Kurdish Studies
Jan 2024
Volume: 12, No: 1, pp. 2715-2732
ISSN: 2051-4883 (Print) | ISSN 2051-4891 (Online)
www.KurdishStudies.net

Received: October 2023 Accepted: December 2023
DOI: https://doi.org/10.58262/ks.v12i1.192

Digital Citizenship Skills and the Attitudes Towards Sustainable Development among University Students

Mohamed Sayed Abdellatif[1]*, Abdelfattah Issa Idris[2], Mohammed Hasan Ali Al-Abyadh[3], Afaf Saeed Faraj Al-Budaiwi[4]

Abstract

The digital citizenship skills support the seventeen Sustainable Development Goals when invested appropriately. The current research aims to determine the level of digital citizenship skills among students of Prince Sattam bin Abdulaziz University (PSAU). Additionally, it seeks to identify gender differences in the level of digital citizenship skills, unveil the relationship between digital citizenship skills and attitudes towards sustainable development, and explore the predictability of attitudes towards sustainable development based on digital citizenship skills. A total of 422 male and female students participated in the research, including 239 males and 183 females from PSAU University. The researchers employed the Digital Citizenship Skills Scale and the Sustainable Development Attitudes Scale. The study utilized a descriptive-analytical approach, specifically employing the correlational predictive method to shed light on the relationship patterns between the research variables and predict the relationships among them. The research results revealed a high level of digital citizenship skills within the research sample. There were statistically significant differences between males and females in favor of females in the level of digital citizenship skills. The findings also indicated a positive statistically significant correlation between digital citizenship skills and attitudes towards sustainable development. Furthermore, the results demonstrated the possibility of predicting attitudes toward sustainable development based on digital citizenship skills within the research sample.

Keywords: *Digital citizenship skills, Attitudes towards sustainable development, University students.*

Introduction

Digital skills constitute one of the most crucial factors in achieving sustainable development (SD) when appropriately leveraged. They impact the process of knowledge production and distribution, thereby influencing productivity rates, increasing job opportunities, enhancing competitiveness, developing human capital, and fostering skill advancement. They empower societies and individuals to collaborate in new forms of innovation (ESCAP, 2018; Nambisan et al., 2019). Digital technologies are considered effective resources for achieving sustainable development goals. Information and Communication Technologies (ICT) and the Internet of Things (IoT) play fundamental roles in promoting sustainable development (Del Río Castro et al., 2021; Langley, 2022; Paiola et al., 2021). Hence, the utilization and acceleration of the digital

[1] Department of Educational Sciences, College of Education, Prince Sattam Bin Abdulaziz University, saudi arabia/ Department of Educational Psychology, College of Education in Assiut, Al-Azhar University, EGYPT. Email: m.heby@psau.edu.sa
[2] Department of Educational Psychology, College of Education, Al-Azhar University, EGYPT. Email: Abdulfattahedrees@gmail.com
[3] College of Education, Thamar University, YEMEN. Email: m.alabyadh@gmail.com
[4] Department of Educational Psychology, College of Human Studies, Al-Azhar University, EGYPT, Email: afafmazrou@gmail.com

transformation and sustainability process are central topics in the discussions of many governments and organizations (Guandalini, 2022).

Digital citizenship skills (DCS) are the responsible, ethical, and secure use of information and communication technologies by individuals, both as members of the national community and as global citizens (Rahman, 2021; Vasiliu-Feltes & Thomason, 2021). They reflect the individual's ability to participate in the networked community, aiming to guide and protect all users, including males and females (children, teenagers, youth, and the elderly) (Simsek & Simsek, 2013). This is achieved by encouraging desired behaviors and combating undesirable behaviors in digital interactions, creating a digital citizen who loves his country and strives for its progress.

DCS illustrate a set of rules and principles that contribute to preparing students to live in the digital age (Abu Almajd & Al-Youssef, 2018). Al-Qarni (2021) describes them as responsible, ethical, and secure usage skills of information and communication technologies by individuals as members of the national and global community. As per Aseeri (2023), DCS encompass a set of rules, laws, systems, and principles that students should possess and adhere to during their various uses of digital technology, guiding them toward effective and secure utilization of this technology.

DCS are categorized into three axes: the education, the respect, and the protection axis (Aseeri, 2023; Couros & Hildebrandt, 2015; Ribble, 2009; Ribble, 2011; Ribble & Miller, 2013; Ribble & Park, 2022). These axes are represented in the following nine dimensions:

1. Digital Access: This involves full electronic participation in society, ensuring that every individual has fair opportunities to access technology (Tan, 2011).
2. It pertains to the electronic buying and selling of goods. Students should learn how and where to make purchases to avoid becoming vulnerable to theft, and educators can engage students in discussions about good and bad experiences with online shopping (Ribble, 2014).
3. Digital Communication: This dimension recognizes the individual's ability to communicate with others through various digital means, such as email, smartphones, instant messaging, forums, and social media (Aseeri, 2023; Ribble & Miller, 2013).
4. Digital Culture: It involves teaching and learning about technology and its use, emphasizing understanding how technology works to ensure its appropriate use (Ribble, 2012).
5. Digital Behavior Rules: Good digital citizens respect others, learn to use technology politely and effectively, and follow digital etiquette to minimize negative impacts on others (Ribble, 2012).
6. Digital Law: This refers to legal requirements, decisions, and ethics related to digital environments that can directly impact students in classrooms, emphasizing respect for intellectual property rights and prohibiting activities like identity theft, software piracy, and computer hacking (Couros & Hildebrandt, 2015; Ribble & Park, 2022).
7. Digital Rights and Responsibility: Users in the digital community are entitled to certain protections, such as the right to privacy and freedom of expression. Digital citizens also have responsibilities toward the community and should agree to live by mutually agreed-upon standards (Park, 2016; Ohler, 2010).
8. Digital Health and Wellbeing: Students should be aware of the harms of using digital technology, including the potential psychological and physical problems associated with internet addiction (Ribble, 2011).
9. Digital Security: Digital security focuses on processes used to protect information, covering both technological approaches like firewalls and antivirus protection (Park, 2016; Ribble & Miller, 2013).

DC significance has become evident in all aspects of life, particularly in the educational domain following the implementation of e-learning systems.DC is closely linked to the education system as it provides educational methods to assist teachers and parents in guiding students to use technology correctly. DC serves as an educational tool and a means of preparing students for integration into society and participation therein (Martin et al., 2019). The International Society for Technology and Education (ISTE) has established national standards for technology and education, outlining the skills and attitudes that learners should develop to become successful citizens in the new digital society. ISTE emphasizes the necessity for learners to be proficient, digital citizens, knowledge creators, innovative designers, and global collaborators (Hollandsworth et al., 2011).

The importance of digital citizenship is elucidated in literature and prior research, emphasizing that its essence goes beyond simply enumerating right and wrong behaviors related to technology use. Instead, it involves the cultivation of a responsible citizen who can harness the benefits of the digital realm while minimizing its drawbacks. This perspective is underscored by scholars (Couros & Hildebrandt, 2015; Lyons, 2012; Ribble, 2009; Ribble & Miller, 2013), who have expounded on this concept in various ways as follows:

1. Personal responsibility for lifelong learning: Digital citizenship entails personal responsibility for continuous learning throughout life.
2. A tool for discerning right from wrong: It serves as a tool to recognize what is true and what is false. It helps educators engage with students in discussions related to real-life situations.
3. Assisting educators in understanding and imparting the concept of digital behavior: Digital citizenship aids teachers in grasping the concept of digital behavior and how to instill it in students.
4. Preparation for active participation in the global online community: It prepares individuals to be active members of the global community through the internet.
5. Safe, responsible, legal, and ethical use of information and technology: Digital citizenship involves practicing safe, responsible, legal, and ethical use of information and technology.
6. Cultivating positive behavior in technology use: It involves acquiring positive behavior in technology use, characterized by collaboration, learning, and productivity.

The contemporary features of rapidity, user-friendliness, substantial impact, and versatile services inherent in modern technology and digital skills make them valuable tools for advancing the objectives of sustainable development (SD) (Clayton & Nicholas, 2018). SD depends on cutting-edge technology for essential processes, including recycling, reusing electronic devices for economic purposes, substituting materials, optimizing production operations, controlling pollution, and ensuring efficient resource utilization (Beder, 2000). The forthcoming years are anticipated to witness the pivotal role of the Internet of Things (IoT) in sustainable community development and environmental protection. This will be achieved through the integration of digital sensors and smart devices (Salam, 2020).

According to the definition provided by Al-Waly, 2023, sustainability is the efficient and equitable distribution of resources among generations, while operating social and economic activities within the boundaries of a limited ecological system. It refers to the effective investment of environmental resources to ensure meeting present needs without neglecting the rights of future generations to these resources (Suleiman, 2020). This aims to guarantee environmental safety, economic viability, and social justice for both current and future generations. SD encompasses three principles or pillars: environmental safety, social justice, and economic prosperity (Gatti et al., 2019).

Education is considered a cornerstone and a key requirement for achieving SD. Education is the primary source for obtaining information related to the environmental, social, and economic aspects of SD. It is also a crucial element in raising individuals' awareness of SD and achieving a sustainable future (Mora et al., 2020). Education for SD aims to enhance students' awareness of sustainability issues and alter their attitudes towards the three dimensions of sustainable development (environment, economy, and society) (Kalsoom& Khanam, 2017). It contributes to creating a conducive learning environment and opportunities for students to develop skills, values, and work efficiency that enable individuals and groups to move toward sustainability.

Individuals are equipped with specific attitudes and skills in the field of sustainability, and sustainable attitudes are crucial for understanding and promoting sustainable behavior (Probst et al., 2019). The concept of SD relies on collective responsibility to promote three interconnected pillars: economic development, comprehensive social development, and environmental protection. These pillars form the foundation of any comprehensive, long-term approach aimed at ensuring the well-being of present and future generations (Illahaqi et al., 2021; Judge et al., 2022).

Communities on a global scale are confronted with trends that intensify the complexities of sustainability, such as shifts in population dynamics, urbanization, globalization, climate change, and the depletion as well as degradation of natural resources. At the core of human-induced sustainability challenges, particularly in addressing the concern of food security, are agricultural food systems, recognized as the primary consumers of natural resources and ecological system services (Probst et al., 2019). Ambusaidi and Al Washahi (2016) underscored the imperative to alter individuals' behavior and attitudes across all facets of life. Achieving this goal is contingent upon the pivotal role of education in effectively shaping the attitudes and behaviors of individuals at both the individual and societal levels toward sustainability.

The attitudes toward sustainable development (ASD) are defined as individuals' inclination toward sustainable development, values, habits, and emotional and behavioral advances (Michalos et al., 2011). It is characterized by an individual's stance regarding sustainable development (Sahin et al., 2012). The three main dimensions of sustainable trends encompass environmental, social, and economic aspects. The environmental aspect covers natural resources, climate change, sustainable urbanization, and disaster prevention. The social aspect includes human rights, peace, human security, gender equality, cultural diversity, intercultural understanding, health, and governance. The economic aspect covers poverty reduction, corporate responsibility, accountability, and market economy. A sustainable society is distinguished by economic development, protection of the natural environment, and fair social development (Probst et al., 2019; Tsai, 2018). Suleiman (2020) defines it as the learners' desire to apply the concept of sustainable development and its principles, evident in their behaviors. UNESCO has identified integrated elements for education for sustainable development: knowledge, skills such as responsible use of technology, values, and attitudes associated with sustainability (Greesh, 2023).

In order to improve the value and quality of life on Earth, there must be a change in the attitudes and behaviors of each individual towards the environment, and a shift in lifestyle patterns to address environmental issues and problems. Generally, an attitude is nothing but an individual's general response to a specific issue of interest to them (Al-Naqbi & Alshanna, 2018). Numerous studies confirm the importance of developing sustainable attitudes among learners at various educational stages (Kalsoom & Khanam, 2017; Michalos et al., 2011; Probst et al., 2019; Tsai et al., 2012).

Several previous research studies have focused on developing ASD among learners at different educational levels. Ull et al. (2014) found that most participants in their study were not aware of the impact of their daily activities on the environment, recommending the integration of sustainability topics into education. Andersson's study (2017) observed a shift towards sustainable development among pre-service teachers after exposure to a course related to sustainable development. Biasutti and Frate (2017) validated and established the reliability of a scale measuring the attitudes of Italian university students toward sustainable development. The scale comprised four dimensions: environment, economy, society, and education. It proved beneficial in detecting differences in sustainable development attitudes among students.

Tomas et al. (2017) also investigated the attitudes of pre-service teachers towards education for sustainability. The study revealed that survey instruments positively influenced teachers' ASD. Additionally, Al-Naqbi and Alshannag (2018) found that students at the United Arab Emirates University demonstrated a high level of understanding, strongly positive attitudes, and moderately positive behavior towards the environment and sustainable development.

Additionally, Tsai (2018) proposed the SOAP model (Social, Object, Action, Place) for developing educational strategies that enable students to engage in online discussions of social and scientific issues. The model aims to impact the scientific competencies and sustainable attitudes of high school and university students. Results indicated that the SOAP strategy had a statistically significant effect on the ASD of university students. Nousheen et al. (2019) found a positive change in students' attitudes after studying an environmental and sustainable development course. The study recommended the necessity of enhancing students' attitudes towards sustainable development. Probs et al. (2019) demonstrated the effectiveness of a multidisciplinary intensive educational design on organic farming in developing ASD and skills.

Digital achievements can support each of the seventeen Sustainable Development Goals (SDGs) and expedite their realization, ranging from eradicating extreme poverty to reducing maternal and infant mortality, promoting sustainable agriculture and decent work, and achieving universal literacy (Pigola et al., 2021). The rapid evolution of technologies has created numerous new opportunities in the field of education for sustainability (Joyce, 2018). Information and Communication Technology (ICT) can help accelerate progress in implementing each SDG of the United Nations' seventeen SDGs.

Education plays a crucial role in sustainable development by influencing individuals' behavior towards achieving SDGs. Technology can be used to enhance education by influencing learners' behavior and assessing this behavioral change (Sung et al., 2020). Jovanovic et al. (2018) found several important results, including a significant correlation between digitization and SD. Al-Dhuhli et al. (2022) concluded that the role of digital technology in achieving SD requirements is at a moderate level. One of the key recommendations is for the School Performance Development Department in the provinces to provide support for the sustainable deployment of digital technology in all administrative processes.

The role of modern technology and DCS in achieving SD can be summarized in the following points (Brynjolfsson & McAfee, 2014; UNCTAD, 2015; UNCTAD, 2018; ESCAP, 2022; Abbasi et al., 2022), as sustainable development helps in:

1. Providing numerous ways to increase income opportunities by enhancing productivity and reducing the cost of goods and services.
2. Creating new job opportunities contributing to economic growth and facilitating global market access.

3. Supporting various pathways for economic and social participation elevates the economic status of developing countries.
4. Offering diverse applications and tools for decision-makers to plan and design innovations.
5. Assisting in achieving food security through the creation of opportunities for food availability, accessibility, utilization, and sustainability, facilitated by technology and digital citizenship skills.
6. Harnessing technologies like artificial intelligence, big data, and the Internet of Things to develop agriculture, establish new farms, and enhance livestock production.
7. Digital citizenship skills provide opportunities for renewable and clean energy, as seen in Chile's leadership in energy transformation and Canada's efforts to become a leader in clean technology.
8. Modern technologies such as learning management systems, augmented and virtual reality, and learning analytics facilitate remote learning and knowledge dissemination. They also contribute to open digital platforms for remote learning, allowing the delivery of courses online and open-source Massive Open Online Courses (MOOCs), fostering self-directed learning and lifelong learning. 3D printing also enhances the educational process.

Despite the importance of DC in achieving SD, several indicators have highlighted the lack of awareness among university students. While students excel in using technology, they are not experts when it comes to proper communication and ethical interaction online. They often do not grasp the meaning of a digital footprint and are unaware that sharing any personal information may pose risks. Most of them do not comprehend the potential dangers of sharing personal details and images online or engaging in conversations with strangers (Young, 2014). Therefore, it is crucial to train and educate them on navigating the digital environment correctly and participating ethically in the digital society. Besides, the concept of DC and its elements in the curriculum, enabling students to engage with technology properly and securely should be incorporated in all curricula (Karaduman & Oztürk, 2014; Sari et al., 2022).

The findings from the research conducted by Jones and Mitchell (2015) underscore a growing interest in augmenting DC education among university students. The study highlights that a decline in the perceived value of digital respect and participation among these students correlates with instances of online sexual harassment. Hollandsworth et al. (2011) elaborate on the necessity of emphasizing the significance of cultivating DC and appropriate behaviors, addressing both male and female students. The development of DC is proposed to be a personal attribute for each student, evolving into a habit, impression, or commitment that emanates from within, rather than being externally imposed. This approach not only aids students in navigating conflicting cultural changes but also enhances their understanding of such changes on a deeper level.

The results of previous studies on DC skills in the Saudi Arabian context regarding the level of these skills and differences between males and females have presented conflicting findings. A study by Al-Samadi (2017) found that the level of digital citizenship skills was average. However, studies conducted by Al-Hadif (2021), Al-Qarni (2021), and AlZebidi & Alsuhaymi (2021) indicated that the level of these skills was high among university students. Concerning the differences between male and female students in digital citizenship skills, previous studies also presented contradictory results. Al-Hadif (2021) reported statistically significant differences favoring females, while a study by Abu Al-Majd and Al-Youssef (2018) found differences favoring males. On the other hand, some studies concluded that there were no statistically significant differences between males and females (Al-Samadi, 2017; AlZebidi & Alsuhaymi, 2021; Alamri & Alqahtani, 2022; Mahadir et al., 2021).

From the aforementioned, it is evident that there is a contradiction in previous studies in this field. Additionally, the importance of research variables and the presence of logical correlation relationships between research variables (digital citizenship skills and the attitude towards sustainable development) become apparent. However, within the extent of the researcher's knowledge, no study has addressed the relationship between these research variables. Due to the lack of previous studies addressing the topic of the current study, the study's objective can be defined as verifying the level of DCS and their relationship with ASD among the study sample. Aligned with these objectives, the subsequent hypotheses have been formulated:

1. There is a moderate level of DCS among the grades of the students at PSAU who participated in the study.
2. there are no statistically significant differences between the mean scores of male and female students at PSAU on the DCS scale, including its dimensions and overall score.
3. there is no statistically significant correlation between the scores of the students at PSAU who participated in the study on the DCS Scale and their scores on the Scale of ASD.
4. ASD can not be predicted based on the information of the scores of the students participating in the study on the DCS Scale in a statistically significant way.

Study Design and Setting

In light of the current research objectives and purposes, the researchers will employ the descriptive-analytical methodology, specifically the correlational predictive approach. This is done to shed light on the pattern of the relationship between the research variables and to predict the relationships among them.

Study Participants

The researcher applied the research tools to 109 male and female students (mean age= 20.64, SD= 1.31) at PSAU. This was done to ensure the psychometric properties of the research tools. The researcher administered the tools to 422 students at PSAU, including 239 male students and 183 female students, all in their final academic levels (mean age = 20.69; SD = 3.34). This was carried out to verify the research hypotheses.

Data Collection Tools

Digital Citizenship Skills Scale

The DCS Scale was developed by the researchers after reviewing theoretical frameworks addressing digital citizenship skills and their components. Previous studies were also consulted to identify methods and determinants of measurement (Al-Hadif, 2021; Aseeri, 2023; Ribble, 2011; Ribble & Miller, 2013; Zuwein, 2017).

The scale comprises nine dimensions categorized into three axes: The education axis, including (Digital culture, Digital communication, and Digital commerce); the Respect axis, including (Digital access, Digital laws, and Digital behavior rules); and the Protection axis, including (Health and well-being, Digital security, and Digital rights and responsibilities). The scale consists of 45 items distributed across its nine dimensions, with each dimension containing 5 items. Participants are required to assess each statement on a five-point scale ranging from strongly agree to strongly disagree (5-4-3-2-1). Higher scores indicate a higher level of digital

citizenship skills, with all items being positively framed. The survey scores range from 45 to 225.

The content validity of the scale was verified by presenting it to five faculty members in educational psychology. The reviewers showed agreement rates ranging from 80% to 100% on the scale's data, indicating content validity. Therefore, the DCS Scale is characterized by content validity. To calculate the internal consistency of the scale, Pearson correlation coefficients were computed between the score of each item and the total score of the corresponding dimension for 109 participants. Additionally, correlations were calculated between the score of each dimension and the total scale score. All correlation coefficients were statistically significant at the 0.01 level, ranging from 0.415 to 0.802, confirming the internal consistency of items with their dimensions and dimensions with the total scale score.

To ensure the stability of the DCS Scale, researchers used both Cronbach's alpha coefficient and the Guttman split-half reliability equation. Due to the unequal variance between the halves of the scale, these reliability measures were applied after administering the scale to the participants in the survey study, totaling 109 students. The reliability coefficients calculated using Guttman's split-half equation (0.815) and Cronbach's alpha coefficient (0.741) all exceeded 0.7. This indicates a high level of reliability for the DCS Scale.

Scale of Attitude Toward Sustainable Development

The Scale of ASD was developed by the researchers after reviewing theoretical frameworks addressing ASD and its components. Additionally, previous studies were consulted to identify methods and determinants of measurement (Al-Naqbi & Alshannag, 2018; Biasutti & Frate, 2017; Michalos et al., 2011; Mohammed, 2022; Suleiman, 2020).

The scale consists of four dimensions: Environmental domain, Social domain, Economic domain, and Educational domain. The scale comprises 20 items distributed across its four dimensions, with each component containing 5 items. Each item consists of 5 alternatives ranging from strongly agree to strongly disagree (5-4-3-2-1). Higher scores indicate a higher level of attitude toward sustainable development, with all items being positively framed. The scale scores range from 20 to 100.

The content validity of the scale was verified by presenting it to five faculty members in educational psychology. The reviewers showed agreement rates ranging from 80% to 100% on the scale's data, indicating content validity. Therefore, the Scale of ASD is characterized by content validity. To calculate the internal consistency of the scale, Pearson correlation coefficients were computed between the score of each item and the total score of the corresponding dimension for 109 participants. Additionally, correlations were calculated between the score of each component and the total scale score. All correlation coefficients were statistically significant at the 0.01 level, ranging from 0.419 to 0.834, confirming the internal consistency of items with their dimensions and dimensions with the total scale score.

To ensure the stability of the Scale of ASD, researchers used both Cronbach's alpha coefficient and the Guttman split-half reliability equation. Due to the unequal variance between the halves of the scale, these reliability measures were applied after administering the scale to the participants in the survey study, totaling 109 students. The reliability coefficients calculated using Guttman's split-half equation (0.809) and Cronbach's alpha coefficient (0.740) all exceeded 0.7. This indicates a high level of reliability for the Scale of Attitude Toward Sustainable Development.

Results

The First Hypothesis Results

The first hypothesis states that there is a moderate level of DCS among the grades of the students at PSAU who participated in the study. To verify the validity of this hypothesis, a One-Sample t-test was employed. The test compared the hypothesized mean of the DCS scale and its dimensions with the mean scores of the research sample on the scale and its dimensions, as illustrated in the following table.

Table (1) One-Sample Statistics Results for Detecting Significance Differences Between the Hypothetical Mean and the Mean Scores of the Research Sample on the Digital Citizenship Skills Scale and its Dimensions.

	Digital Citizenship skills	Test Value	Mean	Std. Deviation	Mean Difference	df	t	Sig.
The Education	Digital Culture	15	19.59	1.42702	4.59	421	282.144	.000
	Digital Commerce	15	19.95	1.19972	4.95	421	341.606	.000
	Digital Communication	15	20.82	1.88988	5.82	421	226.334	.000
The Respect Axis	Digital Access	15	18.75	1.32119	3.75	421	291.554	.000
	Digital Behavior Rules	15	18.60	1.39809	3.60	421	273.359	.000
	Digital Low	15	18.71	1.24897	3.71	421	307.750	.000
The Protection	Digital Rights and Responsibility	15	18.59	1.32339	3.59	421	288.716	.000
	Digital Health and Wellbeing	15	18.75	1.32119	3.75	421	291.554	.000
	Digital Security	15	18.60	1.39809	3.60	421	273.359	.000
	Total score	135	172.39	9.70304	37.39	421	364.980	.000

Table 1 indicates that statistically significant differences were evident at a significance level of (0.01) in t-values ranging from (226.334) to (364.980). This indicates differences favoring the higher mean scores of the actual students. Moreover, differences were observed between the hypothetical mean (15) and the mean scores of the research sample on the nine dimensions of the DCS (Digital Culture, Digital Communication, Digital Commerce, Digital Access, Digital Laws, Digital Behavior Rules, Health and Well-being, Digital Security, and Digital Rights and Responsibilities - Overall Score). It is noteworthy that the mean scores of the research sample on each dimension were higher than the hypothetical mean, suggesting a high level of DCS among the students participating in the study.

The Second Hypothesis Results

The second hypothesis states that there are no statistically significant differences between the mean scores of male and female students at PSAU on the DCS scale, including its dimensions and overall score. To verify the validity of this hypothesis, an Independent-Sample T-Test was

conducted to determine the significance of differences between two independent groups, namely males and females. The following table illustrates the t-values and the significance of differences between the means of the two groups on the DCS scale (dimensions and overall score).

Table (2): Results of the Independent-Sample T-Test for Significance Differences between the Mean Scores of Male and Female Students Participating in the Study on the Digital Citizenship Skills Scale and its Dimensions, According to the Gender Variable.

	Digital Citizenship skills	Male/ Female	N	Mean	Std. Deviation	df	t	Sig. (2-tailed)
The Education	Digital Culture	Males	239	19.38	1.537	420	3.765	.000
		Females	183	19.88	1.214			
	Digital Commerce	Males	239	19.73	1.376	421	4.629	.000
		Females	183	20.23	.841			
	Digital Communication	Males	239	20.34	2.161	421	6.596	.000
		Females	183	21.44	1.211			
The Respect Axis	Digital Access	Males	239	18.51	1.266	421	4.341	.000
		Females	183	19.06	1.328			
	Digital Behavior Rules	Males	239	18.36	1.321	421	4.064	.000
		Females	183	18.91	1.436			
	Digital Low	Males	239	18.46	1.187	421	4.714	.000
		Females	183	19.03	1.257			
The Protection	Digital Rights and Responsibility	Males	239	18.36	1.238	421	4.206	.000
		Females	183	18.90	1.369			
	Digital Health and Wellbeing	Males	239	18.51	1.266	421	4.341	.000
		Females	183	19.06	1.328			
	Digital Security	Males	239	18.36	1.321	421	4.064	.000
		Females	183	18.91	1.436			
	Total score	Males	239	170.03	9.977	421	5.926	.000
		Females	183	175.46	8.413			

From Table (2), it is evident that the t-values are statistically significant at the 0.01 level for all dimensions of digital citizenship skills and the overall score. The t-values ranged from (3.765) to (6.596), indicating statistically significant differences between the mean scores of the two groups (males and females) in DCS (dimensions and overall score) in favor of females. This is attributed to higher mean scores of females in both dimensions and the overall score of DCS. The average score for males on the overall scale was (170.03), while the average score for females on the overall scale was (175.46).

The Third Hypothesis Results

The third hypothesis asserts that there is no statistically significant correlation between the scores of the students at PSAU who participated in the study on the DCS Scale and their scores on the Scale of ASD. To verify the validity of this hypothesis, the researcher calculated the Pearson correlation coefficient between the scores of the research sample on the DCS and their scores on the Scale of ASD, as illustrated in the following table.

Table (3): Pearson Correlation Coefficient Values between the Scores of the Research Sample on the Digital Citizenship Skills Scale and Their Scores on the Scale of Attitudes toward Sustainable Development.

	Variables	(Attitudes toward sustainable development)				
		Environmental field	social field	Economic field	Education, Field	Total score
(Digital Citizenship skills)	Digital Culture	.399**	.411**	.127**	.380**	.372**
	Digital Commerce	.352**	.555**	.143**	.333**	.402**
	Digital Communication	.272**	.416**	.203**	.262**	.305**
	Digital Access	.779**	.553**	.605**	.753**	.777**
	Digital Behavior Rules	.686**	.561**	.568**	.662**	.723**
	Digital Low	.748**	.495**	.571**	.725**	.734**
	Digital Rights and Responsibility	.662**	.460**	.530**	.642**	.666**
	Digital Health and Wellbeing	.781**	.553**	.605**	.753**	.780**
	Digital Security	.686**	.561**	.568**	.662**	.723**
	Total score	.752**	.649**	.531**	.725**	.770**

**Correlation is significant at the 0.01 level (2-tailed).

From the aforementioned table, the following observations can be made: There is a statistically significant positive correlation at the 0.01 level between the scores of the research sample at PSAU on the DCS (Digital Culture, Digital Communication, Digital Commerce, Digital Access, Digital Laws, Digital Behavior Rules, Health and Well-being, Digital Security, and Digital Rights and Responsibilities - Overall Score) and their scores on the Scale of ASD (Environmental Domain, Social Domain, Economic Domain, Educational Domain, and Overall Score). The correlation coefficient values ranged from (.127) to (.780), all of which are statistically significant at the 0.01 level.

The Fourth Hypothesis Results

The fourth hypothesis states that it is not possible to predict ASD based on the information on the scores of the students participating in the study on the DCS Scale in a statistically significant manner. To verify the validity of this hypothesis, a Simple Linear Regression analysis was conducted, considering that the overall score on the Scale of ASD is the dependent variable, and the overall score on the DCS Scale is the independent variable. The following table illustrates this analysis.

Table (4): Results of Simple Linear Regression Analysis to Predict the Attitudes toward Sustainable Development based on the Information of the Students' Scores on the Digital Citizenship Skills Scale.

variables	B	Std. Error	Beta	f value	Sig.	t value	Sig.	R	R2	Adjusted R2
(Constant)	14.852	2.524		611.386**	.000[b]	5.885**	.000	.770[a]	.593	.592
Digital Citizenship Skills	.361	.015	.770			24.726**	.000			

From the above table, it is evident that the F-value to assess the predictability of ASD based on the information of students' scores on the DCS Scale was (611.386), and this value is statistically significant at the 0.01 significance level. This indicates a positive predictability of

attitudes toward sustainable development based on information about DCS. The multiple correlation coefficient value (R) was (.770), and the coefficient of determination value (R^2) was (.593), meaning that the independent variable (digital citizenship skills) explains 59.3% of the total variance in the dependent variable (ASD).

In light of the foregoing, the simple linear regression equation can be formulated as follows:

Attitudes toward Sustainable Development = 14.852 + (0.361) × Digital Citizenship Skills

Discussion

The study outcomes have yielded significant insights into the dynamic relationship between DCS and ASD among students enrolled at PSAU. This discourse delves into the repercussions and importance of the results, scrutinizing the revealed relationships through statistical analyses. The systematically tested hypotheses have facilitated a nuanced comprehension of the potential impact of DCS on shaping ASD.

The results of the first hypothesis indicate the presence of a high level of digital citizenship skills among the students of the university, as observed in the research sample. This finding aligns with several study results (Al-Hadif, 2021; Alqarni, 2021; AlZebidi & Alsuhaymi, 2021), which concluded that the level of these skills was high among university students in the Saudi Arabian environment. However, this result differs from the study conducted by (Alsamadi, 2017), which found that the level of digital citizenship skills was average.

The researchers attribute this result to the efforts of the Kingdom of Saudi Arabia in the field of digital transformation in line with Vision 2030. Among the goals of the vision is the development of digital infrastructure and the emphasis on partnerships between the public and private sectors as a means to enhance the telecommunications and information technology sector in the Kingdom. This has resulted in providing citizens and university students with information and procedures related to digital content. Additionally, the preparation and education of university students in the field of cybersecurity are considered essential components of the digital transformation movement. The Kingdom has also emphasized the provision of necessary skills to university students for future jobs in advanced and emerging technologies, encouraging a positive engagement with these technologies.

The researchers attribute the high level of digital citizenship skills among male and female university students to several factors. Firstly, university students are typically in advanced academic stages, requiring them to extensively use the internet for research, obtaining studies, and accessing information through digital libraries, global databases, and various e-learning platforms. Some courses are also partially or entirely delivered through the Blackboard Learning Management System. Additionally, the recent surge in cases of online extortion and fraud on certain websites and unofficial electronic accounts has compelled students to exercise caution. Their proficiency in digital citizenship skills equips them to navigate online threats effectively. Furthermore, electronic communication tools have become indispensable for both students and the general public.

The University's role in raising technological and electronic awareness through training courses and informative lectures has significantly contributed. Moreover, the maturity of students' intellectual and moral faculties, coupled with their religious principles as members of a Muslim society, has fostered an awareness of the risks associated with improper technology use. They recognize the existence of laws to curb cybercrimes and the corresponding penalties for

offenders. All these factors have collectively elevated the level of digital citizenship skills among male and female university students.

The results of the second hypothesis revealed statistically significant differences between the average scores of male and female students at PSAU in DCS (both dimensions and overall scores), favoring females. This outcome aligns with a study conducted by Al-Hadif (2021) in the Saudi Arabian context, which also found statistically significant differences favoring females attributed to the gender variable. However, it diverges from other study findings (Abu Elmagd & Al-Youssef, 2018; Alsamadi, 2017; AlZebidi & Alsuhaymi, 2021; Alamri & Alqahtani, 2022), indicating that there were no statistically significant differences between males and females.

The researchers attribute the observed favoritism towards females in DCS to the fact that females tend to use social media and modern technologies more frequently than males. This is partly because females may have fewer personal commitments that occupy their time, unlike males. These findings align with a study conducted by Jones and Mitchell (2016), which reported higher DCS among females. Furthermore, the researchers attribute the superiority of females in DCS to several factors. Firstly, females often exhibit a greater inclination towards socializing through digital media, aiding in the development of digital interaction skills. Additionally, females may have a stronger awareness of internet safety and the need to protect their personal information. Females also tend to show more interest in creative content and digital arts, enhancing their interaction with these media. This heightened interest makes them more responsive to technological innovations and the use of new technologies in general.

The results of the third and fourth hypotheses indicate a statistically significant positive relationship between DCS (digital literacy, digital communication, digital commerce, digital access, digital laws, digital behavior rules, health and well-being, digital security, digital rights and responsibilities, and overall score) and the ASD (environmental, social, economic, educational domains, and overall score). Additionally, the findings suggest the possibility of predicting ASD through DCS. These results are in line with various studies (Al-Dhuhli et al., 2022; Abbasi et al., 2022; ESCAP, 2022; Ghosn-Chelala, 2019; Joyce, 2018; Lozano-Díaz & Fernández-Prados, 2020; Pigola et al., 2021; Sung et al., 2020).

The researchers attribute these results to the fact that DCS and technology contribute to addressing educational challenges, providing opportunities for self-directed learning and lifelong learning. Moreover, they can make the world more just, peaceful, and equitable. Digital achievements can support each of the seventeen Sustainable Development Goals (SDGs), hastening their realization. They help in ending poverty, reduce maternal and infant mortality, promoting sustainable agriculture, ensuring universal literacy, providing opportunities for renewable and clean energy, and achieving food security by creating opportunities for food availability and access.

DCS offer various ways to increase income, boost productivity, and reduce time, effort, and costs in task completion. They create new job opportunities contributing to economic growth. Through digital communication, individuals can participate in global dialogues on sustainable development issues, exchange experiences and solutions with people worldwide, and disseminate ideas and solutions through social media and other digital platforms. Digital skills can be used to develop sustainable economic projects, contributing to the economic transformation towards more sustainable and resource-efficient patterns.

Conclusion

In summary, this research investigates the DCS of students at PSAU, revealing a notable proficiency aligned with national digital transformation goals outlined in Vision 2030. Gender-based disparities indicate higher DCS among females, consistent with global trends and increased female engagement in social media and modern technologies. The study establishes positive correlations between DCS and ASD, emphasizing the role of these skills in addressing contemporary global challenges and contributing to Sustainable Development Goals (SDGs).

Educationally, the findings underscore the importance of integrating digital citizenship education into academic curricula. Recognizing the impact of such skills on societal, economic, and environmental dimensions, policymakers, educators, and stakeholders can leverage these insights to enhance digital literacy initiatives. The educational applications extend to cultivating a digitally literate populace capable of actively contributing to SDGs, promoting economic growth, and fostering global cooperation. Embracing DCS is thus deemed essential for shaping a more inclusive, well-informed, and sustainable future.

Acknowledgment

"This project is sponsored by Prince Sattam Bin Abdulaziz University (PSAU) as part of funding for its SDG Roadmap Research Funding Programme project number PSAU-2023-SDG- "

References

Abbasi, K. R., Hussain, K., Haddad, A. M., Salman, A., & Ozturk, I. (2022). The role of financial development and technological innovation towards sustainable development in Pakistan: fresh insights from consumption and territory-based emissions. *Technological Forecasting and Social Change,* 176, 121444. DOI: 10.1016/j.techfore.2021.121444

Abu Almajd, M. A., & Al-Youssef, I. Y. (2018). Social media networks and their employment methods in enhancing digital citizenship dimensions among students of the College of Education at King Faisal University. *Al-Majallah Al-Tarbiyah, 56*, 691-722. https://doi.org/10.21608/edusohag.2018.23934

Alamri, H., & A Alqahtani, A. (2022). Digital Citizenship among Saudi Community Colleges' Undergraduates: Reality and Requirements for Enablement. *European Online Journal of Natural and Social Sciences*, *11*(4), 1144-1165. www.european-science.com

Al-Dhuhli, R., Alkindi, L, & Al-Taani, W. (2022). Digital Technology and its Role in Achieving Sustainable Development Requirements in Basic Education Schools in the Sultanate of Oman. Jordan Journal of Applied Science Humanities Science Series (JJOAS), 31(1), 1-15. https://digitalcommons.aaru.edu.jo/jjoas-h/vol31/iss1/4

Al-Hadif, N. B. M. (2021). The level of availability of digital citizenship skills among postgraduate students at the College of Education, Qassim University: Their perspectives and its relationship to some variables. *Umm Al-Qura University Journal of Educational and Psychological Sciences, 13*(4), 189-219.

Al-Naqbi, A. K., & Alshanna, Q. (2018). The status of education for sustainable development and sustainability knowledge, attitudes, and behaviors of UAE University students. *International Journal of Sustainability in Higher Education*, *19*(3), 566-588. https://doi.org/10.1108/IJSHE-06-2017-0091

Al-Qarni, Z. (2021). The role of Saudi universities in promoting digital citizenship values: An analytical study of the websites of Saudi universities. *Journal of King Abdulaziz University, Arts and Humanities, 29*(2), 247–290. http://dx.doi.org/10.4197/Art.29-2.10

Al-Samadi, H. S. I. (2017). Students' perceptions of digital citizenship: A field study on a sample of students at Qassim University. *Journal of Psychological and Educational Studies, 1*(18), 175-184. DOI: 10.35156/1192-000-018-013

Al-Waly, M. F. R. (2023). The Role of Technology in Achieving Sustainable Development in the Light of Egypt's Vision 2030. *International Journal of Contemporary Educational and Human Sciences, 2*(1), 1–21.

AlZebidi, A. A., & Alsuhaymi, D. S. (2021). Investigating Students' Digital Citizenship Practices for Undergraduate Students at Al-Qunfudhah University College. *Ilkogretim Online*, *20*(5), 2089-2104. DOI: 10.17051/ilkonline.2021.05.230

Ambusaidi, A., & Al Washahi, M. (2016). Prospective teachers' perceptions about the concept of sustainable development and related issues in Oman. *Journal of Education for Sustainable Development*, *10*(1), 3-19. https://doi.org/10.1177/0973408215625528

Andersson, K. (2017). Starting the pluralistic tradition of teaching? Effects of education for sustainable development (ESD) on pre-service teachers' views on teaching about sustainable development. *Environmental Education Research*, *23*(3), 436-449. https://doi.org/10.1080/13504622.2016.1174982

Aseeri, M. A. I. (2023). *The role of social media networks in developing digital citizenship skills among postgraduate students at Jazan University*. Master's thesis. Jazan University, Jazan.

Beder, S. (1994). The role of technology in sustainable development. *IEEE Technology and Society Magazine*, *13*(4), 14-19. https://doi.org/10.1109/44.334601

Biasutti, M., & Frate, S. (2017). A validity and reliability study of the attitudes toward sustainable development scale. *Environmental Education Research*, *23*(2), 214-230. https://doi.org/10.1080/13504622.2016.1146660

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. WW Norton & Company.

Clayton, T., & Radcliffe, N. (2018). *Sustainability: a systems approach*. Routledge.

Couros, A, & Hildebrandt, K. (2015). *Digital Citizenship Education in Saskatchewan Schools: A policy planning Guide for School Divisions and schools to implement Digital Citizenship Education from kindergarten to Grade 12*. Saskatchewan Ministry of Education.

Del Río Castro, G., González Fernández, M. C., & Uruburu Colsa, Á. (2021). Unleashing the convergence amid digitalization and sustainability towards pursuing the Sustainable Development Goals (SDGs): A holistic review. *Journal of Cleaner Production*, *280*(1), 1-15. https://doi.org/10.1016/j.jclepro.2020.122204

ESCAP, U. (2022). Frontier ICT's for sustainable development for digital leaders: submodule C: Internet of Things. United Nations ESCAP.

Gatti, L., Ulrich, M., & Seele, P. (2019). Education for sustainable development through business simulation games: An exploratory study of sustainability gamification and its effects on students' learning outcomes. *Journal of Cleaner Production*, *207*, 667-678. https://doi.org/10.1016/j.jclepro.2018.09.130

Ghosn-Chelala, M. (2019). Exploring sustainable learning and practice of digital citizenship: Education and place-based challenges. *Education, Citizenship and Social Justice*, *14*(1), 40-56. https://doi.org/10.1177/1746197918759155

Greesh, D. S. (2023). The effectiveness of a training program based on video modeling for developing some sustainable development skills among gifted children with autism spectrum disorder "Savant Syndrome. *Journal of the College of Education, 39*(2), 66-110. https://dx.doi.org/10.21608/mfes.2023.294800

Guandalini, I. (2022). Sustainability through digital transformation: A systematic literature review for research guidance. *Journal of Business Research*, *148*, 456-471. http://dx.doi.org/10.1016/j.jbusres.2022.05.003

Hollandsworth, R., Dowdy, L., & Donovan, J. (2011). Digital citizenship in K-12: It takes a village. *TechTrends: Linking Research and Practice to Improve Learning*, 55 (4), 37-47. https://eric.ed.gov/?id=EJ926721

Illahaqi, A. A. D., Nurcahyo, H., & Panjaitan, M. H. (2021, March). Advancing students' environmental sustainability awareness through science mobile learning: A literature review. In *6th International Seminar on Science Education (ISSE 2020)* (pp. 795-800). Atlantis Press.

Jones, L. M., & Mitchell, K. J. (2016). Defining and measuring youth digital citizenship. *New media & society*, *18*(9), 2063-2079. https://doi.org/10.1177/1461444815577797

Jovanović, M., Dlačić, J., & Okanović, M. (2018). Digitalization and society's sustainable development–Measures and implications. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, *36*(2), 905-928. http://dx.doi.org/10.18045/zbefri.2018.2.905

Joyce, A. (2018). How can Information and Communication Technologies support education for sustainable Development? A Critique. In *EDULEARN18 Proceedings* (pp. 9245-9254). IATED. http://dx.doi.org/10.21125/edulearn.2018.2170

Judge, J. P., Morgan, K. N., & Clifton, A. (2022). Video Modeling to Support Physical Activity in Children with Autism Spectrum Disorder: A Systematic Review. *Journal of the American Academy of Special Education Professionals*, *34*, 48. https://eric.ed.gov/?id=EJ1353982

Kalsoom, Q., & Khanam, A. (2017). Inquiry into sustainability issues by preservice teachers: A pedagogy to enhance sustainability consciousness. *Journal of cleaner production*, *164*, 1301-1311. https://doi.org/10.1016/j.jclepro.2017.07.047

Karaduman, H., & Ozturk, C. (2014). The effects of activities for digital citizenship on students' attitudes toward digital citizenship and their reflections on students' understanding about digital citizenship. *Journal of Social Studies Education Research*, *5*(1), 38-78.

Langley, D. J. (2022). Digital product-service systems: The role of data in the transition to servitization business models. *Sustainability*, *14*(3), 1303. https://doi.org/10.3390/su14031303

Literacy with ICT. (2009): Digital Citizenship. Retrieved January .10, 2009, from: http://lwictdigitalcitizenship.wikispaces.com

Lozano-Díaz, A., & Fernández-Prados, J. S. (2020). Educating digital citizens: An opportunity to critical and activist perspective of sustainable development goals. *Sustainability*, *12*(18), 7260. https://doi.org/10.3390/su12187260

Lyons, R. (2012). *Investigating student gender and grade level differences in digital citizenship behavior* (Doctoral dissertation, Walden University).

Mahadir, N. B., Baharudin, N. H., & Ibrahim, N. N. (2021). Digital Citizenship Skills among Undergraduate Students in Malaysia: A Preliminary Study. *International Journal of Evaluation and Research in Education*, *10*(3), 835-844. http://dx.doi.org/10.11591/ijere.v10i3.21277

Martin, F., Gezer, T., & Wang, C. (2019). Educators' perceptions of student digital citizenship practices. *Computers in the Schools*, *36*(4), 238-254. https://doi.org/10.1080/07380569.2019.1674621

Michalos, A. C., Creech, H., McDonald, C., & Kahlke, P. M. H. (2011). Knowledge, attitudes and behaviours. Concerning education for sustainable development: Two exploratory studies. *Social indicators research*, *100*, 391-413. https://doi.org/10.1007/s11205-010-9620-9

Mohammed, M. A. H. (2022). A proposed program in light of the dimensions of sustainable development and green economy and its impact on developing sustainable thinking, cognitive balance, and sustainable attitudes among science stream students at the College of Education. *Journal of the College of Education, 38*(3), 106–170. https://doi.org/10.21608/mfes.2022.228315

Mora, H., Pujol-López, F. A., Mendoza-Tello, J. C., & Morales-Morales, M. R. (2020). An education-based approach for enabling the sustainable development gear. *Computers in Human Behavior*, *107*, 105775, 1-7. https://doi.org/10.1016/j.chb.2018.11.004

Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research policy*, *48*(8), 103773. https://doi.org/10.1016/j.respol.2019.03.018

Nousheen, A., Zai, S. A. Y., Waseem, M., & Khan, S. A. (2020). Education for sustainable development (ESD): Effects of sustainability education on pre-service teachers' attitude towards sustainable development (SD). *Journal of Cleaner Production*, *250*, 119537. https://doi.org/10.1016/j.jclepro.2019.119537

Ohler, J. B. (2010). *Digital community, digital citizen*. Corwin Press.

Paiola, M., Schiavone, F., Grandinetti, R., & Chen, J. (2021). Digital servitization and sustainability through networking: Some evidences from IoT-based business models. *Journal of Business Research*, *132*, 507-516. https://doi.org/10.1016/j.jbusres.2021.04.047

Park, Y. (2016). An Innovative Digital Citizenship Initiative in Singapore and Korea. In *SITE-Society for Information Technology & Teacher Education International Conference*. Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/173241/

Pigola, A., da Costa, P. R., Carvalho, L. C., Silva, L. F. D., Kniess, C. T., & Maccari, E. A. (2021). Artificial intelligence-driven digital technologies to the implementation of the sustainable development goals: A perspective from Brazil and Portugal. *Sustainability*, *13*(24), 13669. https://doi.org/10.3390/su132413669

Probst, L., Bardach, L., Kamusingize, D., Templer, N., Ogwali, H., Owamani, A., ... & Adugna, B. T. (2019). A transformative university learning experience contributes to sustainability attitudes, skills and agency. *Journal of Cleaner Production*, *232*, 648-656. https://doi.org/10.1016/j.jclepro.2019.05.395

Rahman, H. (Ed.). (2021). *Human-computer Interaction and Technology Integration in Modern Society*. IGI Global.

Ribble, M, (2011). *Digital Citizenship in Schools.* ISTE (International Society for Technology in Education).

Ribble, M. (2009). Passport to Digital Citizenship: Journey toward Appropriate Technology Use at School and home. *Learning & Leading with Technology*, 36(4), 14-17. https://eric.ed.gov/?id=EJ904288

Ribble, M. (2012). Digital citizenship for educational change. *Kappa Delta Pi Record*, *48*(4), 148-151. https://doi.org/10.1080/00228958.2012.734015

Ribble, M. (2014). The Importance of Digital Citizenship: Why schools should help, young people navigate the digital landscape. District Administration.

Ribble, M. (2015). *Digital citizenship in schools: Nine elements all students should know*. International Society for technology in Education.

Ribble, M., & Miller, T. N. (2013). Educational leadership in an online world: Connecting students to technology responsibly, safely, and ethically. *Journal of asynchronous learning networks*, *17*(1), 137-145.

Ribble, M., & Park, M. (2022). *The digital citizenship handbook for school leaders: Fostering positive interactions online*. International Society for Technology in Education.

Sahin, E., Ertepinar, H., & Teksoz, G. (2012). University Students' Behaviors Pertaining to Sustainability: A Structural Equation Model with Sustainability-Related Attributes. *International Journal of Environmental and Science Education*, *7*(3), 459-478.

Salam, A. (2020). Internet of things for sustainable community development: introduction and overview. In *Internet of Things for sustainable community development* (pp. 1-31). Springer, Cham.

Sari, D. P., Sapriya, S., & Fitriasari, S. (2022, January). Analysis of students' digital citizenship practices on distance learning activities during pandemic Covid-19. In *Annual Civic Education Conference (ACEC 2021)* (pp. 507-513). Atlantis Press. https://doi.org/10.2991/assehr.k.220108.091

Simsek, E., & Simsek, A. (2013). New literacies for digital citizenship. *Contemporary educational technology*, *4*(2), 126-137. https://doi.org/10.30935/cedtech/6097

Suleiman, F. R. A. (2020). A proposed unit in light of sustainable development and the green economy to impart to students of the scientific departments at the College of Education some concepts related to green economy and sustainable trends. *Educational and Psychological Studies, 10*(108), 85-149. DOI: 10.21608/sec.2020.102858

Sung, A., Leong, K., Cunningham, S. (2020). Emerging Technologies in Education for Sustainable Development. In: Leal Filho, W., Azul, A., Brandli, L., Özuyar, P., Wall, T. (eds) Partnerships for the Goals. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319-71067-9_61-1

Tan, T. (2011). Educating digital citizens. *Leadership*, *41*(1), 30-32. https://eric.ed.gov/?id=EJ965963

Tomas, L., Girgenti, S., & Jackson, C. (2017). Pre-service teachers' attitudes toward education for sustainability and its relevance to their learning: Implications for pedagogical practice. *Environmental Education Research*, *23*(3), 324-347. http://dx.doi.org/10.1080/13504622.2015.1109065

Tsai, C. Y. (2018). The effect of online argumentation of socio-scientific issues on students' scientific competencies and sustainability attitudes. *Computers & Education*, *116*, 14-27. http://dx.doi.org/10.1016/j.compedu.2017.08.009

Ull, M. A., Martínez-Agut, M. P., Piñero, A., & Aznar-Minguet, P. (2014). Perceptions and attitudes of students of teacher-training towards environment and sustainability. *Procedia-Social and Behavioral Sciences*, *131*, 453-457. https://doi.org/10.1016/j.sbspro.2014.04.147

UNCTAD. (2015). Science, Technology and Innovation for Sustainable Urbanization, UNCTAD Current Studies on Science, Technology, and Innovation no. 10. United Nations publication.

UNCTAD. (2018). Technology and innovation report 2018: Harnessing frontier technologies for sustainable development. United Nations publication.

Vasiliu-Feltes, I., & Thomason, J. (Eds.). (2021). *Applied Ethics in a Digital World*. IGI Global.

Young, D. (2014). A 21st-century model for teaching digital citizenship. *Educational Horizons*, *92*(3), 9-12. http://dx.doi.org/10.1177/0013175X1409200304

Zuwein, S. H. M. (2017). The effectiveness of using electronic blogs in teaching geography on developing digital citizenship skills for student teachers at the College of Education. *College of Education Journal, 33*(9), 461-531.