ISTE Standards Implementation in Higher Education: An Exploratory Study of Prince Sattam bin Abdulaziz University, Saudi Arabia

Khalid Abdullah Bingimlas[1,*]

[1]Department of Curriculum and Instructions, College of Education, Prince Sattam bin Abdullaziz University, Al-Kharj 11942, Saudi Arabia

*Correspondence: Department of Curriculum and Instructions, College of Education, Prince Sattam bin Abdullaziz University, Al-Kharj 11942, Saudi Arabia

Abstract

This study aims to explore the extent of utilization of the ISTE standards for students in higher education. It also aims to examine the impact of some demographic variables (gender, specialization, and academic degrees) on implementing the ISTE standards for the students. The researcher used a questionnaire method to collect the data from the students of Prince Sattam bin Abdulaziz University and sent it to the 626 participants who consented affirmatively and included 614 valid responses from them. A correlational analysis was carried out, and the statistical findings highlight that most of the participants signaled to achieve ISTE standards positively, and the availability of the standards was positive. The findings revealed statistically significant differences in responses between male and female students in all standards, with females outperforming males. Female participants exhibited a higher orientation in the use and implementation of the standards. However, the students' specializations and their respective degree programs made no significant difference in implementing the standards. The research overall finds efficacy in implementing the ISTE standards in all the universities for both the students and the teachers. It is recommended to embed these standards in the regular curriculum of the university's degree programs and create a regular mechanism to enhance awareness and provide training to the users to ensure efficacy in improving the educational standards.

Keywords: ISTE standards, high education, educational technology, Saudi Arabia

1. Introduction

The contemporary world is developing in various fields of life, whether cultural, economic, or social. Scientific and technological advancements are obvious, and most countries have been keen to keep pace with these developments and changes. This happens by building human cadres that have a comprehensive and integrated set of knowledge, skills, and values that can keep pace with these developments. One of the most prominent of these developments is the interest in technological skills. Thus, it has become necessary for youth, whether in public or university education, to acquire this knowledge and skills. In this context, the requirement to give teachers and students directions on how to use and integrate technology into education has received attention from various groups. One of these groups is the International Society for Technology in Education (ISTE), which issued a set of technology standards in 1998.

ISTE is a non-profit organization established in 1979 in Washington, USA. It is one of the most famous educational institutions that have been concerned with the use and employment of technology in education. It has developed technological standards for students, teachers, school administrators, and those interested in computer science. These standards focus on teaching, learning, and leading in the digital age (Grant & Basye, 2014). ISTE motivates teachers worldwide to use technology to enhance teaching and learning, expedite good practice, and solve difficult problems in education (Almisad, 2020). Therefore, ISTE offers various types of standards that are defined as a framework for teachers, students, directors, supervisors, coaches, and computer science instructors to reconsider education and build creative learning environments (ISTE, 2016). Subsequently, the ISTE updated these standards frequently until the latest version was issued in 2016, and these standards are considered levels of technical performance for students (ISTE, 2016).

The use of technology in teacher education programs can be regulated and assessed using the ISTE standards. These standards inspire future educators and students to participate in the digital age, and they serve as tangible indicators of how much students are using technology (Dondlinger et al., 2016). ISTE Standards for Students can be used for several reasons. According to (Crompton, 2014) it can be used for evaluating students' technological skills at different grade levels and examining what needs to be better users of technologies. Also, they may contribute to developing students' technological abilities and skills and rooting their creativity and innovation values. This could be accomplished by employing their knowledge to find new ideas and to rely on new teaching strategies and methods such as simulations, models, and scenarios. In addition, technology can be employed in the effective communication and exchange of data and information related to teaching and learning processes. As well as employed in solving problems, conducting research, designing, implementing, and evaluating educational projects (Sanders, 2016).

2. Research Problem

The advancement in technology is attracting the youth widely and specifically the students. Therefore, directing students to use technology correctly and positively is educationally important to counteract the accompanying adverse uses of technology, such as the spread of online cultures, pornography, violation of individual privacy, and other uses that may affect user identity on the Internet. This may lead to negative psychological effects on the family and society as well as political and security risks (Aldosari et al., 2020)

Saudi Arabia has taken initiatives in preparing and developing young people for the next stage of competitiveness and technological revolution. This is confirmed by Saudi Arabia's Vision 2030 (Vision 2030 of Kingdom of Saudi Arabia) because one of its most important programs is the "Digital Transformation Program"(Govt of Saudi Arabia, 2022), which aims to build a digital society and create digital platforms to enrich effective interaction and community participation. This contributes to achieving many objectives, such as improving competitiveness in technology and innovation, developing industry, having a positive impact on the economic situation, providing better services to beneficiaries, and creating a digital homeland. The Kingdom has therefore paid great attention to the field of communication and information technology, digital technology as an essential tool in the local community, and a means on which many individuals rely in their daily lives.

There are other studies such as (Nair, 2021; Aldosari et al., 2020; Ayad & Ajrami, 2017) confirm the importance of adopting international technology standards (ISTE, 2016) for students. These standards impact the educational process and the student's technical skills positively. International standards have therefore emphasized technical competencies as one of the competencies that should be inculcated in today's students. Therefore, the importance of this study lies in the benefit of educators and decision-makers at Prince Sattam bin Abdulaziz University and other similar universities for identifying the extent to which university students possess technological standards. This study also contributes to developing the performance of the teaching practices of faculty members when identifying the degree of availability of ISTE standards for students of Prince Sattam bin Abdulaziz University.

2.1 Research questions

In view of the preceding discussion and considering the aim of the study, this study seeks to answer the following research questions:

1). What is the extent of use of the ISTE standards for students at Prince Sattam bin Abdulaziz University?

2). Are there statistically significant differences at the level ($\alpha = 0.05$) in the students' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with their gender, specialization, and degrees?

3. Literature Review

The International Society for Technology in Education (ISTE) is keen to constantly develop ISTE standards for students. The society issued the first edition of the standards (ISTE) in 1998, which defines what students should know to be able to do it using technology in their schools, which focused on learning to use technology. Subsequent changes culminated at year 2016 when these standards became composed of six parts (ISTE, 216; Vucaj, 2022; Aldahmash et al., 2019). The ISTE standards for students include seven standards. The first standard is Empowered Learner, where the student has a wide influence in choosing, achieving, and demonstrating competence to achieve learning goals (ISTE, 2016). Students define and establish personal learning objectives, create technology-enhanced strategies to achieve them, and evaluate the learning process itself to enhance learning

outcomes (Almisad, 2020). They set up networks and adapt their classroom environments in a way that promotes learning, and they also comprehend the basic principles of technology operations (Aslam et al., 2020).

The second standard is Digital Citizen, who knows his rights, duties, and opportunities to live, learn and work in an interconnected digital world (ISTE, 2016). Students demonstrate safe, moral, and ethical behavior by acting in accordance with their knowledge of the rights, obligations, and opportunities that come with living, learning, and working in a linked digital environment (Kirschner et al., 2008). Students create and control their online identities and reputations and are conscious of the lasting effects of their actions. They behave in a way that is ethical, safe, and positive when using technology, particularly online social interactions, or the use of networked devices (Ayad & Ajrami, 2017).

The third standard is Knowledge Constructor, using digital tools to build knowledge (ISTE, 2016). Students use technologies to critically curate a range of resources to develop their understanding, create artistic works, and create memorable learning opportunities for both themselves and other people. Moreover, students gain knowledge through actively investigating challenges and problems from the actual world, creating ideas and theories, and seeking solutions (Baek & Sung, 2020).

The fourth standard is Innovative Designer, who uses a variety of techniques to identify and solve problems by creating new and useful means (ISTE, 2016). In a design process, students work using a range of technologies to identify issues and come up with fresh, clever, or beneficial solutions. According to(Almisad, 2020), prototypes are created, tested, and improved by students as part of an iterative design process and, students demonstrate ambiguity tolerance, persistence, and the ability to solve open-ended tasks.

The fifth standard is Computational Thinker, which collects data and uses digital means to analyze it (ISTE, 2016). The strategies that students build and use for comprehending and resolving issues use technological approaches to create and assess solutions. In this standard, students define problems that can be explored and solved using technology-assisted techniques like data analysis, abstract modeling, and algorithmic reasoning (ISTE, 2016).

The sixth standard is Creative Communicator, who communicates with students clearly and expresses himself creatively (ISTE, 2016). Students use the platforms, formats, tools, styles, and digital media suited to their aims to express themselves effectively and creatively for various purposes. In this standard, students select the best methods and resources to achieve the goals they have for their creations or communications. They also create or utilize a variety of digital objects, such as visualizations, models, or simulations, to clearly and efficiently express complicated ideas. For their target audiences, students publish or deliver material that is the message- and medium-specific (Aslam et al., 2020).

The seventh standard is Global Collaborator, by working effectively in teams both locally and globally. By interacting with others and doing well in teams locally and worldwide, students use digital tools to expand their learning and widen their perspectives. In this standard, students can interact with students from different origins and cultures through digital tools, engaging with them in ways that deepen understanding and learning (ISTE, 2016). They collaborate with others using collaborative technology to study topics and problems from various angles, whether they are peers, experts, or community members. Students actively participate in project teams, taking on various tasks and duties to work efficiently toward a common objective (Kirschner et al., 2008).

There are many previous studies that have dealt with ISTE standards in Arabic and English countries. For an instant, a recent study (Al-Qahtani, 2022) aimed to determine the level of awareness among students at Hail University on the ISTE standards. A sample of (389) B.A./M.A. female students were selected. The results of the study have shown that the level of awareness about the ISTE standards was very low. Aldosari et. al, (2020) aims at determining the extent to which middle and high school students in Riyadh, Saudi Arabia, were familiar with the ISTE Digital Citizenship standards. A sample of 394 students from various middle and high schools participated in the survey. The four ISTE categories of digital citizenship served as the foundation for the survey items' development (Digital identity, Ethical behavior, Intellectual property, and Digital privacy and security). The Study results showed that students had high levels of Internet self-efficacy and availability of digital citizenship in the first and second domains.

Almsiad (2020) research aims to examine how well pre-service teachers at the Public Authority for Applied Education and Training (PAAET) college of basic education were achieving ISTE standards from their perspective. The number of pre-service teachers who answered the questionnaire was 280. The findings revealed that the participants had favorable opinions about meeting ISTE standards. Based on their gender, age, major, and academic year, pre-service teachers' assessments of the ISTE standards' attainment indicated negligible differences.

Aslam et al. (2020) aim to examine the association between technology integration and TPK in private secondary schools in Karachi using the ISTE Standards for Teachers. TPK was classified as two ISTE-2008 standards: encouraging student innovation and developing assessments appropriate for the digital age. Using a simple random sampling method, 120 instructors from 12 private secondary schools in Karachi were chosen. The integration of ICT and TPK were found to be strongly and significantly correlated. ICT integration and teachers' capacity to foster creativity and develop digital-age assessments were shown to be strong and some what significantly correlated, respectively. 32% of the variation in teachers' professional expertise was explained by ICT integration. This study was done to find out how much each teacher at a private secondary school used technology to help with their student's education. The study focused on how teachers might use technology in the classroom to foster students' creativity and provide assessments appropriate for the digital age, in accordance with ISTE standards for teachers.

Baek & Sung (2020) research aims to look at pre-service teachers' perceptions of their technological proficiency. Data were gathered at one of the national universities of education in South Korea using a mixed-methods strategy. The existing technology education courses that pre-service teachers are taking are inadequate in their eyes since they are neither adapted to their technological proficiency levels nor strategically coordinated with one another. According to this study, teacher education curricula should be modified to provide teachers with more and better opportunities to develop classroom-ready technology teaching abilities. By assessing technology proficiency and usage levels, this study aimed to develop an effective technology-integrated education strategy based on the ISTE's suggested standards for the teacher's role. The study also looked at the relevance and applicability of the ISTE Standards in South Korea.

3. Methodology

In this study, the descriptive survey method was used to describe the literature and previous studies and analyze collected data (Al-Assaf, 1995). The goal of descriptive research is to describe a phenomenon, and its characteristics, and survey tools are often used to gather data (Gall et al., 2007). The data were necessary to measure the degree of availability of the ISTE standards for university students. Studies that aim to know the point of view are preferred to be treated with the descriptive approach (Adas, 1992).

3.1 Study Sample and Population

The study population consisted of all male and female students from the faculties of Prince Sattam bin Abdulaziz University which is located 85 kilometers south of Riyadh. The questionnaire was distributed via official e-mail to all male and female students in the university's faculties. The total of completed survey responses was 626, and 614 valid responses were selected. The demographic information about the participants has been provided in Table 1.

Table 1. Teacher Participants' Characteristics

Demographic Information (n=614)			
Variable	Answer	Frequency	Percentage
Gender	Male	298	48.5%
	Female	316	51.5%
	Total	614	100.0%
Specialization	Humanitarian	428	69.7%
	Scientific	132	21.5%
	Healthy	54	8.8%
	Total	614	100.0%
academic degree	Diploma	162	26.4%
	Bachelor	372	60.6%
	Master's	80	13.0%
	Total	614	100.0%

3.2 Study Questionnaire

The survey had two parts. The first part was designed to collect demographic information such as participants' gender, academic degrees (whether diplomas, bachelor's degrees, or master's degrees), and specialization, which means the students' university major. This aspect was useful for understanding participants' backgrounds and facilitating the testing of different variables. The second part was designed based on the standards of the International Society for Technology in Education for students, which were issued in 2016. This part consisted of seven main standards, including several indicators. The total of those indicators reached 33.

3.3 Validity and Reliability Test

The validity of the questionnaire was already done in the studies (Al-Qahtani, 2022; Aldahmash et al., 2019) and the survey in this study was designed based on the ISTE standards for students. Several past studies have used these standards, including the research of Al-Qahtani (2022) and Albrahim (2020). Therefore, this survey was done to increase the validity of not only the current research but also to substantiate the previous studies (Roberts, 1999). The use of a pilot approach allowed some suggestions that helped in revising the items. It involves testing the wording of questions, identifying ambiguous questions, and testing the techniques used to collect data. The Pearson correlation coefficient between each statement and each standard was calculated to examine internal consistency. The Pearson correlation coefficient was between 788 and 907 for the correlation among each standard, as shown in Table 2. This shows the high level of positive significance of the research variables. All these coefficients were statistically significant at level 1. $<.01$ (Field, 2013).

Table 2. Correlations between Each Standard and the Total Degree of Questionnaire

Standards	Items	Correlation	P-Value
Empowered Learner	5	0.863**	0.000
Digital citizen	5	0.788**	0.000
Knowledge Constructor	5	0.816**	0.000
Innovative designer	5	0.907**	0.000
Computational Thinker	5	0.804**	0.000
Creative Communicator	4	0.838**	0.000
Global Collaborator	4	0.834**	0.000
Note: (**) means the correlation statistically significant at (0.01) or less			

3.4 Statistical Reliability

The reliability coefficient was examined by using Cronbach's Alpha. The following table shows the extracted values. The Cronbach's alpha of the seven standards ranged from .777 for the Empowered Learner standard to .856 for the Global Collaborator standard. The overall reliability coefficient was (0.this ;this indicates that the survey is characterized by great stability. A value of Cronbach's Alpha that indicates an acceptable level of reliability has generally been 7 or higher (Field, 2013).

Table 3. Reliability Coefficients Cronbach's Alpha

Standards	Indicators	Cronbach's alpha
Empowered Learner	5	0.777
Digital citizen	5	0.821
Knowledge Constructor	5	0.815
Innovative designer	5	0.853
Computational Thinker	5	0.815
Creative Communicator	4	0.818
Global Collaborator	4	0.856
Overall reliability coefficients	33	0.954

4. The Results: Questions and the Findings

4.1 First question: What is the degree of availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University?

To examine the degree of availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University mean, standard deviation, ranking, and interpretation were conducted for each standard. This is provided in table 4. Students thought that the availability of ISTE standards for students was generally high. The overall mean was 3.78 with a standard deviation of 0.94.

Table 4. Descriptive Statistics for Each Standard

No	Standard	Mean	S.D	Ranking	Interpretation
2	Digital citizen	4.28	0.90	1	Very High*
3	Knowledge Constructor	3.99	0.98	2	High**
1	Empowered Learner	3.82	0.97	3	High**
6	Creative Communicator	3.69	1.13	4	High**
7	Global Collaborator	3.67	1.14	5	High**
5	Computational Thinker	3.51	1.16	6	High**
4	Innovative designer	3.47	1.22	7	High**
	Overall mean (all standards)	3.78	0.94	-	High**

Very High*: The participants believed that Digital citizen element was much higher than the others

High** The participants believed that the other elements were also highly available but lesser than Digital citizen

The first standard included five items demonstrating the degree of availability of the Empowered Learner standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 3.82 with a standard deviation of 0.97. All the items indicating high ratings ranged from 73.9% to 51.1% (See Table 5). The mostly found perception, related to the "Empowered Learner" standard was generally "agree", among amajority of master's students.

Table 5. Descriptive Statistics for Each Item in Standard (Empowered Learner)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
4	I Use technology to get feedback to develop my skills	454 73.9%	74 12.1%	4.10	1.17	1	High
5	I have an ability to choose, use and explore new technologies	430 70%	70 11.4%	4.02	1.19	2	High
2	I use technology to critique (understand the pros and cons) of the personal learning process and improve learning outcomes	376 61.2%	82 13.4%	3.82	1.21	3	High
1	I clearly define personal learning goals and invest technology in achieving them.	376 61.2%	104 16.9%	3.76	1.23	4	High
3	I Build learning networks to support my learning	314 51.1%	182 29.6%	3.39	1.43	5	Medium
	Overall mean			3.82	0.97	-	High

The second standard included five items that demonstrate the degree of availability of the Digital Citizen standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 4.28 with a standard deviation of 0.90. All the items indicating high ratings ranged from 85.7% to 57.7% (See Table 6). The mostly found perception, related to the "Digital Citizen" standard was generally "agree", among amajority of Master's students.

Table 6. Descriptive Statistics for Each Item in Standard (Digital citizen):

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
7	I act in a safe, legal, and ethical manner when using the Internet and social network	526 85.7%	42 6.8%	4.50	1.00	1	Very High
9	I maintain my digital privacy when using the Internet and social network	516 84.0%	50 8.1%	4.47	1.07	2	Very High
10	I understand that my surfing on the internet can be tracked through data collection technology	522 85.0%	50 8.1%	4.45	1.05	3	Very High
8	I respect the rights and obligations of sharing intellectual property when using the Internet and social network	496 80.8%	66 10.7%	4.35	1.18	4	Very High
6	I build for myself a digital identity and reputation	354 57.7%	124 20.2%	3.63	1.35	5	High
	Overall mean			4.28	0.90	-	Very High

The third standard is Knowledge Constructor which included five items. These items demonstrate the degree of availability of the standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 4.07 with a standard deviation of 1.21. All the items indicating high ratings ranged from 71.0% to 64.5% (See Table 7). The mostly found perception, related to the "Knowledge Constructor" standard was generally "agree", among majority of master's students.

Table 7. Descriptive Statistics for Each Item in Standard (Knowledge Constructor)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
14	I explore the problems and issues of the world through technology	436 71.0%	76 12.4%	4.07	1.21	1	High
15	I develop my ideas to reach logical solutions through technology	438 71.3%	68 11.1%	4.06	1.16	2	High
12	I evaluate the accuracy and reliability of information, media, and technology data	416 67.8%	68 11.1%	4.00	1.21	3	High
13	I elicit meaningful information and results from digital resources	422 68.7%	78 12.7%	3.96	1.23	4	High
11	I employ effective research strategies to identify information and sources that achieve my intellectual growth and creativity	396 64.5%	88 14.3%	3.84	1.24	5	High
	Overall mean			3.99	0.98	-	High

Another standard is Innovative Designer. It included five items that demonstrate the degree of availability of the Innovative Designer standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 3.47 with a standard deviation of 1.22. All the items indicating high ratings ranged from 59.0% to 45.9% (See Table 8). The mostly found perception, related to the "Innovative Designer" standard was generally "agree", among majority of master's students.

Table 8. Descriptive Statistics for Each Item in Standard (Innovative designer)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
20	I have the ability and persistence to deal with ambiguous problems	362 59.0%	118 19.2%	3.65	1.30	1	High
16	I use the design process for generating ideas or testing theories	332 54.1%	148 24.1%	3.56	1.38	2	High
17	I use the design process for creating innovative artifacts and solve real-world problems	324 52.8%	150 24.4%	3.51	1.43	3	High
18	I use digital tools to plan and manage the design process	290 47.2%	172 28.0%	3.36	1.42	4	Medium
19	I develop and test prototypes as part of the design process	282 45.9%	196 31.9%	3.29	1.45	5	Medium
	Overall mean			3.47	1.22	-	High

The fifth standard included five items that demonstrate the degree of availability of the Computational Thinker standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 3.51 with a standard deviation of 1.16. All the items indicating high ratings ranged from 63.8% to 45.0% (See Table 9). The mostly found perception, related to the "Computational Thinker" standard was generally "agree", among a majority of master's students.

Table 9. Descriptive Statistics for Each Item in Standard (Computational Thinker)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
23	I break problems into small parts to make them easier to solve	392 63.8%	112 18.2%	3.78	1.36	1	High
22	I use digital tools to collect and analyze data and represent data in various ways to facilitate problem-solving and decision-making	342 55.7%	134 21.8%	3.60	1.34	2	High
25	I understand how to automate work	330 53.7%	142 23.1%	3.52	1.38	3	High
21	I deal with problems in a computational way of thinking (which relies on data analysis and abstract models) to discover and solve them	282 45.9%	162 26.4%	3.34	1.38	4	Medium
24	I develop models to understand complex systems	276 45.0%	182 29.6%	3.30	1.43	5	Medium
	Overall mean			3.51	1.16	-	High

The following standard included four items that determine the degree of availability of the Creative Communicator standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 3.69 with a standard deviation of 1.13. All the items indicating high ratings ranged from 70.7% to 54.7% (See Table 10). The mostly found perception, related to the "Creative Communicator" standard was generally "agree", among a majority of master's students.

Table 10. Descriptive Statistics for Each Item in Standard (Creative Communicator)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
26	I choose the appropriate platforms and tools for effective communication	434 70.7%	58 9.4%	4.07	1.14	1	High
29	I publish digital content to deliver appropriate messages to others	378 61.6%	132 21.5%	3.67	1.41	2	High
28	I communicate complex ideas clearly and effectively through a variety of digital means	332 54.1%	154 25.1%	3.50	1.37	4	High
27	I create and remix digital resources to reach new creations	336 54.7%	148 24.1%	3.50	1.38	3	High
	Overall mean			3.69	1.13	-	High

The last standard included four items that prove the degree of availability of the Global Collaborator standard for students at Prince Sattam bin Abdulaziz University from their perspectives. The overall mean was 3.67, with a standard deviation of 1.14. All the items indicating high ratings ranged from 71.0% to 50.2% (See Table 11). The mostly found perception, related to the "Global Collaborator" standard was generally "agree", among a majority of master's students.

Table 11. Descriptive Statistics for Each Item in Standard (Global Collaborator)

No	Items	Very High/ High	Very Low/ Low	Mean	Standard deviation	Ranking	Interpretation
31	I use digital communication with others, experts, and the community to collaborate and work for solving problems	436 71.0%	68 11.1%	4.03	1.23	1	High
30	I use digital tools to communicate and exchange experiences with learners from a variety of backgrounds and cultures	364 59.3%	128 20.8%	3.65	1.37	2	High
33	I use collaborative technologies to work with others to explore and solve local and global issues	344 56.0%	164 26.7%	3.55	1.45	3	High
32	I contribute for building project teams with different responsibilities to achieve common goals	308 50.2%	160 26.1%	3.46	1.39	4	High
	Overall mean			3.67	1.14	-	High

4.2 Second Question

Are there statistically significant differences at the level ($\alpha = 0.05$) in the students' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with their gender, specialization, and degrees?

Further discussion of the results is associated with the six domains that have indicated the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University from their perspectives based on their gender, specialization, and degrees. The differences were examined through mean scores, standard deviations, and independent samples t-test for each variable.

The evaluation of the differences between male and female students' perspectives was carried out by using the comparison method between means and standard deviations. Statistically significant differences between male and female students' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in all standards were found and inclined in favor of females. The t-values reached -3.22, with p-values of < 0.01 as shown in Table 12.

Table 12. Results of Independent Sample t-Test to Significance Difference between Responses of the Sample of the Study, according to (gender)

Variable	Standard	Category	N	Mean	Std. Deviation	t-Test	DF	P-Value
Gender	Empowered Learner	Male	298	3.71	0.99	-2.74**	612	0.01
		Female	316	3.92	0.93			
	Digital citizen	Male	298	4.18	0.97	-2.67**	612	0.01
		Female	316	4.37	0.82			
	Knowledge Constructor	Male	298	3.86	1.03	-3.06**	612	0.00
		Female	316	4.10	0.90			
	Innovative designer	Male	298	3.29	1.23	-3.71**	612	0.00
		Female	316	3.65	1.18			
	Computational Thinker	Male	298	3.39	1.14	-2.45**	612	0.01
		Female	316	3.62	1.17			
	Creative Communicator	Male	298	3.57	1.13	-2.31*	612	0.02
		Female	316	3.78	1.14			
	Global Collaborator	Male	298	3.55	1.13	-2.69**	612	0.01
		Female	316	3.79	1.13			
	All standard (Total)	Male	298	3.65	0.95	-3.22**	612	0.00
		Female	316	3.89	0.91			

However, to examine the differences between three specialties including Humanity, Science, and Health, One Way ANOVA (Analysis of Variance) was performed. According to ANOVA outcomes, there were no significant results appeared among all standards based on students' specialization. This is provided in Table 13.

One Way ANOVA was performed to examine the differences between the three academic degrees including Diploma, Bachelor's, and Master. According to ANOVA outcomes, there were no significant results appeared among the Empowered Learner and Digital Citizen standards based on the students' academic degrees. However, the standards of Knowledge Constructor, Innovative Designer, Computational Thinker, Creative Communicator, and Global Collaborator were significantly different in accordance with their degree at level p-values of < 0.01 (See Table 14).

Table 13. Results of One Way ANOVA to Significance Differences in the Responses of Study Sample According to (Specialization)

Variable	Standard	Sources of variation	Sum of Squares	D.f	Mean Square	F	P-Value (Sig.)
Specialization	Empowered Learner	Between Groups	1.28	2	0.64	0.68	0.51
		Within Groups	571.57	611	0.94		
		Total	572.85	613			
	Digital citizen	Between Groups	0.83	2	0.42	0.51	0.60
		Within Groups	499.59	611	0.82		
		Total	500.42	613			
	Knowledge Constructor	Between Groups	2.84	2	1.42	1.49	0.23
		Within Groups	580.05	611	0.95		
		Total	582.89	613			
	Innovative designer	Between Groups	0.50	2	0.25	0.17	0.85
		Within Groups	909.07	611	1.49		
		Total	909.57	613			
	Computational Thinker	Between Groups	3.23	2	1.61	1.20	0.30
		Within Groups	823.69	611	1.35		
		Total	826.91	613			
	Creative Communicator	Between Groups	10.60	2	2.55	2.01	0.08
		Within Groups	778.97	611	1.27		
		Total	789.57	613			
	Global Collaborator	Between Groups	0.21	2	0.11	0.08	0.92
		Within Groups	794.24	611	1.30		
		Total	794.45	613			
	All standard (Total)	Between Groups	1.15	2	0.57	0.65	0.52
		Within Groups	535.70	611	0.88		
		Total	536.85	613			

Table 14. Results of One Way ANOVA to Significance Differences in the Responses of Study Sample according to (academic degrees)

Variable	Standard	Sources of variation	Sum of Squares	Df	Mean Square	F	P-Value (Sig.)
Academic degrees	Empowered Learner	Between Groups	4.74	2	2.37	2.55	0.08
		Within Groups	568.11	611	0.93		
		Total	572.85	613			
	Digital citizen	Between Groups	2.10	2	1.05	1.29	0.28
		Within Groups	498.33	611	0.82		
		Total	500.42	613			
	Knowledge Constructor	Between Groups	7.03	2	3.51	3.73**	0.02
		Within Groups	575.86	611	0.94		
		Total	582.89	613			
	Innovative designer	Between Groups	11.53	2	5.77	3.92**	0.02
		Within Groups	898.04	611	1.47		
		Total	909.57	613			
	Computational Thinker	Between Groups	27.63	2	13.82	10.56**	0.00
		Within Groups	799.28	611	1.31		
		Total	826.91	613			
	Creative Communicator	Between Groups	24.31	2	12.15	9.70**	0.00
		Within Groups	765.26	611	1.25		
		Total	789.57	613			
	Global Collaborator	Between Groups	33.73	2	16.86	13.54**	0.00
		Within Groups	760.72	611	1.25		
		Total	794.45	613			
	All standard (Total)	Between Groups	11.83	2	5.91	6.88**	0.00
		Within Groups	525.02	611	0.86		
		Total	536.85	613			

The Scheffé test was utilized to find the binary differences of students' degrees which is used to make unplanned comparisons among group means in an ANOVA experiment (Scheffé, 1956). (See Table 15).

Table 15. Results of Scheffé Test to Find the Binary Differences of (academic degrees).

Variable	Standard	Academic degree	N	Mean	Std. Deviation	Diploma	Bachelor	Master's
Academic degrees	Empowered Learner	Diploma	162	3.89	1.01	-		
		Bachelor	372	3.75	0.99		-	
		Master's	80	3.99	0.74			-
	Digital citizen	Diploma	162	4.31	1.00	-		
		Bachelor	372	4.24	0.92		-	
		Master's	80	4.41	0.59			-
	Knowledge Constructor	Diploma	162	3.99	1.04	-		
		Bachelor	372	3.92	0.97		-	
		Master's	80	4.25	0.80	*	*	-
	Innovative designer	Diploma	162	3.68	1.27	-		
		Bachelor	372	3.37	1.20	*	-	
		Master's	80	3.56	1.14			-
	Computational Thinker	Diploma	162	3.83	1.20	-		
		Bachelor	372	3.34	1.15	*	-	
		Master's	80	3.62	0.98			-
	Creative Communicator	Diploma	162	3.88	1.15	-		
		Bachelor	372	3.53	1.14		-	
		Master's	80	4.02	0.96	**	**	-
	Global Collaborator	Diploma	162	3.86	1.19	-		
		Bachelor	372	3.49	1.13	**	-	
		Master's	80	4.13	0.88		**	-
	All standard (Total)	Diploma	162	3.92	0.99	-		
		Bachelor	372	3.66	0.93	**	-	
		Master's	80	3.99	0.73		**	-

(*) there are statistically significant differences at the level ($\alpha = 0.05$)

(**) there are statistically significant differences at the level ($\alpha = 0.01$)

As shown in Table 15, statistically significant differences were obtained between the perspectives of diploma students and Bachelor students in several standards including Innovative Designer, Computational Thinker, and Global Collaborator. Also, the differences between the diploma students and master's students were founded including Knowledge Constructor and Creative Communicator. Moreover, statistically significant differences were observed in the standards of Knowledge Constructor, Creative Communicator, and Global Collaborator between students who have bachelor's degrees and master's degrees (p-values of < 0.01).

5. Discussion

This study aims to explore the availability of the ISTE standards for students in high education. The result of this study shows that most participants viewed achieving ISTE standards positively. There appears to be a good level of availability of the ISTE standards among the students. They assumed they had high levels of compliance with each ISTE standard. This result is consistent with a recent Saudi study conducted by Almsiad (2020), who found that students have a high perception of their technological ability toward ISTE standards' achievement. Likewise, a current study (Nair, 2021) identified that the perception of students on the impact of technology was positive

based on seven ISTE standards for students. However, the interesting thing, the result of this study differs from a recent study (Al-Qahtani, 2022) which showed that the level of students' awareness of ISTE standards was very low. Similarly, the results did not agree with another study (Ayad & Ajrami, 2017) that revealed students and instructors did not find the wide use of ISTE standards. In this context, several studies (Gomez et al., 2022; Hakami, 2019; Ibrahem & Ashaelah, 2020) showed that the degree of ISTE standards availability among students from their point of view is intermediate.

In addition, the results of this study demonstrate that students suppose that they achieve the "digital citizen" standard the most, while they achieve "Innovative designer" the least. This means that students are keen to pay attention to the digital citizen. This result is supported by Aldosari et al. (2020) who showed that students had high levels of Internet self-efficacy and availability of digital citizenship in the first and second domains. Also, Almsiad (2020) in his study claimed that the students believed that they achieved the "digital citizen" standard the most.

Moreover, the results showed that there are differences in the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with gender, in favor of females. This indication is culturally supported as well due to the fact that female students at the university level acquire their education, besides female teachers, from male teachers through the internet and the use of technological gadgets, so they are more inclined towards digitalization. These results showed that female students had higher perceptions of the achievement of ISTE standards than males. This means that the availability of the ISTE standards for females is higher than for males. The digital citizen received the highest percentage among the seven standards in favor of females. However, the results showed that there were no differences between the participants' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with the field of their specialization. This result may be because all the participants came from a homogeneous population.

Furthermore, the results showed that there are differences between students' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with their academic degrees (Diploma, Bachelor, Master's). The results are distributed among the degrees and reveal that the "Digital citizen" standard received the highest mean percentage. This result shows that master's students are more than bachelor's students in the availability of ISTE standards. This result is consistent with a study by (Al-Qahtani, 2022). The result of the recent study may be attributed to the point that master's degree students are often more aware of technology skills than bachelor's students.

As above, the results of this study showed that there are differences between students' responses about the availability of the ISTE standards for students at Prince Sattam bin Abdulaziz University in accordance with gender and academic degrees, while there are not statistically significant differences in the field of specialization. This result is consistent with a recent study (Almsiad, 2020), which proved that there were minimal differences in students' perceptions of the ISTE standards' achievement according to their gender, age, major, and academic year.

6. Recommendations

The students of Prince Sattam bin Abdulaziz University participated to measure the availability of ISTE for students in higher education. However, no significant results appeared among all standards based on the student's specialization. To enhance the degree of implementation of the ISTE standards for students in higher education, it is recommended to provide training courses for male students at the universities to introduce, encourage and motivate students to take up the ISTE standards. There is a great need to integrate ISTE standards into academic courses and embed these standards as part of the regular curriculum. A regular follow-up mechanism is needed to keep up the awareness and efficacy of these standards. The faculty at the universities must be involved to implement ISTE standards effectively.

This study has limitations in several areas. This study was limited to the ISTE standards for students issued in 2016. Also, this study was applied to students at Prince Sattam bin Abdulaziz University (located in a governorate south of Riyadh) in the second semester of the academic year 2021–2022. To facilitate greater research, a diverse range of participants, both students and faculty at various universities, should be involved in the future, not only from the Arab region but also from other regions.

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