship into education can cultivate conscientious global citizens contributing to sustainable development.

Introduction

The current global landscape is experiencing significant changes due to the rapid progress of telecommunications and information technology. These advancements have become deeply integrated into daily life, influencing various sectors and functionalities. They not only improve efficiency but also transform educational approaches, promoting holistic development. Despite the numerous benefits of technology, its widespread use presents challenges that require careful consideration. While facilitating communication, knowledge sharing, and societal progress, technology also requires careful management to address potential drawbacks and risks. Finding a balance between harnessing the benefits of digital citizenship and mitigating associated challenges is essential. It's vital for individuals, including students, educators, and educational institutions, to develop a nuanced understanding of digital citizenship and technological proficiency to navigate the digital age effectively. Cultivating a culture of digital citizenship within education is crucial. Educational systems need to adapt by prioritizing the development of digital literacy to prepare individuals for the ongoing digital revolution, as economies worldwide transition towards digitalization driven by rapid technological advancements.

The transition from being an ordinary citizen to a digital citizen emerged during the twenty-first century, coinciding with the globalization of citizenship driven by the concept of the global village, notably accelerated by the profound technological revolution leading to rapid digitalization (Saputra & Al Siddiq, 2020). Digital citizenship is acknowledged as a multifaceted and intricate concept (Choi, 2016). Digital citizenship skills (DCS) refer to the competencies required for the ethical, responsible, and secure engagement with information and communication technologies (ICT) by individuals across both national and international arenas (Rahman, 2021; Vasiliu-Feltes & Thomason, 2021). These competencies are crucial for fostering positive engagement in digital communities and ensuring the safeguarding of all users, irrespective of age or gender (Gu et al., 2023). Through the promotion of desirable behaviors and the mitigation of undesirable ones, DCS nurtures a sense of civic responsibility and dedication to societal progress among digital citizens.

The term "digital citizenship" refers to an individual's capacity to engage constructively, critically, and competently in the digital realm, utilizing effective communication and creation skills while upholding the rights and dignity of others and demonstrating responsible technology use (Sari et al., 2022). Teenagers, often equipped with cell phones and multiple online accounts, are expected to engage in online communities with politeness, ethics, and safety in mind, embodying the traits of responsible digital citizens (Pua'at, 2023). Furthermore, digital citizenship education encourages students to advocate for human rights such as freedom, privacy, and security, reflecting a growing concern among students for online safety (Hui, 2013).

These skills serve as a framework to empower individuals, particularly students, to excel in the digital age (Lu et al., 2023). Shenishen (2023) further characterizes them as skills that facilitate responsible, ethical, and secure usage of ICT within both local and global contexts. Aseeri (2023) expands upon this notion, portraying DCS as a comprehensive framework encompassing rules, laws, systems, and

principles guiding students in effectively and safely utilizing digital technology across diverse contexts. In a society profoundly influenced by technology, grasping the concept of digital citizenship is paramount. This understanding includes the acquisition of technical skills and adherence to accepted norms and standards when engaging with technology in various settings, such as home, school, or professional environments (Logan, 2016). DCS are structured around three principal dimensions: education, respect, and protection (Ribble & Park; 2022; Ribble, 2011).

Ribble and Bailey (2007) elaborate on nine facets of digital citizenship crucial for understanding its breadth and challenges. These dimensions encompass equitable access to electronic information (Digital Access), awareness of legitimate and illicit online transactions (Digital Commerce), mindful communication across digital platforms (Digital Communication), proficiency in technology use and content evaluation (Digital Literacy), adherence to digital interaction norms (Digital Etiquette), understanding of legal rights and cybercrime consequences (Digital Law), recognition of digital rights and ethical responsibilities (Digital Rights and Responsibilities), maintenance of digital well-being (Digital Health and Safety), and implementation of security measures to protect electronic data (Digital Security). Each dimension underscores the importance of responsible digital citizenship in promoting positive engagement and mitigating risks within the digital landscape.

Educators and students alike are urged to grasp these dimensions, a sentiment echoed by numerous scholars (Couros & Hildebrandt, 2015; Ribble, 2015; Hollandsworth & Donovan, 2011; Kara, 2018; Giddour, 2016; Boonlab& Pasitpakakul, 2023). Understanding the nuances of digital citizenship is not only pertinent but also imperative in today's educational landscape. These references highlight the critical necessity of incorporating digital citizenship education within educational curricula to equip students with the skills and knowledge necessary for responsible digital engagement. Educators must heed these insights to effectively guide students in navigating the complexities of the digital world, fostering a culture of digital responsibility and ethical conduct (Prasetivo et al., 2023).

The importance of Digital Citizenship (DC) has become increasingly evident across various facets of life, particularly in education, driven by the widespread adoption of e-learning systems. Within the education sector, DC plays a critical role by providing pedagogical strategies to aid educators and parents in directing students toward responsible technology usage, digital citizenship education functions as both an instructional resource and a tool for equipping students for engagement in society and active participation (Martin et al., 2019; Öztürk, 2021). The International Society for Technology in Education has developed national standards for integrating technology into education, delineating the competencies and perspectives students must cultivate to excel as proficient citizens within the continuously evolving digital terrain. Stressing the importance of nurturing proficient digital citizenship, ISTE advocates for learners to acquire competencies as digital citizens, creators of knowledge, designers of innovation, and collaborators on a global scale (Hollandsworth et al., 2011; Bal & Akcil, 2024; Hussainy & Jamalullah, 2021).

Teppers et al. (2014) find that adolescents who interact on social networking sites tend to experience reduced feelings of loneliness related to their peers compared to those who do not use such platforms, indicating a positive influence on their social connectivity. Mills (2016) adds that these teenagers are acquiring important social skills necessary for fostering positive relationships with peers through their engagement on social media platforms. Despite serving as a medium for communication, idea exchange, and emotional expression, social media also yields both advantageous and detrimental effects. Bocar & Jocson's (2022) research highlights differing perspectives on social media's impact among various populations, with Indonesian respondents reporting more favorable outcomes compared to Omani counterparts, who mention disturbances in sleep patterns and feelings of missing out on

positive experiences.

Additionally, the prevalence of online fraud, misinformation, and disinformation underscores the importance of providing individuals with the necessary skills through digital citizenship education to navigate these challenges effectively (Leca, 2022). Concerns raised by Sparrow et al. (2011) about potential declines in memory retention and interpersonal interactions due to Internet use are countered by Sherman et al. (2013), who argue that digital communication still enables emotional bonding through nonverbal cues like emoticons and video chats. Ferguson et al. (2015) suggest that Internet access may diminish individuals' confidence in their problem-solving abilities, potentially impacting cognitive development. However, Mills (2016) cautions against drawing definitive conclusions regarding the cognitive effects of Internet use on teenagers, advocating for further empirical research in this area. Thus, while internet use can influence cognitive development among young users, its precise effects remain subject to ongoing investigation.

Scholars (Couros & Hildebrandt, 2015; Lyons, 2012; Ribble, 2009; Ribble & Miller, 2013) have extensively examined the multifaceted nature of digital citizenship, stressing its significance beyond simple guidelines for technology usage. Instead, it embodies the cultivation of responsible individuals capable of effectively utilizing digital resources while mitigating potential risks. This perspective encompasses several crucial aspects. Firstly, it underscores the importance of personal responsibility for ongoing learning, emphasizing the need for continuous educational development. Secondly, digital citizenship serves as a framework for distinguishing truth from falsehood, facilitating constructive dialogue within educational environments. Thirdly, educators find guidance in understanding and teaching principles of digital conduct to students. Additionally, it promotes preparedness for active involvement in the global online community, encouraging informed participation. Moreover, it highlights the importance of safe, legal, and ethical use of technology and information. Finally, digital citizenship fosters positive technological behaviors centered on collaboration, learning, and productivity.

When employed effectively, digital skills emerge as crucial drivers of sustainable development (SD), wielding significant influence over knowledge creation and dissemination. They play a pivotal role in enhancing productivity levels, broadening job opportunities, bolstering competitiveness, nurturing human capital, and facilitating skill development. Through enabling collaboration in innovative forms of innovation, digital competencies empower both societies and individuals (ESCAP, 2022; Nambisan et al., 2019). Digital technologies, encompassing the Internet of Things (IoT) and Information and Communication Technologies (ICT), are acknowledged as potent instruments for advancing sustainable development goals (Del Río Castro et al., 2021; Sandoval, 2019; Langley, 2022; Paiola et al., 2021). Consequently, governments and organizations prioritize discussions on the integration and acceleration of digital transformation within sustainability agendas (Guandalini, 2022; Al-Abdullatif & Gamiel, 2020).

Contemporary technology and digital skills are characterized by attributes such as speed, ease of use, significant impact, and versatility, rendering them pivotal in advancing sustainable development (SD) goals (Clayton & Nicholas, 2018). Sustainable development heavily relies on state-of-the-art technology for essential processes such as recycling, economic reuse of electronic devices, material substitution, production optimization, pollution control, and efficient resource utilization (Goralski& Radcliffe, 2020). In the foreseeable future, the Internet of Things (IoT) is expected to play a significant role in sustainable community development and environmental protection by integrating digital sensors and smart devices (Salam, 2020). Sustainability, as defined by Al-Waly (2023), revolves around ensuring the effective and fair allocation of resources across generations while engaging in economic and social activities into ecological limitations. It entails investing in environmental resources effectively to meet

current needs without compromising the rights of future generations (Suleiman, 2020). Sustainable development encompasses three pillars: environmental safety, social justice, and economic prosperity (Gatti et al., 2019).

Education stands as a fundamental pillar for achieving sustainable development, serving as a key conduit for acquiring knowledge on social, environmental, and economic aspects of sustainable development (Mora et al., 2020). It plays a pivotal role in increasing one's awareness and shaping attitudes towards sustainability dimensions. Education for sustainable development aims to cultivate awareness and alter attitudes towards sustainability across environmental, economic, and societal domains, providing an enabling learning environment for skill and value development (Kalsoom & Khanam, 2017). Individuals require specific attitudes and skills in sustainability, crucial for comprehending and advocating for sustainable behaviors (Probst et al., 2019). Sustainable development hinges on collective responsibility, promoting economic advancement, holistic social development, and environmental preservation (Illahaqi et al., 2021; Judge et al., 2022).

Global communities grapple with complexities in sustainability due to changes in population dynamics, globalization, urbanization, climate change, and the depletion of natural resources. Addressing these challenges necessitates altering individuals' behaviors and attitudes across all aspects of life, underscoring the vital role of education in shaping sustainable attitudes and behaviors (Ambusaidi & Al Washahi, 2016). Attitudes toward sustainable development (ASD) encompass individuals' inclinations, values, habits, and emotional and behavioral attitudes toward sustainable development (Michalos et al., 2011). ASD spans environmental, social, and economic dimensions, contributing to economic development, environmental protection, and equitable social development (Probst et al., 2019; Tsai, 2018). Technology and digital citizenship skills play critical roles in achieving sustainable development goals. They provide avenues for increasing income opportunities, generating new job prospects, fostering economic growth, supporting decision-making, enhancing agriculture, promoting renewable energy, and facilitating education through remote learning (Brynjolfsson & McAfee, 2014; UNCTAD, 2015; UNCTAD, 2018; ESCAP, 2022; Abbasi et al., 2022).

Despite the crucial role of digital citizenship in achieving sustainable development, university students often lack awareness of its importance and proficiency in online communication and ethical interaction skills (Young, 2014). Integrating digital citizenship components into the curriculum can empower students to engage with technology securely and ethically (Karaduman & Oztürk, 2014; Sari et al., 2022). There is an increasing interest in enhancing digital citizenship education among higher education students, highlighting the importance of fostering digital respect and appropriate behaviors (Jones & Mitchell, 2015; Hollandsworth et al., 2011). However, findings regarding the level of digital citizenship skills among students and gender differences are varied (Al-Samadi, 2017; Al-Hadif, 2021; Al-Qarni, 2021; AlZebidi & Alsuhaymi, 2021; Abu Al-Majd & Al-Youssef, 2018; Alamri & Alqahtani, 2022; Mahadir et al., 2021).

Numerous research studies underscore the importance of fostering sustainable attitudes among learners across different educational levels. However, a review of the psychological literature in this field reveals a notable dearth of Arab studies. To the best of the researchers' knowledge, no study has examined the impact of training in DCS developing programs on the development of attitudes toward sustainable development among university students. Globally, communities grapple with trends exacerbating sustainability challenges, including population dynamics, urbanization, globalization, climate change, resource depletion, and environmental degradation. Ambusaidi & Al Washahi (2016) highlighted the necessity of altering individuals' behaviors and attitudes across all domains of life, a task unachievable without the active involvement of education in shaping individuals' behaviors and

attitudes, both at the individual and societal levels, towards sustainability.

To enhance the value and quality of life on Earth, a shift in individuals' behaviors and attitudes towards lifestyle patterns and the environment is imperative to address environmental challenges and issues. Hence, an attitude represents an individual's overall response to a reaction to a particular matter of concern. Numerous research studies emphasize the significance of cultivating sustainable attitudes among learners at various educational stages (Michalos et al., 2011; Tsai et al., 2012; Kalsoom & Khanam, 2017; Probst et al., 2019). The primary research question identified is: What is the impact of digital citizenship skills training on the development of university students' attitudes toward sustainable development? From this question the following hypotheses are developed:

- There are statistically significant differences between the mean ranks of scores of individuals in the experimental and control groups in the components of the Sustainable Development Attitude Scale and the total score after implementing the program in favor of the experimental group.
- There are statistically significant differences between the mean ranks of scores of individuals in the experimental group in the components of the Sustainable Development Attitude Scale and the total score in both the pre-test and post-test, favoring the post-test measurement.
- There are no statistically significant differences between the mean ranks of scores of individuals in the experimental group in the components of the Sustainable Development Attitude Scale and the total score in both the post-test and the follow-up test (one month later).

Methodology

Research Design and Setting

The researchers employed a quasi-experimental methodology to investigate the impact of the digital citizenship skills training program (as an independent variable) on the development of attitudes toward sustainable development among university students (as a dependent variable). The researchers controlled for intervening factors in both the experimental and control groups under conditions where factors that could influence the dependent variables were regulated.

Research Participants and Sampling

The research community consisted of first-year students at a college complex in Wadi Al Dawasir province during the first semester of the 2023/2024 academic year. The researchers intentionally selected the research community to teach them during the first semester. Participants in the survey research included (109) students from the College of Arts and Sciences (age mean=20.64, SD= 1.31) to ensure the psychometric properties of the research tools.

To verify the research hypotheses, the researchers selected (141) students from the Colleges of Medical Sciences and Engineering as a basic research sample. The researchers chose the College of Engineering (control group) consisting of (67) students and the College of Medical Sciences (experimental group) consisting of (74) students. The Scale of Attitudes toward Sustainable Development was applied to them, and students' scores on this scale were arranged in descending order. The researchers selected those who scored low after responding to the scale, those falling in the lowest quartile representing (25%) of the scores on the scale, with a value of (25) points. They comprised (13) students in Medical Sciences and (12) students in Engineering. Thus, students who scored (25) or less were considered to have low attitudes toward sustainable development and were divided into experimental and control groups.

The researchers controlled for extraneous variables that might confound the effect of the independent variable (training program) on the dependent variable (attitudes toward sustainable development). Among the extraneous variables deemed potentially influential by the researchers was

gender. Therefore, the study was limited to male students only, to eliminate gender bias in attitudes toward sustainable development.

Furthermore, the researchers personally conducted the digital citizenship skills training for the experimental group during the training program. The two groups' equivalence was also established in terms of age, DCS, and attitudes toward sustainable development before the intervention. The results indicated no statistically significant differences between the mean ranks of the experimental and control groups in the pre-test measurement of chronological age, digital citizenship skills, including their components, as well as attitudes toward sustainable development and its components. This suggests the equivalence of the two groups in the pre-test measurement.

Data Collection Tools and Techniques

The training program.

The researchers developed and administered the training program as follows:

Principles of program construction

- Alignment of program content with participants' characteristics, inclinations, and general problems affecting their thinking patterns and psychological states. The program ensured a liberated content, comprising scenarios, activities, and real-life issues that stimulate thinking beyond university curricula. Psychological frameworks regarding digital citizenship skills and relevant prior studies were consulted in building the training program.
- The program had a general objective to achieve, along with operational behavioral objectives for each session. These operational objectives were integrated to achieve the overall goal of the program.
- Close correlation among all elements of each program session, including session objectives, content, utilized skills, duration, activities, and evaluation tools.
- Participant engagement ensured each student's active participation in the program, with various activities, stimuli, and multiple tasks fostering enthusiasm, activity, and preventing boredom. These included formulating session content in PowerPoint segments, cooperative learning circles among students, conducting competitions, presenting riddles, and participants performing theatrical presentations of certain scenarios.
- Repetitive training on each component ensured consolidation and refinement.
- Diverse techniques used in sessions encouraged active participation, alleviated boredom, and achieved session objectives, and consequently, the overall program goals.
- Utilization of formative assessment during training sessions to guarantee students' proficiency in program activities, and to conduct a final assessment after the program using an evaluation form that evaluates the objectives of each session.
- Designing specific sessions for each digital citizenship skill to introduce participants to each mechanism and train them on it at the beginning of the program.
- The program comprised a segment for knowledge, a segment for training, and a segment for actual practice. This involved presenting information about digital citizenship skills, then training participants on these skills during sessions, followed by participants' actual practice of these skills.

Steps of building the program

1. *Program Objectives:* The researchers defined the program objectives based on the definition of digital citizenship skills. The program content, methods, techniques, and evaluation methods were chosen according to the predetermined objectives. The general goal of the current program was defined as "training university students on digital citizenship skills to enhance their attitudes toward sustainable development." Subsidiary objectives of the program were formulated in light of digital citizenship skills.

2. *Program Content:* The program included skills and topics skills essential for university students with low attitudes toward sustainable development as follows:
   - *Session 1 (Introduction and Familiarization with the Training Program):* Introducing the researchers to the trainees, and pre-application of research tools, familiarizing with the nature of work and program objectives, and implementing its plan.
   - *Session 2 (Digital culture):* Understanding digital literacy skills, understanding how technology works, and using it appropriately.
   - *Session 3 (Digital culture):* Employing digital literacy skills in practical training exercises.
   - *Session 4 (Digital communication):* Understanding digital communication skills, understanding mechanisms and types of digital communication
   - *Session 5 (Digital communication):* Employing digital communication skills in practical training exercises, and communicating with others using various technological communication options.
   - *Session 6 (Digital commerce):* Understanding digital trade skills, and understanding mechanisms and methods of digital commerce.
   - *Session 7 (Digital commerce):* Employing digital trade skills in practical training exercises, electronic buying and selling of goods.
   - *Session 8 (Digital Access):* Understanding digital access skills, understanding mechanisms and methods of digital access.
   - *Session 9 (Digital Access):* Employing digital access skills in practical training exercises, utilizing modern applications in the learning and scientific research process.
   - *Session 10 (Digital laws):* Understanding digital laws skills, familiarizing yourself with intellectual property rights and ethics of the digital environment.
   - *Session 11 (Digital laws):* Employing digital law skills in practical training exercises, technologically protecting individual intellectual property, and digital security for applications and devices.
   - *Session 12 (Digital etiquette):* Understanding digital code of conduct skill, respecting intellectual property rights and ethics of the digital environment.
   - *Session 13 (Digital etiquette):* Employing digital code of conduct skills in practical training exercises, respecting others online, utilizing technology politely and effectively.
   - *Session 14 (Health and well-being):* Understanding health and well-being skills, and awareness of the harms of excessive use and addiction to digital technology.
   - *Session 15 (Health and well-being):* Employing health and well-being skills in practical training exercises, utilizing technology healthily and safely.
   - *Session 16 (Digital security):* Understanding digital security skills and recognizing the importance of information protection.
   - *Session 17 (Digital security):* Employing digital security skills in practical training exercises and utilizing firewalls and virus protection.
   - *Session 18 (digital rights and responsibilities):* Understanding digital rights and responsibilities skill, recognizing digital rights and responsibilities.
   - *Session 19 (Digital rights and responsibilities):* Employing digital rights and responsibilities skills in practical training exercises, utilizing privacy and freedom of expression in communication processes.
   - *Session 20:* The post-program application and follow-up of research tools one month after the conclusion of the training program.

1. *Tra Training Techniques and Methods in the Program:* Dialogue and discussion, lecture, brainstorming, cooperative learning, direct and symbolic modeling, self-evaluation of thoughts and behaviors, role-playing, conscious action, hypothetical thinking, gradual desensitization, positive self-talk, alternative method individual and group exercises to practice What would you do in the following situations?

2. *Program Duration and Number of Sessions:* The program was scheduled over ten weeks, in which 19 training sessions were conducted (each session lasting 60 minutes), with two sessions held weekly. The difficulty level of sessions was progressive, ranging from easy to difficult. Additionally, sessions for pre-test, post-test, and follow-up measurements were included. The following table illustrates the content of the training program.

3. *Program Evaluation*
   - Pre-assessment: Before implementing the program, a pre-assessment of digital citizenship skills was administered to participants of the experimental group.
   - Formative Assessment: Progress during program sessions was monitored by the researchers through an evaluation form focusing on session objectives. These forms were provided to participants after each session. Additionally, discussions about homework assignments were utilized by the researchers to evaluate the participants' level of benefit from the session, track progress in the program, and address any emerging shortcomings.
   - Final Assessment: Upon completion of the program, the final evaluation of program sessions encompassed:

     a. Post-assessment of digital citizenship skills for participants of the experimental group.
     b. Homework assignments: Students solved questions at home.
     c. Application of an effectiveness scale for experimental procedures.
     d. Conducting a follow-up assessment one month after the program's completion to verify the retention of learning effects after training.

4. *Program Validity*

The program was presented to a panel of five experts consisting of professors in educational technology and educational psychology to assess the validity of the training program, its procedures, objectives, and content. They were asked to provide their opinions on the program's suitability and the appropriateness of the evaluation for session objectives. Appropriate adjustments were made based on feedback and suggestions gathered. After reviewing the opinions of the experts, it was found that the program was suitable for its intended purpose. Their feedback confirmed the suitability of the arbitration elements for the program, with agreement percentages ranging from (80% - 100%). Additionally, the researchers applied three sessions of the program to five participants from the survey research to ensure the appropriateness of the program content, objectives, activities, techniques, and session timing for the participants.

Scale of Attitude toward Sustainable Development

The Attitude toward Sustainable Development (ASD) Scale was formulated by researchers following a thorough examination of theoretical frameworks concerning ASD and its constituent elements. They also drew upon prior research to ascertain measurement methods and factors (Biasutti & Frate, 2017;

Al-Naqbi & Alshannag, 2018; Suleiman, 2020; Mohammed, 2022; Michalos et al., 2011). Comprising four dimensions—Environmental, Economic, Social, and Educational—the scale includes 20 items evenly distributed across these dimensions, each containing five items. Respondents rate each item on a five-point scale ranging from strongly agree to strongly disagree (5-4-3-2-1), with higher scores indicating a more positive attitude toward sustainable development.

The scale's content validity was established by presenting it to seven educational psychology staff members, who demonstrated agreement rates ranging from 80% to 100% on the scale's content, affirming its content validity. Internal consistency was assessed using Pearson correlation coefficients, which showed statistically significant correlations (ranging from 0.419 to 0.834 at the 0.01 level) between item scores and corresponding dimension scores, as well as between component scores and the total scale score, indicating satisfactory internal consistency. To assess reliability, both the Guttman split-half reliability equation and Cronbach's alpha coefficient were employed after administering the scale to 109 participants. The resulting reliability coefficients (0.809 for Guttman's split-half equation and 0.740 for Cronbach's alpha coefficient) exceed the threshold of 0.7, indicating the high reliability of the ASD Scale.

Ethical Consideration

Regarding ethical considerations, before commencing the study, participants were briefed on the objectives of the research, and their informed consent was obtained. This transparent communication aimed to alleviate any potential anxiety among participants and encourage their commitment to honest responses, discouraging any inclination towards dishonest behavior. Furthermore, participants were not given any specific details to prevent data contamination which could skew the results.

Results

Results of the First Hypothesis

'There are statistically significant differences between the mean ranks of scores of individuals in the experimental and control groups in the components of the Sustainable Development Attitude Scale and the total score after implementing the program in favor of the experimental group' To test this hypothesis, the researchers utilized the "Mann-Whitney Test" to indicate differences as table (1) indicates.

Table 1. Differences between Control and Experimental Groups on Post-Application of the Attitudes toward Sustainable Development Scale (Mann-Whitney Test)

Attitudes toward sustainable development	Group	N	Mean of ranks	Sum of ranks	U	Z	Sig.	Effect Size «r"
Environmental field	Control	12	6.50	78,0	0	4.30	<0.001	0.860
	Experimental	13	19.0	247,0				
social field	Control	12	6.50	78,0	0	4.28	<0.001	0.856
	Experimental	13	19.0	247,0				
Economic field	Control	12	6.50	78,0	0	4.29	<0.001	0.858
	Experimental	13	19.0	247,0				
Education Field	Control	12	6.50	78,0	0	4.31	<0.001	0.862
	Experimental	13	19.0	247,0				
Total Score	Control	12	6.50	78,0	0	4.26	<0.001	0.852
	Experimental	13	19.0	247,0				

The previous table (1) indicates statistically significant differences at a significance level of (0.01) between the mean ranks of the scores of individuals in the experimental and control groups in the components of the Sustainable Development Attitude Scale and the total score after implementing the program in favor of the experimental group. This means that the first hypothesis is valid, as the average ranks of the experimental group were higher than those of the control group, indicating a statistically significant increase in the attitudes level towards sustainable development in the experimental group compared to the control group.

To ascertain the high effect of the training program utilized in developing the attitude toward sustainable development and its components, the researchers calculated the effect size of the program utilizing the R equation for the effect size of the Mann-Whitney U test:

Where:

- The value of the Mann-Whitney test statistic.
- The number of individuals in the 1st group.
- The number of individuals in the 2nd group.

The effect size value is considered large if it is greater than or equal to (0.5). If the value ranges between (0.3, and 0.5), the effect size is considered "medium". If the value is less than or equal to (0.1), the effect size is considered "small" (Pallant, 2016, p. 229).

Upon examining the effect size values in the table (1), it is evident that they are large. This means that the leve l of attitudes towards sustainable development and its components increased significantly among the experimental group individuals after implementing the program compared to the control group. This confirms the effectiveness of the training program in developing the attitude level toward sustainable development and its components.

Results of the Second Hypothesis

'There are statistically significant differences between the mean ranks of scores of individuals in the experimental group in the components of the Sustainable Development Attitude Scale and the total score in both the pre-test and post-test, favoring the post-test measurement' To test the second hypothesis, the researchers used the Wilcoxon test to indicate differences, and the following table (2) illustrates the results.

Table 2. Differences between the Post and Follow-Up Applications of the Experimental Group in Attitudes toward Sustainable Development Scale (Wilcoxon Signed Ranks Test)

Attitudes toward sustainable development	Ranks	*N*	Mean of ranks	Sum of ranks	*Z* value	Sig.	Effect Size «r"
Environmental field	Negative ranks	0	0	0	3.21	<0.001	0.629
	Positive ranks	13	7.00	91.00			
	Ties	0					
social field	Negative ranks	0	0	0	3.22	<0.001	0.631
	Positive ranks	13	7.00	91.00			
	Ties	0					

Attitudes toward sustainable development	Ranks	*N*	Mean of ranks	Sum of ranks	*Z* value	Sig.	Effect Size «r"
Economic field	Negative ranks	0	0	0	3.19	<0.001	0.625
	Positive ranks	13	7.00	91.00			
	Ties	0					
Education Field	Negative ranks	0	0	0	3.21	<0.001	0.629
	Positive ranks	13	7.00	91.00			
	Ties	0					
Total Score	Negative ranks	0	0	0	3.18	<0.001	0.623
	Positive ranks	13	7.00	91.00			
	Ties	0					

From the above table, it is clear that all z-values are statistically significant at the 0.01 level. This indicates significant differences between the mean ranks of the scores of individuals in the experimental group on the Sustainable Development Attitude Scale and its components in both pre-test and post-test measurements, in favor of the post-test measurement. This means that the average positive ranks (post-test) are higher than the average negative ranks (pre-test), confirming the validity of the second hypothesis. This serves as an indication of the effectiveness of the suggested training program utilized in developing the attitude toward sustainable development and its components among individuals in the experimental group.

To ascertain the effectiveness of the training program employed in developing the attitude toward sustainable development and its components, the researchers calculated the effect size of the program using the equation R for the effect size of the Wilcoxon signed-rank test. Upon examining the effect size values in Table (2), it is evident that they are large. This illustrates that the level of attitude toward sustainable development and its components increased significantly among the individuals in the experimental group after implementing the program compared to the pre-test, confirming the effectiveness of the training program in developing the attitude toward sustainable development and its components.

To validate the effectiveness of the training program used in developing the attitude toward sustainable development and its components, the researchers calculated the effect size of the training program using the equation R for the effect size of the Mann-Whitney U test: where Z is the value of the Wilcoxon test statistic, and N is the number of participants (Pallant, 2016, p. 229). Upon examining the effect size values in the previous table, it is evident that they are large. This illustrates that the level of attitude toward sustainable development and its components increased significantly among the individuals in the experimental group after implementing the program compared to the pre-test, confirming the effectiveness of the suggested training program in developing the attitude toward sustainable development and its components.

Results of the Third Hypothesis

"There are no statistically significant differences between the mean ranks of scores of individuals in the experimental group in the components of the Sustainable Development Attitude Scale and the total score in both the post-test and the follow-up test (one month later). To test this hypothesis, the researchers used the Wilcoxon test to indicate differences, and the following table (3) illustrates the results.

Table 3. Differences between Post and Follow-Up Applications of the Experimental Group in Attitudes toward Sustainable Development Scale (Wilcoxon Signed Ranks Test)

Attitudes toward sustainable development scale	Ranks	*N*	Mean of ranks	Sum of ranks	*Z* value	Sig.
Environmental field	Negative ranks	0	0	0	1.414	0.157
	Positive ranks	2	1.50	3.00		
	Ties	11				
social field	Negative ranks	1	1.50	1.50	0.000	1.000
	Positive ranks	1	1.50	1.50		
	Ties	11				
Economic field	Negative ranks	1	2.00	2.00	0.577	0.564
	Positive ranks	2	2.00	4.00		
	Ties	10				
Education Field	Negative ranks	3	3.00	9.00	0.447	0.655
	Positive ranks	2	3.00	6.00		
	Ties	8				
Total Score	Negative ranks	3	4.50	13.50	0.707	0.480
	Positive ranks	5	4.50	22.50		
	Ties	5				

From the above table, it is evident that there are no statistically significant differences between the mean ranks of scores of individuals in the experimental group on the Sustainable Development Attitude Scale and its components in both the post-test and the follow-up test (one month later). Consequently, the third hypothesis is confirmed, as z-values were not statistically significant, with all of them being greater than (0.05).

Discussion

The previous results indicate significant differences between the mean ranks of scores of the experimental and control groups in the post-test measurement of the Sustainable Development Attitude Scale and its components, in favor of the experimental group. Additionally, there are significant differences between the mean ranks of scores of individuals in the experimental group in the components of the Sustainable Development Attitude Scale and the total score in both the pre-test and post-test, favoring the post-test measurement. These results align with different studies (Joyce, 2018; Sung et al., 2020; Pigola et al., 2021; ESCAP, 2022; Abbasi et al., 2022; Al-Dhuhli et al., 2022).

The findings suggest that skills related to digital citizenship and technological advancements play a crucial role in overcoming obstacles in education, offering chances for independent and continuous learning. Moreover, they have the potential to contribute toward creating a world that is more equitable,

secure, and just. Digital successes are capable of supporting and hastening the progress of all seventeen Sustainable Development Goals (SDGs), from eradicating poverty and lowering rates of maternal and infant deaths to fostering sustainable farming practices, ensuring universal literacy, facilitating access to renewable and clean energy sources, and securing food availability and access to achieve food security. Skills in digital citizenship can significantly boost income, enhance productivity, and decrease the time, effort, and expenses associated with task completion. They open up new employment possibilities that spur economic expansion. Digital communication channels allow people to engage in international discussions about sustainable development, share insights and solutions with a global audience, and spread their ideas and solutions using various online platforms and social media. Additionally, digital competencies can be leveraged to create sustainable economic initiatives, aiding in the shift towards economic practices that are more sustainable and efficient in their use of resources.

The researchers attributes the superiority of the experimental group to the training program used, explaining the differences between the two groups in their attitude toward sustainable development and its components in favor of the experimental group. Additionally, there are differences between the pre-test and post-test applications for the experimental group in their attitude toward sustainable development and its components in favor of the post-test application for several reasons.

The training program provided students in the experimental group with an opportunity to train on digital citizenship skills (health and well-being, digital commerce, digital laws, digital culture, digital behavior rules, digital communication, digital access, digital security, and digital rights and responsibilities). It encouraged students to practice these skills during program sessions and tasked them with performing them in simulated scenarios. This continuous practice helped instill these skills in students, contributing to the development of their attitude toward sustainable development.

The skills of digital literacy and digital access encompass educational sustainability through their inclusion of knowledge, skills, and values in digital citizenship, which have contributed to understanding how technology operates and its appropriate utilization. Furthermore, the utilization of modern applications in the processes of learning and scientific research aligns with the findings of studies such as those by Brynjolfsson & McAfee (2014) and UNCTAD (2015).

These studies affirm that contemporary technologies, including augmented and virtual reality, learning management systems, and learning analytics, streamline distance learning procedures and the sharing of knowledge. Furthermore, modern technology as a whole plays a crucial role in establishing accessible digital platforms for distance education, facilitating the online delivery of courses, and the proliferation of massive open online courses (MOOCs), thereby nurturing avenues for self-directed and lifelong learning. Additionally, three-dimensional printing plays a role in enriching the educational experience.

The skills of digital communication, digital laws, and digital etiquette encompass knowledge and skills in social sustainability and communication with others through various technological communication options, while respecting others online and employing technology politely and effectively. This is corroborated by studies such as those conducted by Ribble (2009) and Lyons (2012), which assert that digital citizenship skills help learners engage in discussions related to real-life situations and prepare individuals to be active participants in the global community online.

The skills of health and well-being, along with digital rights and responsibilities, encompass knowledge, skills, and values that contribute to the development of environmental sustainability through understanding intellectual property rights and digital ethics, as well as awareness of the harms of digital technology use and addiction, and employing technology healthily and safely. This aligns with a study conducted by Abbasi et al. (2022), which affirmed that digital citizenship skills help provide

clear opportunities for renewable and clean energy, as seen in Chile becoming a pioneer in energy transformation management, and Canada's efforts to lead in the clean technology sector.

The skills of digital commerce and digital security include knowledge, skills, and values in economic sustainability that have contributed to the development of the economic aspect. This involves understanding the mechanisms and methods of digital trade, as well as electronic buying and selling of goods. This is affirmed by studies conducted by UNCTAD (2018), ESCAP (2022), and Abbasi et al. (2022), which highlight that modern technology and digital citizenship skills contribute to achieving sustainable development by providing various ways to increase income through enhanced productivity and reduced costs of goods and services. Moreover, they create new job opportunities, thereby stimulating economic growth and facilitating access to global markets.

The increase in the level of inclination towards sustainable development and its components among the experimental group may be due to the content of the program they were trained on, which is digital citizenship skills, and the motivation, values, and beliefs included therein. All of these factors contributed to uplifting morale. Additionally, the role of the trainer in the program as a role model for students could be a contributing factor. The trainer encouraged students and trained them on positive, logical, and rational thinking skills, overcoming experiences of failure, and creating an atmosphere of friendliness, love, affection, and fun during training sessions. Moreover, the trainer employed methods, techniques, and activities available in the program, all of which contributed to enhancing the level of inclination towards sustainable development and its components among the participants (Abdellatif, 2023).

Given the results of the third assessment, it becomes evident that there are no statistically significant differences between the pre-test and post-test measurements, one month later, regarding the level of attitude toward sustainable development and its components. This indicates the sustained impact of the training on the performance level of the experimental research group concerning attitude toward sustainable development and its components. The continued impact of the training program utilized by individuals in the experimental group lies in their mastery of digital citizenship skills and their attainment of proficiency in these skills. Their continuous practice of these skills during training sessions has led them to apply them automatically in other contexts. Consequently, the domains of attitude toward sustainable development (environmental, educational, social, and economic) have retained a lasting influence on the students.

Furthermore, the program content, coupled with its relevance to the social, economic, educational, and environmental realities of the students, has entrenched their learning and level of attitude toward sustainable development, enabling them to employ these skills when needed in various situations. This indicates a sustained impact of the training over a longer period. Additionally, the activities, exercises, models, and scenarios practiced by the students, characterized by continuity, have facilitated their effective and enduring application. The integration of knowledge, practice, and underlying beliefs within the program content, along with their reinforcement through homework assignments and the utilization of skills in real-life situations, has further contributed to the program's lasting impact. Digital citizenship skills are not merely pieces of information, but skills solidified through training and practice, attaining stability and firmness. This indicates the continued effectiveness of the suggested training program in fostering an attitude toward sustainable development and its components.

Recommendations

The recommendations drawn from the discussion underscore the importance of replicating and expanding digital citizenship skills training programs to enhance societal attitudes toward sustainable development. Institutions are encouraged to integrate these skills into their curricula across various disciplines and educational levels, ensuring students receive comprehensive training in utilizing technology for sustainable development from an early stage. Continuous professional development for educators is essential to effectively impart these skills to students and reinforce their importance in achieving sustainable development goals. Moreover, collaboration among educational institutions, governments, non-governmental organizations, and industry stakeholders is crucial for the successful implementation of digital citizenship programs, enabling the pooling of resources and expertise to develop more impactful initiatives.

Conclusion

The study's findings highlight the pivotal role of digital citizenship skills in cultivating a sustainable development mindset among students. The implemented training program yielded statistically significant and enduring improvements in sustainable development attitudes across environmental, educational, social, and economic dimensions. The program's success can be attributed to its comprehensive content, effective delivery methods, and real-world relevance. Integrating digital citizenship skills into the curriculum and reinforcing them through practice further bolstered the program's impact. In essence, investing in digital citizenship education not only prepares individuals for the digital realm but also empowers them to contribute meaningfully to sustainable development, fostering a generation of socially conscious and digitally literate citizens committed to creating a fairer, more sustainable future.

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Authorship and Level of Contribution

All authors contributed to the research of the literature, collection of data, analysis, and interpretation of the collected data.

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