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Views of Students, Parents, and Teachers on Smartphones and Tablets in the Development of 21st-Century Skills as a Prerequisite for a Sustainable Future

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Abstract: It is no longer just an opinion but a fact that the only way to prevent a catastrophic future for humanity on a planetary scale is to introduce sustainable practices in all areas of human endeavour. The key role in these processes is activity to education. The aim of this study is to investigate the perceptions of Slovenian secondary school students, parents, and teachers (SPTs) regarding the role of smartphones and tablets in promoting 21st-century skills. This study explores the views of Slovenian secondary school students, parents, and teachers (SPTs) on the value of smartphones and tablets in 21st-century skills education. The results show a consensus among participants that smartphones and tablets make a positive contribution to various aspects of 21st-century skills as a Prerequisite for Sustainable Future. Participants consistently rated the suggested benefits of smartphones and tablets above the middle of the scale, with a focus on internet, digital, and information literacy. However, there is still room for improvement in basic skills and higher-order thinking skills. The factorial analysis revealed three correlated factors: Holistic Learning skills, Higher-Level Cognitive skills, and Digital Information Literacy skills. Subsequent analysis revealed significant differences between the focus groups, with students showing stronger agreement with the positive impact of smartphones and tablets on a wide range of skills. While teachers recognized the value of smartphones and tablets for students' digital literacy and engagement, the differences between teachers and other groups were relatively small. These findings underscore the importance of integrating smartphone strategies and technology tools to promote 21st-century skills as a Prerequisite for Sustainable Future. Educators and policymakers can use these findings to promote effective teaching and learning practices that meet the demands of the 21st century.

Keywords: 21st-century skills; smartphone; mobile learning

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1. Introduction

It is widely recognised that sustainable practises must be integrated into every facet of human endeavour to prevent a catastrophic future for humanity on a global scale. However, no agreement has yet been reached on how to navigate between or connect the technological, structural, and cognitive aspects by translating the ideas of sustainability into sustainable solutions. There is no doubt that education is an important driver for these crucial changes. However, a major challenge is to prepare young students to deal with foreseeable environmental problems and with problems that have not even been recognised in recent times, and secondly, how technology can help in these efforts. Education plays two important roles in the realisation of the Sustainable Development Goals (SDGs). Firstly, education is recognised as one of the Sustainable Development Goals [1], and secondly, education can be one of the key components for achieving the SDGs [2] or, alternatively, formulate the goals in terms of an environmentally sound and sustainable component of human activities [3]. However, it can be argued that emphasis should be placed on

the development of lifelong skills [4] that enable action in situations that may arise in an unpredictable future. Due to the seriousness of the situation, action must be taken immediately, using the means available. One such means can be the activation of knowledge and devices such as smartphones and tablets, whose main objective is not education. Smart portable devices now play a central role in people's everyday lives, both as stand-alone devices and as companions to other digital devices [5]. As companions literally from early childhood [6,7] to old age [8], smartphones and tablets with the power of supercomputers from the past are not only used as a means of communication in combination with a camera and a range of applications, but also provide access to a wealth of information and resources, making them, at least potentially, a valuable educational tool that combines formal and informal experiences [9]. While the ubiquity of these devices in pockets is becoming a fact of everyday life, their place and role in formal education is controversial, to say the least [10]. While some see them as a valuable educational tool with great potential, others see them more as a distraction from the learning process [11]. In practice, these differing views lead to decisions ranging from an outright ban to unrestricted and uncontrolled use in schools. As debates about the role of smartphones and tablets in education are rarely based on solid evidence [12], our interest as educators is to explore their potential as a multipurpose tool for developing various aspects of so-called 21st-century skills development [13]. As an argument for the importance of exploring this research topic, it can be said that they are considered by many to be one of the most important missing outcomes of modern formal education [14,15] in the context of digital literacies [16].

The aim of the research is to examine the viewpoints of students, parents, and teachers (SPTs) regarding the integration of smartphones and tablets to foster 21st-century skills development so that students can maximise their benefits not only for improving school outcomes, but also for learning transferable skills that are usable in daily routines [16], and extend these skills as part of the lifelong competence of "learning to learn". The theoretical framework linking in-school and out-of-school settings through smartphones has been recognised through their use in the development of 21st-century skills as a Prerequisite for Sustainable Future [14,17]. As the views of students, parents, and teachers (hereafter SPTs) on the capabilities of smartphones and tablets in developing such skills may differ, which can be seen as a barrier to optimising their use, their views were explored in an online survey [16].

The starting point of the research was that formal educational institutions and the educators working in them can be considered the backbone of modern civilization, which has recently become heavily dependent on the use of digital technologies. Therefore, educational institutions should not only be designed according to the expectations and proposals of organizations and their think tanks such as UNESCO, the Organization for Economic Cooperation and Development (OECD) [18], the European Union [19], and the European Parliament and the Council but should also prepare students for the unpredictable digital future, even though it has been recognized that the introduction of digital technologies in education does not bring significant improvements in some important aspects [20], and that a more important aspect to consider is a pedagogy of introducing technology into educational practice [12].

Smartphones and Tablets in 21st-Century Skills Development

The need to cultivate 21st-century skills in students for a sustainable future is undeniable. As the world gravitates towards an increasingly digital era, the integration of technology in education is emerging as a cardinal pillar in this endeavour. Smartphones and tablets, the pinnacle of portable technology, promise to revolutionize educational paradigms by fostering essential skills such as critical thinking, creativity, collaboration, and digital literacy.

Scholarly engagement with mobile technology in education has evolved significantly over the years. Early forays into the field were characterized by exploratory studies that investigated the potential of mobile devices to enhance learning outcomes. For example,

ref. [21] posited the utility of the mobile learning device in extending educational opportunities beyond the traditional classroom setting, a premise that has only gained traction over time. Subsequent research has shifted the focus to smartphones and tablets, driven by their ubiquity and advanced capabilities. A meta-analysis [22] highlighted the positive impact of mobile learning on student learning outcomes and motivation. The story that unfolds over time is one of increasing recognition of the potential of these devices to meet diverse learning needs and preferences.

The integration of smartphones and tablets in education shows remarkable geographic diversity, reflecting different educational policies, technological infrastructures, and pedagogical cultures. In developed countries, where digital literacy rates are high and access to technology is widespread, smartphones have been used to facilitate blended learning models and personalized education [23]. For example, they are known for their progressive education systems, in which mobile technology is an integral part of fostering a student-centred learning environment [24]. Conversely, in developing regions, where challenges such as limited access to technology and infrastructure deficits persist, the advent of smartphones has been heralded as a gateway to previously inaccessible educational resources. Studies [25,26] highlight how mobile learning initiatives can mitigate educational inequalities by providing flexible and accessible learning opportunities.

Integrating smartphones and tablets in education has numerous benefits, including improved access to information and resources, enhanced engagement, and better learning outcomes [27]. Learners can access a vast repository of educational content anytime and anywhere, which fosters self-paced and lifelong learning. Additionally, the interactive features of these devices support innovative teaching strategies that can engage students more effectively than traditional methods. The use of smartphones in educational settings presents challenges [28]. One notable concern is distraction, as studies have shown that unrestricted smartphone use can detract from the learning experience. Additionally, the issue of the digital divide highlights the need for equitable access to technology to prevent exacerbating existing educational inequalities [29].

This paper uses the concept of 21st-century skills adapted for the purpose of the research. It was not within the scope of our work to develop a standardised definition of 21st-century skills, but to create a list that is understandable to the research population and allows connections to be made between it and smartphones [13,14,30]. We have defined 21st-century skills as a set of skills, competencies, and knowledge that individuals need to succeed in today's rapidly changing world characterised by technological advancement, globalisation, and evolving social dynamics. These skills are essential for both personal and professional success and are often seen as crucial for lifelong learning and adaptability. Whilst there is no universal list of 21st-century skills, they generally include cognitive skills such as critical thinking and problem solving, creativity and innovation, psychosocial skills such as communication skills, adaptability and flexibility, and the ability to collaborate and work in a team, and for technology-based skills, information literacy and technological literacy. From the review of concepts, it is evident that the current educational discourse is mainly focused on teaching 21st-century skills in the context of the emerging information society, which supports its association with the use of smart devices. The institutional response to the problems arising from the mismatch between the outcomes of the education sector and the needs of society in all its complexity has produced several concepts that call on educators to incorporate them into their teaching routines. Regardless of the name (competencies, key competencies, transversal competencies, 21st-century skills, etc.), all these concepts have many similarities. They are mostly described as a combination of knowledge, skills, and attitudes that are crucial for personal development, social inclusion, active citizenship, and employability in the knowledge society and are associated with the need to develop critical thinking, problem solving, collaboration, and creativity (see UNESCO Glossary for more details). According to the documents, the main objective of learning is no longer just to acquire "knowledge", but also to develop the ability to use the acquired knowledge and skills flexibly and creatively in a variety of situations. To

avoid confusion, we will use the term "twenty-first-century skills" below; i.e., the set of interconnected skills that enable students to be successful in their everyday and future professional lives. Education is on the cusp of a transformative change that requires the acquisition of 21st-century skills as a Prerequisite for Sustainable Future. This imperative obliges educators, institutions, and curriculum architects to find a way to align with the changing landscape of society and the profession to equip students with the skills to navigate the complex mosaic of the 21st century. Regardless of their importance, however, these skills are often not operationalized, leaving educators unsure of how to integrate them into their daily routines.

Twenty-first-century skills are viewed from a variety of perspectives, each characterised by different terminological and conceptual subtleties. For example, [13] astutely outlined the domain of 21st-century skills as a comprehensive range of core competencies such as critical thinking, problem solving, communication, collaboration, technological literacy, computational thinking, coding, and programming. This holistic set reflects the diverse demands that characterise today's educational requirements. To broaden intellectual horizons, ref. [31] prepared a comprehensive categorization of these skills and summarised their essence in a variety of attributes. This spectrum includes critical thinking, problem solving, inquiry, information access, analysis and synthesis, communication, innovation, creativity, curiosity, imagination, decision making, global citizenship, intercultural interaction, entrepreneurship, productivity, responsibility, and leadership. This taxonomy corresponds to the intricate web of skills woven into the dynamics and complexity of modern social and professional domains. Hursen [32] strengthened the conceptual foundations of 21st-century skills by emphasising their inextricable link to students' cognitive paradigms. They believe that fostering these skills requires a pedagogical environment in which teachers have diverse skills in multiple domains, innovative methods, and a sense of professional growth. Transforming traditional pedagogical paradigms into ecosystems that meet the demands of today's world is critical to fostering these skills. Educational systems play a central role in efforts to cultivate 21st-century skills as they provide the architectural formulation of frameworks that prioritise the holistic development of skills, knowledge, and attitudes that meet the demands of today's world [33]. These architectural contours extend to curricula in which learning outcomes, content, pedagogical environments, and assessment mechanisms are seamlessly aligned with the evolving demands of the 21st century. Perdue [34] argues for a clear call for reform, pointing to the incongruence between entrenched educational paradigms and the principles of modern education. This mismatch is an obstacle to preparing students for the many challenges they will face in their personal and professional lives. In this context, Shields and Chugh emphasise the central role of schools in preparing students for the complex demands of today's world and point to the obligation of schools to provide the necessary knowledge and skills. This assertion underscores the role of schools as a crucible for fostering the acumen needed to navigate today's environment.

The rapid development of technology, especially in the digital field, does not simplify work in education, but makes it more complex and disrupts established routines. It is evident that even when technology is available, teachers are far from homogeneous in terms of acceptance and actual use of digital technologies [35–37]. The heterogeneity of teachers in the adoption and use of digital technologies and the factors that explain their behaviour in digital worlds have been investigated in numerous studies [28,38,39]; however, it is beyond the scope of this paper to review them.

The relentless pace of technological advancement means that certain digital pedagogical tools and approaches do not make it into classrooms, and when they do, many of them become obsolete before their full potential can be realised. The highlighted cases involve software applications and hardware machines running on earlier, no longer supported systems (DOS and earlier versions of Microsoft Windows); in other cases, the anticipated potential of some technologies has proven to be pure wishful thinking after being tested in practice [20,40]. Therefore, recognising what is worth including in the classroom is an

ongoing challenge for educators who strive to teach their students skills that are not only relevant but also adaptable to the ever-changing technological landscape.

To make teachers' lives even more miserable, their work is constantly confronted with complaints from employers who claim that graduates are ill-prepared for the labour market, citing skills shortages and skills mismatches as the main problems [41]. Interestingly, these concerns are being voiced at a time when employers themselves are struggling to define the specific skills and occupations that are in demand [42]. The changing nature of work and the dynamic demands of different sectors underline the need for educators to navigate this uncertain terrain. An important factor is also parents, who need to be involved in the struggle to provide quality education for their children [43]. In terms of smartphone technology, the role of parents is crucial when their children are still minors. They are the main gatekeepers for technology use outside of school, as only they can control access to the devices [44]. In this context, formal education and its stakeholders are under strong pressure to change to promote adaptability to the changing needs of the labour market and society in general, sometimes taking into account completely different views of SPTs living in an ever-changing material and social environment.

Views on the presence of smartphones and tablets in a school are anything but unanimous. On the one hand, proponents of integrating smartphones and tablets into the classroom argue that they can transform traditional classrooms into dynamic learning environments [28] that engage students and promote active learning [45,46]. However, it is crucial that teachers are given clear guidance on how to use these devices effectively to teach 21st-century skills as a Prerequisite for Sustainable Future. With the right approach, these devices can help prepare students for the demands of the 21st century and provide them with the skills they need to navigate and succeed in a rapidly evolving digital world.

This article explores the intricate interplay between SPTs and the challenges posed by the introduction of smartphones and tablets into the school day and aims to shed light on their potential added value in developing 21st-century skills in response to the challenges a young person may face when the only certainty is change.

The main objective of the research focuses on the perspectives of key stakeholders in the educational process—SPTs—in relation to the use of smartphones and tablets to develop 21st-century skills as a Prerequisite for Sustainable Future. By analysing their views, we will investigate how these devices influence learning and the development of key skills necessary in modern society. In this way, we aim to gain a holistic understanding of the dynamics between technology and education, with a particular focus on how different stakeholders are responding to the challenges and opportunities presented by the integration of smart devices [16] into the learning process.

2. Materials and Methods

2.1. Research Methodology

The research methodology presented in this paper can be considered exploratory and is based on the quantitative analysis of data collected in a survey of a sample of Slovenian SPTs as part of a dissertation entitled, "Added value of smartphones and tablets in laboratory and fieldwork in lower secondary biology", by the first author and supervised by the second author [16,47].

2.2. Sampling

The survey instrument in the form of an online questionnaire based on the 1ka platform (www.1ka.si, accessed on 25 February 2024) was made available to the respondents. The target group was informed via various channels, online social media, and contacts with schools and individual teachers, so that at least potentially anyone with access to the internet could respond. The data collection started in January 2023 and ended in March 2023. The survey was conducted in accordance with Slovenian guidelines and regulations for educational research, on the condition that no personal or sensitive data were collected. As the survey was completely anonymous and voluntary, we had no control over the

respondents who answered the call via social media or from their peers. Participation in the research was considered consent, as there was the option to leave the research at any time, and respondents were informed of the fair use of the data in the production of the thesis and subsequent publications.

2.3. Respondents

The target population was primary lower and upper secondary school biology teachers, students from various Slovenian lower (last two final classes) and the first class of upper secondary schools, and their parents. Exact population numbers are unknown and can be only estimated. The number of students in three years in a row was according to the census and estimated to be 55,000; however, the exact number of teachers, and parents of these students can be only guessed.

Response rates were as follows: 3234 clicks on the survey, 2139 (66%) visited the survey, 1967 (61%) gave partial responses, and 1041 (32%) gave all responses with irregularly positioned missing data. Because we wanted to analyse only the records of one question—(Q17) looking at the added value of smartphones and tablets in 21st-century skill training—we selected only those who answered this question completely. Therefore, our research sample comprised 934 participants. Of these, 465 (49.8%) were students from various Slovenian lower (last two final classes) and the first class of upper secondary schools, 281 (30.1%) were parents, and 188 (20.1%) were teachers. At this point, it should be mentioned that we collected data in addition to biology teachers from several teachers of different subjects. However, in post hoc analyses it was revealed that their views were not different from the focus group; therefore, they were included in a data set assuring higher statistical power of the tests. The decision to collect data about their previous experiences and views by inclusion of students attending the 1st classes of upper secondary schools was practical because their experiences can be attributed to a number of teachers and schools. The population of participating students consisted of 19.1% 8th- and 9th-grade lower secondary school students and 80.9% 1st-grade upper secondary school students (80.9%). Students described themselves as male students (27.7%) and female students (67.8%), and the remainder (4.5%) did not wish to provide gender information.

Besides the basic information about their status, we asked parents if they are currently employed in education: 80.8% of them stated that they are not employed in education, while the remaining percentage (19.2%) confirmed that they are employed in education. Parent participants described themselves as male (23.5%) and female (76.1%), and the remainder (0.4%) did not wish to provide gender information.

The population of participating teachers consisted of lower secondary school biology teachers (47.3%), upper secondary school biology teachers (38.6%), and other teachers (14.1%). When we tested for differences between the three groups of teachers, we did not find any statistically significant differences; therefore, we considered them as one group of teachers. Participating teachers described themselves as male (9.2%) and female (90.2%), and the remainder (0.6%) did not wish to provide gender information.

2.4. Instrument

A structured questionnaire was used as the primary research instrument for data collection. The instrument used in this study was part of the questionnaires from a large study designed to investigate the added value of smartphones and tablets in biology education [16]. In this paper, we have presented part of the questionnaire in which we asked SPTs about the added value of smartphones and tablets in the development of 21st-century skills as a Prerequisite for Sustainable Future.

They were instructed to give an answer according to their level of agreement to 22 statements following the sentence: "Due to the use of smartphone and tablets in lessons and for schoolwork, I believe that this will be a positive added value for". The response format ranged from 0 (strongly disagree; totally disagree) to 10 (strongly agree; totally agree) and 5—reflecting a neutral point. Later, and for the purposes of statistical analysis,

the scale was transferred to the format 1–11, with 6 representing a neutral (neither–nor) point. Theoretically, the sum of the responses can range from the rejection of any positive added value (sum = 22) to the maximum value of 242, which reflects the positive impact of one of the items listed.

To the best of the authors' knowledge, the instrument has not been used in this form in the surveys of other researchers, but there are overlaps in the demographic section of the survey [47]. Six items were designed to investigate the usability and potential impact of smartphones and tablets in the classroom, and the remaining items were designed to investigate their potential in developing various 21st-century skills from the literature [13]. The validity of the questionnaire was ensured by consulting published frameworks and consulting the reviewers of the dissertation proposal. Reliability was assessed post hoc by calculating Cronbach's alpha.

2.5. Data Analysis

Statistical analyses were performed using the open-source statistical programme Jamovi, 2.3. Each research variable was analysed for Mean, Median (Me), Mode (Mo), standard deviation (SD), and assumptions of normality and homogeneity of variance leading to decisions of the tests to be applied. It was revealed that distribution of data of all items did not follow normal distribution (Shapiro–Wilk test, $p < 0.001$); therefore, the results of this test are not presented. Reliability analysis using Cronbach's alpha was conducted to evaluate the internal consistency of the questionnaire, and it was found to have a value of 0.981. It was also in the researchers' interest to investigate correlations between the items of the questionnaire in order to recognise patterns and improve the instrument in the future. Since there was no theoretical basis that would have allowed the use of methods to confirm the theoretical assumptions, exploratory analysis was a good choice. Principal Axis Factoring analysis (PAF) with direct oblimin rotation was performed to assess the underlying latent structure of the instrument. Parallel analysis was a choice to retain extracted factors. The reliability of the factors resulting from the PAF analysis was assessed using Cronbach's alpha coefficient. Values greater than 0.7 indicate satisfactory reliability of the components.

To assess the statistical significance in views of the different groups of participants (SPTs), a nonparametric Kruskal–Wallis test was applied. The criteria for detecting significantly are p value as $p < 0.05$. Epsilon squared (ε^2) was chosen as a measure of effect size.

3. Results

The results are organized in such a way that the first table shows the measures of the central tendencies of the responses and the factor loadings of the PAF analysis of all participants regarding their views on the added value of smartphones and tablets in 21st-century education. The second part presents the differences between the central tendencies of the focus groups of the SPTs.

3.1. Central Tendencies of Response and Factor Loadings of PAF Analysis

From the results (Table 1) of the central tendencies (Mean, Med, Mode) of the answers given by the SPTs regarding the potential added value of smartphones and tablets for the outcomes listed in Table 1, the following can be seen:

- Responses to all questions are above the median value of six, and only two questions have mean values slightly below this value.
- At the top are four questions relating to the concept of digital skills. At the top (highest mean, median, and mode) is the respondents' opinion on the possible influence of smartphones and tablets on the development of digital skills.
- At the bottom of the table is collaboration with others and social skills.

Table 1. Descriptive statistics and factor loadings (F) of students', parents', and teachers' views on the added value of smartphones and tablets for 21st-century skills instruction. Cronbach's alpha = 0.98.

Code	Due to the Use of Smartphones and Tablets in Lessons and for Schoolwork, I Believe That This Will Be a Positive Added Value for	*n*	Mean	Median	Mode	SD	F1	F2	F3
Q17ad	Internet skills	891	8.35	9	11 (26.6%)	2.62			0.79
Q17ab	digital (ICT) literacy	892	8.14	9	11 (24.8%)	2.67			0.94
Q17ac	information literacy	892	8.06	9	11 (23.1%)	2.64			0.94
Q17ap	understanding the devices that enable the information age	880	7.75	8	11 (21.0%)	2.68		0.72	
Q17am	Curiosity	887	7.56	8	11 (19.1%)	2.76		0.52	
Q17ao	understanding methods and publishing information	882	7.38	8	11 (16.8%)	2.71		0.93	
Q17an	understanding of facts, figures, statistics, and data	885	7.25	7	6 (16.6%)	2.78		0.82	
Q17af	communication with others	891	7.16	8	11 (16.7%)	3.00	0.45		
Q17aq	development of higher thought processes (e.g., synthesis, analysis, evaluation)	882	6.88	7	6 (17.2%)	2.81		0.57	
Q17ak	Adaptability	887	6.79	7	6 (17.2%)	2.84	0.55		
Q17ba	creativity and innovation	881	6.68	7	6 (15.8%)	2.92	0.68		
Q17ar	self-initiative	884	6.66	7	6 (18.6%)	2.82	0.56		
Q17al	Productivity	883	6.60	7	6 (17.6%)	2.85	0.59		
Q17aj	practical skills	890	6.48	6.5	6 (16.0%)	3.05	0.64		
Q17ax	learning to learn	881	6.32	6	6 (19.1%)	2.93	0.79		
Q17av	ability to solve problems	883	6.25	6	6 (18.5%)	2.83	0.83		
Q17ah	critical thinking	891	6.19	6	6 (18.9%)	2.88	0.54		
Q17bb	Leadership	879	6.19	6	6 (20.5%)	2.87	0.74		
Q17au	ability to make decisions	884	6.14	6	6 (20.0%)	2.88	0.94		
Q17aw	the ability to be aware, understand and regulate one's own mental activity (metacognition)	879	6.09	6	6 (21.3%)	2.84	0.93		
Q17at	cooperation with others	881	5.99	6	6 (14.0%)	3.09	0.93		
Q17as	social skills	882	5.55	6	6 (14.1%)	3.12	0.89		
	Variance [%]						40.5	18.0	15.3
	Eigenvalue						8.91	3.95	3.37
	Cronbach's alpha						0.97	0.94	0.94

Principal axis factoring (PAF) revealed three main highly correlated factors (r_{12} = 0.803; r_{13} = 0.578; r_{23} = 0.738) that accounted for a substantial amount of the variance (73.8%) in participants' responses. Model fit measures show acceptable model structure (RMSEA = 0.08 (CI90 = 0.076–0.085); TLI = 0.937; BIC = −42.9; χ^2 = 1081, df = 168; $p < 0.001$).

The first factor (F1) (Table 1), referred to as Holistic Learning skills, encompasses a broad range of skills and attributes related to effective learning, critical thinking, problem solving, adaptability, and social interaction; all, except Q17af (communication with others), ranged in the bottom part of the Table 1 with means and medians below seven, showing opinion about the minimal positive influence of smartphones and tablets on the development of these skills. The first factor explained 40.5% of the variance. Most of the items forming this factor are according to measures of central tendencies behind the items forming factor 2. The second factor (F2) (18% of variance), referred to items from the upper part of the scale reflecting Higher Level Cognitive skills with the medians mostly at the value of eight. The third factor (F3) (15.3% of variance), referred to as Digital Information skills, focused on skills related to digital literacy, information management, and technological literacy. The component is formed from items where the view of the PSTs is most positive with medians of 9, and modes 11.

3.2. Analysis of Differences between STP

The differences were explored in two ways. The first part (Table 2) shows the results of the Kruskal–Wallis test. In the second part (Table 3), the sums of the answers were examined.

Table 2. Central tendencies and results of Kruskal–Wallis test of SPTs differences in views on the added value of smartphones and tablets in 21st-century skills instruction. They responded by either disagreeing or strongly agreeing that using smartphones and tablets in lessons and for schoolwork has a positive impact on the listed 21st-century skills. (N = 892, n (students) = 435, n (parents) = 280, n (teachers) = 179).

		Students		Parents		Teachers		Kruskal–Wallis Test			
Code	**Due to the Use of Smartphones and Tablets in Lessons and for Schoolwork, I Believe That This Will Be a Positive Added Value for**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	χ^2	p	ε^2	**Effect Size**
Q17as	social skills	6.48	3.00	4.85	3.23	4.41	2.55	77.78	<0.001	0.088	Moderate
Q17at	cooperation with others	6.63	3.05	5.51	3.24	5.20	2.64	36.81	<0.001	0.042	Moderate
Q17au	ability to make decisions	6.72	2.85	5.59	3.04	5.59	2.39	34.66	<0.001	0.039	Weak
Q17aw	the ability to be aware, understand and regulate one's own mental activity (metacognition)	6.62	2.87	5.59	2.92	5.59	2.39	30.61	<0.001	0.035	Weak
Q17aj	practical skills	7.02	2.93	5.88	3.23	6.13	2.83	24.67	<0.001	0.028	Weak
Q17an	understanding of facts, figures, statistics, and data	7.65	2.83	6.92	2.89	6.78	2.36	22.77	<0.001	0.026	Weak
Q17ak	Adaptability	7.22	2.88	6.33	2.90	6.45	2.52	19.60	<0.001	0.022	Weak
Q17av	ability to solve problems	6.67	2.88	5.86	2.89	5.85	2.46	19.35	<0.001	0.022	Weak
Q17aq	development of higher thought processes (e.g., synthesis, analysis, evaluation)	7.29	2.76	6.58	2.96	6.37	2.54	18.61	<0.001	0.021	Weak
Q17bb	Leadership	6.60	2.90	5.73	2.94	5.91	2.53	18.57	<0.001	0.021	Weak
Q17ao	understanding methods and publishing information	7.71	2.72	7.14	2.85	6.97	2.37	15.08	<0.001	0.017	Weak
Q17ax	learning to learn	6.66	3.05	6.08	3.07	5.89	2.24	13.12	0.001	0.015	Weak
Q17ba	creativity and innovation	6.98	2.97	6.28	2.99	6.57	2.58	10.46	0.005	0.012	Weak
Q17ah	critical thinking	6.48	2.91	5.81	3.03	6.05	2.47	9.14	0.010	0.011	Weak
Q17ab	digital (ICT) literacy	7.89	2.74	8.24	2.83	8.60	2.17	8.35	0.015	0.009	Negligible
Q17ac	information literacy	7.85	2.65	8.16	2.78	8.41	2.32	6.98	0.030	0.008	Negligible
Q17ap	understanding the devices that enable the information age	7.89	2.71	7.74	2.78	7.44	2.45	5.93	0.051	0.007	Negligible
Q17af	communication with others	7.33	2.95	6.77	3.20	7.35	2.76	5.03	0.081	0.006	Negligible
Q17al	Productivity	6.79	2.93	6.37	2.92	6.49	2.52	4.23	0.121	0.005	Negligible
Q17ar	self-initiative	6.86	2.79	6.51	3.01	6.42	2.52	3.46	0.178	0.004	Negligible
Q17am	Curiosity	7.70	2.81	7.39	2.90	7.47	2.38	2.94	0.230	0.003	Negligible
Q17ad	internet skills	8.32	2.66	8.32	2.73	8.45	2.37	0.05	0.976	>0.001	Negligible

Table 3. Results of descriptive statistics of students', parents', and teachers' views on the added value of smartphones and tablets for 21st-century skills instruction.

							Percentiles		
Group	**N**	**Mean**	**Median**	**SD**	**Min**	**Max**	**25th**	**50th**	**75th**
Students	397	158	158	50.0	22	242	130	158	196
Parents	261	143	144	54.8	22	242	111	144	180
Teachers	174	145	145	43.0	26	242	120	145	172

The differences in the measures of central tendencies and the results of the nonparametric Kruskal–Wallis test (Table 2) were used to determine whether there are significant differences between the target groups in terms of the opinion that the use of smartphones and tablets in the classroom and for school work promotes the acquisition of 21st-century skills. It was easy to see that students were more likely to believe that smartphone and tablet use has a positive impact on the acquisition of 21st-century skills and abilities. Although statistically significant differences were found between the three focus groups for 15 statements, these were only in the moderate effect size range for two items. Both items (social skills and cooperation with others) are at the bottom of Table 1. The differences for

all other items can be interpreted as weak or even negligible in terms of effect size. It is interesting to note the teachers' position digital (ICT) competence, information competence, internet skills, and communication with others were slightly above the results of the other two groups, although the differences assessed as effect sizes are negligible.

We obtain additional insight by evaluating the sums (Table 3) of the responses on a scale between 22 (disagreement in all items) and 142 (agreement with all items).

From the reported central tendencies (Table 3), it can be seen that the highest values were given by the students and that the differences between the two adult groups are minimal. It can also be seen that although the differences are statistically significant ($\chi^2 = 17.2$, df = 2, $p = 0.02$), and the students are slightly more optimistic than their parents and teachers, the effect size is small ($\varepsilon^2 = 0.02$). When comparing the differences using pairwise Dwass–Steel–Critchlow–Fligner comparisons, it was found that statistically significant differences could be found between students and parents ($W = -4.77$, $p = 0.002$), students and teachers ($W = -4.91$, $p = 0.002$), but not between parents and teachers ($W = -0.20$, $p = 0.989$).

4. Discussion

We can start the discussion by saying that all three groups (students, parents, and teachers) rated the importance of smartphone and tablet use for the acquisition of 21st-century skills and that they contribute to a sustainable future as neutral or positive in most cases. According to the summarised results, all suggestions for the added value of smartphones and tablets received ratings above the middle of the scale, indicating a positive or neutral perception. Among all options listed, ratings were particularly high for items related to developing skills such as internet literacy, digital literacy, information literacy, and understanding the devices that enable the information age, but not for acquiring social and cognitive skills. As we cannot compare our findings with those of other studies, we can summarise that while smartphones and tablets have a positive impact on the development of some of the 21st-century skills, they are not a technology that works on its own, but that pedagogy matters, as is the case with the other digital educational technologies [20]. It can be concluded that the inclusion of smartphones and tablets in schoolwork can help to improve 21st-century digital skills, which depends on the pedagogy and context. On the other hand, not using smartphones and tablets does not harm schoolwork especially when other technologies can be seen as beneficial, and smartphones and tablets can be recognized as a multipurpose substitute tool [48]. Therefore, in our opinion, they must be used carefully and purposefully to avoid the negative side effects of digital technologies [49,50]. The impact of smartphones and tablets on the quality of basic school knowledge and the development of higher-order thinking processes was relatively low. This finding indicates potential for improvement in these areas by the development of pedagogies. The role of schools in developing lifelong learning skills and the answer to the question: "Who should teach the sensible use of smartphones and tablets in private life if they are banned at school?" remains open. Since this is a retrospective study, we can suggest that teachers use smartphones and tablets for practices that have already proven effective, such as using smartphones and tablets in fieldwork, monitoring bodily functions, documenting events with a camera, and the like. They can also be considered as a tool for quick access to information, but for the majority of schoolwork, they should only be considered as a secondary tool that cannot surpass the notebook.

Further analysis using the Kruskal–Wallis test revealed significant statistical differences between the three focus groups (SPTs) only for some of the items regarding their opinions on the impact of smartphones and tablets on the acquisition of 21st-century skills as a Prerequisite for Sustainable Future. Students were more likely to agree that smartphones and tablets have a positive impact on several skills, including social skills, collaboration with others, decision-making skills, metacognition, practical skills, academic success, understanding facts and data, adaptability, problem solving, higher-order thinking processes, leadership skills, understanding methods and publishing information, learning

to learn, creativity and innovation, and critical thinking. While the effect size between groups was weak for most statements, indicating insignificant differences in opinion, teachers also recognised the value of smartphones and tablets in promoting students' digital literacy, information literacy, and active engagement in the classroom. However, the effect size for these statements was negligible, indicating a relatively small difference in perspectives between the SPTs. This result can be considered good, as agreement in beliefs can prevent tension between participants. The question remains as to how to deal with the opinions of a small but perhaps commendable minority of opponents who were recognised in all three groups.

The findings suggest that smartphones and tablets can enhance essential 21st-century skills among students. Mobile devices play a significant role in improving digital literacy, critical thinking, collaboration, communication, and creativity skills. These insights offer valuable guidance for educators, policymakers, and stakeholders who aim to promote effective teaching and learning approaches aligned with the demands of the 21st century. The research emphasises the importance of integrating technology in education to prepare students for success in a rapidly evolving digital landscape. Educators can utilise these findings to develop innovative teaching methods that leverage the capabilities of smartphones and tablets to engage students, personalise learning experiences, and cultivate transferable skills that are essential for future academic and professional endeavours. Policymakers can use these findings to inform decisions related to technology integration in schools, curriculum development, and professional development initiatives for teachers. The perceived benefits of smartphones and tablets in education can help stakeholders collaborate to create supportive environments that leverage technology to enhance teaching and learning outcomes. The findings provide practical implications for designing effective educational interventions and policies that utilize smartphones and tablets to promote the development of 21st-century skills and prepare students for success in an increasingly digital world.

5. Conclusions

Our study's findings make a significant contribution to the ongoing discussion on integrating mobile technology in educational settings to equip learners with the skills necessary for success in the 21st century. The SPTs collectively recognize smartphones and tablets as powerful tools for acquiring digital literacies, which are essential for navigating the complexities of a digitized global landscape. The potential of smartphones and tablets to serve as multipurpose educational tools—capable of supporting fieldwork, augmenting access to information, and facilitating novel learning experiences—necessitates a strategic and purposeful deployment, mindful of the possible pitfalls associated with their misuse. Therefore, educators should design learning experiences that utilize the strengths of smartphones and tablets while minimizing their distractions and promoting a balanced development of both digital and non-digital competencies. Based on our study, policymakers and educational leaders should consider the implications of our findings for curriculum development, teacher training, and the creation of guidelines that encourage the effective use of smartphones and tablets in education. The alignment of technology integration strategies with pedagogical objectives and the cultivation of a supportive educational ecosystem are imperative for realizing the full potential of smartphones and tablets in advancing 21st-century skills. Research sheds light on the complex relationship between mobile technology and education, emphasizing the ways in which technological tools and pedagogical practices can work together to shape the future of learning. As we adapt to changing educational paradigms, the insights gained from our study provide a valuable guide for using smartphones and tablets as catalysts for educational transformation and sustainability.

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