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DIFFERENCES IN THE WISHES OF STUDENTS, TEACHERS, AND PARENTS ON INTEGRATION OF SMARTPHONES AND TABLETS IN BIOLOGY LESSONS

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Abstract. *Smartphones and tablets have permeated various aspects of life. This study explores the differences in wishes between students, parents, and teachers regarding the use of smartphones and tablets in biology classes in the upcoming school year. An online questionnaire was used for the study, which provided eight different scenarios for the use of smartphones for teaching purposes. The data were collected from 934 participants, including 465 students, 282 parents, and 188 biology teachers from various Slovenian lower secondary schools. The principal component analysis revealed the unidimensional structure of the instrument, explaining 59.7% of the variance (alpha = .91). The results showed that the use of smartphones and tablets for distance learning, teaching purposes, schoolwork and homework is generally desirable. There was less consensus on their use for laboratory and field work, evaluation of knowledge, and biology lessons. The main finding was that the differences between the groups were small or even negligible in terms of effect sizes. Statistically significant differences were found between the focus groups, with students and teachers expressing greater agreement than parents. These findings emphasize the importance of addressing parents' concerns and understanding the perspectives of stakeholders in order to effectively integrate smartphones and tablets into the classroom.*

Keywords: *differences in wishes, lower secondary school biology, mobile learning, smartphones and tablets integration, students and parents and teachers*

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Introduction

The integration of information and communication technologies into society has become increasingly important, and several seminal strategic documents promote even greater digitalization, including the education sector (European Commission, 2021; OECD, 2019). One area of technological advancement that has attracted much attention recently is the use of smartphones and tablets in the classroom (Anshari et al., 2017; Nikolopoulou, 2020). While their use as communication tools and powerful pocket-sized computers has become ubiquitous in private lives (Boyd, 2014), influencing both utilitarian and hedonistic aspects of life (Akdim et al., 2022), their use in education is controversial at best (Anshari et al., 2017; Flanigan & Babchuk, 2022). As these devices, according to the references (Hartley & Andújar2022), offer a range of opportunities to enhance teaching and learning experiences, provide access to educational resources, promote collaboration and increase engagement, smartphones and tablets have therefore become, at least potentially, a learning tool with great potential for formal and informal learning (Fu & Hwang, 2018; Gikas & Grant, 2013: Kacetl & Klímová, 2019; Longman & Younie, 2021; Qureshi et al., 2020; Statti & Villegas, 2020). Although the integration of learning with mobile technologies in education has been explored by many, adoption and integration in lectures are still limited due to various barriers (Criollo et al., 2021; Nikolopoulou, 2020; Nikolopoulou, 2021; Sánchez-Prieto et al., 2019; Whyley, 2018). For example, smartphones/cell phones in the classroom are seen more as a distraction rather than a learning aid (Anshari et al., 2017; Beeri & Horowitz, 2020), which is why they may even be banned in schools (Montag & Elhai, 2023) due to problematic smartphone use (Busch & McCarthy, 2021) or their impact on health and mental health (Abi-Jaoude et al., 2020; Brodersen et al., 2022; Odgers, 2018). While a ban may prevent some problems related to the negative use of smartphones, the question is who should teach students how to use them wisely. Unguided use for self-education, based on the assumption that students are digital natives because of their intensive use (Prensky, 2001), has failed (Lang et al., 2024). Furthermore, Dolenc and Šorgo (2020) have shown that students who spend more time using digital devices may actually exhibit lower levels of

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information literacy and that the skills and cognitive abilities students need for academic success are negatively affected by excessive phone use (Sunday et al., 2021).

The guiding premise of our work was that schools may not have the power to restrict smartphone use outside of school grounds, but they can at least potentially increase the quality of digital work by providing learning experiences and teaching students how to use mobile devices wisely. The starting point was the paradoxical situation that a complete ban on smartphones in schools could be counterproductive because students are not taught how to use smartphones intelligently in the name of preventing their potentially and actually harmful effects, even if the benefits can be recognized as a lifelong skill. Examples of such applications in the life sciences include the use of smartphones in health and environmental monitoring, biodiversity documentation and collaboration in citizen science projects, among many other possibilities.

Recent research has investigated the potential applications of smartphones and tablets in biology lessons (Lang & Šorgo, 2023). Many possibilities have been tested with prospective science teachers as well as with primary and secondary school students. The collective observations that emerge from both our experience and the comprehensive study of established practices show that smartphones and tablets are useful in biology education. In addition to their basic role as a source of communication and information, these devices can also serve multifunctional purposes, e.g. as data loggers, microscopes, and identification keys (Lang & Šorgo, 2023). As school biology also covers topics such as health and the environment, some applications whose primary intention is not education, but health monitoring can also be included (Ernsting et al., 2017; Mosa et al., 2012). In summary, however, according to an analogy used by many, smartphones and tablets function like a "Swiss army knife" (Adalar, 2021), which can be useful and helpful but cannot replace a toolbox of professionally developed devices for teaching biology.

The successful use of smartphones and tablets in biology classrooms not only faces tensions between the content to be taught, the technology to be used, and the pedagogy to be applied in a given context (Mishra, 2019), but also depends on understanding the preferences and perspectives of teachers, parents, and students, who are key stakeholders in educational processes that link school and home (Gao et al., 2017; Matteucci & Helker, 2018). The differences between views, expectations, and wishes regarding the use of technology, as well as the pedagogy used and possible side effects, can be seen as an important issue to explore. The key players in this process are the teachers because they hold the key to technology in the classroom. However, parents can be seen as promoters and suppressors of the educational use of smartphones/tablets (Hadad et al., 2020). On the other hand, teachers' power ends at the front door, where they can influence smartphone use by giving students homework that involves smart devices. This situation can lead to tensions between the three partners, as only the children are "full-time employers" in both worlds. Therefore, it would be wise to design the use of smart technologies in a way that aligns with the wishes and expectations of all three partners in the educational process. Despite their importance, our search did not reveal any studies that investigated the different perspectives of students, teachers, and parents regarding the use of smartphones in (science) biology lessons using a standardized quantitative survey instrument across all participant groups. The research gap to be filled was, therefore, to investigate what students, teachers, and parents wish to use smartphones and tablets for various purposes in class and for schoolwork in the coming school year. Knowing wishes can be important because they can be actualized in actual educational use in the sense of theories such as the Theory of Reasoned Action (Ajzen, 1980), the Technology Acceptance Model (Davis, 1989; Davis et al., 1992) and UTAUT (Venkatesh et al., 2003). The aim was to identify potential inequalities that could hinder the integration of an effective multipurpose tool in (science) biology education. This tool should facilitate the transformation of skills acquired in biology classes into lifelong learning opportunities.

Research Aim and Research Questions

The aim of the research was to comprehensively understand the wishes of students, parents, and teachers regarding the use of smartphones and tablets for educational purposes, with a focus on biology education. At this point, it is appropriate to point out a limitation of the study resulting from the guaranteed anonymity of the survey. This limitation meant that it was not possible to compare the wishes of specific teachers, their students, and parents.

Therefore, a series of research questions were posed that relate to the topics shown in Table 1. All research questions can be interpreted in terms of the hypothesis that there are statistically significant differences in each of the listed items concerning the expected use of smartphones and tablets in the classroom and at home in the context of biology (science) lessons. The following research questions were formulated:

RQ1: How often do students, teachers, and parents wish to use smartphones and tablets for various teaching purposes in biology lessons in the coming school year?

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RQ2: How do differences in the wishes of students, parents and teachers differ regarding the use of smartphones and tablets for various teaching purposes in biology lessons in the coming school year?

RQ3: What significant differences are there between the wishes of students, parents, and teachers regarding the use of smartphones in biology lessons?

RQ4: To what extent do the wishes of students, parents and teachers agree when it comes to the integration of smartphones in biology lessons?

Research Methodology

General Background

For this study, a survey strategy was implemented with the use of an online questionnaire. The aim of the questionnaire was to collect information about the differences in wishes of students, parents, and teachers regarding the use of smartphones and tablets in biology lessons. Data collection began in January 2023 and ended in March 2023 at lower secondary schools throughout Slovenia.

It is imperative to acknowledge an inherent limitation of the study— the guaranteed anonymity of the survey. This limitation restricted the ability to match specific teachers with their corresponding students and parents.

Sample

The survey instrument in the form of an online questionnaire based on the 1ka platform (www.1ka.si) was made available through various channels, online social media, contacts with schools and individual teachers. 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, provided that no personal or sensitive data were collected. As the survey was completely anonymous and voluntary, respondents' decision to take part in the survey was not influenced by social media or peer relationships. However, this strategy made it possible to assume that at least potentially every member of the target population of interest, which was teachers, parents, and lower secondary school students in the last grades (8th and 9th) of the nine-year compulsory Slovenian school, could provide answers to the survey.

The exact population number of teachers, parents, and lower secondary school students in the last grades (8^{th} and 9^{th}) of the nine-year Slovenian compulsory school can only be roughly estimated and is around 20,000 for a generation of students, approximately two times more for parents, and about 150 biology teachers teaching each generation. The response rate was as follows: 3234 visits to the survey homepage, 2139 (66%) continued to the first page with an explanation of the aims of the survey, 1967 (61%) gave partial responses, and 1041 (32%) gave all responses with irregularly positioned missing data. Since the aim was to analyze the records of their wishes to use smartphones and tablets in class and for schoolwork in the coming school year (codes Q15a – q15h in tables and figures) – selected were only those who answered this question completely. Therefore, the research sample includes 934 participants. Of these, 465 (49.8%) were students from various Slovenian lower secondary schools (the last two final grades) and the first grade of upper secondary school; 281 (30.1%) were parents, and 188 (20.1%) were teachers. The decision to collect data also from students in the first grade of upper secondary school was practical, as their experiences can be matched to a range of teachers and schools. The population of participating students consisted of 19.1% Grade 8 and 9 lower secondary students and 80.9% Grade 1 students. The students described themselves as male students (27.7%) and female students (67.8%), while the remainder (4.5%) did not wish to provide gender information.

In addition to basic information about the parents' status, they answered whether they were currently involved in education. The majority, or 80.8% of respondents, mentioned that they were not currently employed in the field of education, while the remaining percentage (19.2%) confirmed that they were employed in education. Participating parents described themselves as male (23.5%) and female (76.1%), while the rest (0.4%) did not want to provide gender information.

The population of participating teachers consisted of lower secondary biology teachers (47.3%), upper secondary biology teachers (38.6%) and teachers of other subjects (14.1%). When examining the differences between the three groups of teachers, no statistically significant differences were found. Therefore, they were treated together as a single group of teachers. The participating teachers described themselves as male (9.2%) and female (90.2%), the rest (0.6%) did not want to give gender information.

One limitation of the study could be the representativeness of the sample. The biggest limitation in data collec-

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tion is self-selection, which can lead to distorted answers. The other problem is the lack of responses from the unseen majority of students, parents, and educators. For them, we can only speculate that their answers match those of the respondents. However, it is impossible to correct this potential flaw in the study design.

Instrument

A structured questionnaire was used as the primary tool for data collection. The instrument of interest for the study took the form of a table in which the introductory statement was followed by nine items. Students, teachers, and parents were asked about their wishes regarding the use of smartphones and tablets for various purposes in class and for schoolwork in the coming school year. Theoretically, wishes regarding the use of technology can be seen as a correlate to behavioral intentions, which may or may not predict actual behavior depending on facilitating conditions as defined by theories such as the Theory of Reasoned Action (Ajzen, 1980), the Technology Acceptance Model (Davis, 1989; Davis et al., 1992) and UTAUT (Venkatesh et al., 2003).

The instrument includes 9 items (see Table 1) that participants were asked: "We would like to know if you would like the smartphones and tablets to be used for the following purposes in the coming school year." The response format was a 6-point scale of 0 (never), 1 (very rarely), 2 (rarely), 3 (occasionally), 4 (often), 5 (very often). In the statistical analyses, the values were converted from 1 (never) to 6 (very often). Later in analyses, Item 9 (other) was excluded, and the results of this item are not reported.

The reliability of the questionnaire was assessed by calculating Cronbach's alpha, which resulted in a high value of .907. Content validity was ensured through consultations with the experts in the field and by piloting previous versions of the questionnaire (Lang & Šorgo, 2022; Lang & Šorgo, 2023). The convergent validity of the construct was assessed by checking the component loadings, which were calculated by applying principal component analysis. All items have a loading of over .6 (see Table 1).

Data Analysis

Each research variable was examined for central tendencies, dispersion, and normality distribution. Based on the data, non-parametric statistics were chosen for further testing. A polychoric correlation matrix was calculated, and a Gaussian graphical model was used to graphically represent the polychoric correlation matrix. By summation of eight items, it was possible to identify the respondents who did not wish to use smartphones and tablets (sum = 8) in any form in the next year, as well as those who wished to use smartphones very often in all listed (sum = 48). Because of the non-linear scale, sums between the extremes were not further explored.

Principal component analysis (PCA) with direct oblimin rotation was conducted to assess the dimensionality of the instrument. The reliability of the components that emerged from the PCA analysis was assessed using Cronbach's alpha coefficient, and the value of .7 was chosen as the cut-off value for continuing the analyses. To further explore the structure of the instrument, a CFA analysis was performed. Due to the ordinal nature of the data, the DWLS (Diagonally Weighted Least Squares) method was applied to explore the predicted dimensional structure of the matrix.

To assess the statistical significance of the differences between the participant groups (students, parents, and teachers), the non-parametric Kruskal Wallis Test was applied, and the ε^2 (epsilon squared) values are reported as a measure of the effect sizes. The criterion for demonstrating significance is the *p*-value as $p < .05$ and the effect sizes are interpreted as: .00 < .01 – negligible; .01 < .04 – weak; .04 < .16 – moderate; .16 < .36 – relatively strong; .36 < .64 – strong; .64 < 1.00 – very strong (Rea & Parker, 2014). Since three groups were considered, pairwise comparisons were made using the Dwass-Steel-Critchlow-Fligner statistic. Statistical analyses were conducted using the open-source statistical program jamovi, 2.3 (The jamovi project, 2022). CFA was performed using the tools of the Structural Equation Modelling package (SEM module) in jamovi.

Research Results

Based on the research conducted, general results were presented on the students', parents', and teachers' wishes to use smartphones and Tablets for various purposes in class and for schoolwork in the coming School year.

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Table 1

Measures of Central Tendencies and PCA Loadings of Wishes to Use Smartphones and Tablets for Various Purposes in Class and for Schoolwork in the Coming School Year (n = 934)

Codes	Items	*Me*	*Mo*	*PCA*
Q15h	To participate in distance learning (video conferences).	5	6	.64
Q15a	For teaching purposes in any school subject.	4	4	.87
Q15d	For schoolwork at school.	4	4	.86
Q15c	For homework.	4	4	.79
Q15b	In biology class.	4	4	.83
Q15e	For field work.	4	4	.78
Q15g	To test knowledge.	4	4	.75
Q15f	For laboratory work.	4	4	.79
	Variance			59.7
	Eigenvalue			5.37
	Cronbach's alpha			.907

Note. KMO = .920; $\chi^2 = 2276$, $df = 36$; $p < .001$, PCA = component loadings.

All combined results of students', parents', and teachers' wishes (Table 1) on smartphone use in the biology classroom are above the median value (4) of the scale. At the high end of the scale (median = 5; mode = 6), where participants consider the use of smartphones and tablets in the classroom is the use "For distance learning participation (video conferencing)". For all other items, except Other, the median and mode values were the same (4), which means 'occasionally' in absolute terms. The item 'Other' (Q15i) was not included in the follow-up analyses. Even though the differences are small, use in biology lessons, fieldwork, tests, and lab work are at the end of the series, which shows the tendency that smartphones are most likely seen as a general means of communication and access to information, rather than as a more specialized educational tool.

In order to gain further insights, the answers of the participants who answered all the questions ($n = 903$) were summarized. It turned out that only 17 students (1.9%) did not wish to use smartphones for educational purposes in the next year. At the other end of the scale, 41 people from all three groups (4.5%) wished to use smartphones very frequently in all the situations listed. Due to the non-linear scaling, the results between the minimum and maximum were not interpreted.

The reliability of the instrument was high, as shown by Cronbach's alpha value of .907. After PCA, only one component was identified that explained 59.7% of the variance with an eigenvalue of 5.37. This indicates the unidimensionality of the instrument designed to assess wishes to use smartphones and tablets in the coming school year. Based on this result, the combination of items could be used as a latent construct in follow-up studies, if such studies are planned.

Additional insight into the relationships between the items was gained by using the polychoric correlation as a measure of effect size. The polychoric correlation coefficient, a measure of the relationship between ordinal variables, was used. The values were listed in Table 2 and plotted in Figure 1 to illustrate the Gaussian graphical model.

Table 2

Polychoric Correlation Coefficients of the Relationship between Variables

Code	Q15a	Q15b	Q15c	Q15d	Q15e	Q15f	Q15g	Q15h
Q15a	1							
Q15b	.79	1						
Q15c	.72	.63	1					
Q15d	.78	.74	.73	1				
Q15e	.64	.63	.59	.63	1			
Q15f	.64	.68	.57	.67	.76	1		

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Code	Q15a	Q15b	Q15c	Q15d	Q15e	Q15f	Q15g	Q15h
Q15g	.65	.65	.60	.64	.54	.56	1	
Q15h	.59	.44	.56	.50	.54	.51	.50	1

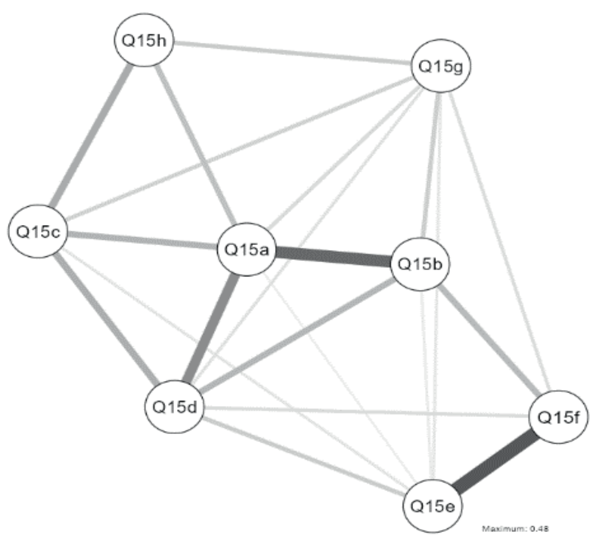
Note. The values above .7 are printed in bold. For an explanation of the codes, see Table 1.

By analyzing the polychoric correlation matrix it was realized that only wishes to use smartphones and tablets in biology class correlate with participation in distance learning below the 0.5 levels interpreted as a threshold for moderate correlation. The pattern most probably indicates the view that biology cannot be completely taught online because of many constraints, such as the use of practical and hands-on activities, as well as demonstrations and field work.

All other correlations can be interpreted as moderate or, in three cases, even as strong, exceeding the .75 level. Four items exploring the wishes to use smartphones and tablets for teaching purposes (Q15a – Q15d) correlate above the .7 levels making a cluster. Additionally, the correlation coefficient indicates a moderate to strong correlation between the wish to use a smartphone or tablet for laboratory and field work (0.76), allowing the formation of one variable instead of two. The strength of the relations is presented by the Gaussian Graphical Model in Figure 1.

The model was further scrutinized by applying the CFA using the DWLS method. Constraining the variables Q15e and Q15f (laboratory and fieldwork) resulted in the following model fit: $\chi^2 = 71.1$, $df = 19$, $p < .001$; TLI = 0.997; SRMR = 0.031; RMSEA = 0.055 (CI95 = 0.042 – 0.069); AVE = 0.568. Standardized loadings ranged from .57 (Q15h) to .90 (Q15a).

Figure 1
Gaussian Graphical Model Representing the Polychoric Correlation Matrix



Note. For an explanation of the codes, see Table 1. The figure was created with jamovi 3.2.

Differences Between the Wishes of Students, Parents, and Teachers

In Table 3, the medians, modes and results of the nonparametric Kruskal-Walis test used to determine if there were significant differences between the focus groups regarding the wishes to use smartphones and tablets in school and for schoolwork, and accompanying effect sizes are provided. The key finding was that the differences between the three groups are minor or even negligible in terms of effect sizes. In order to gain further insights, pairwise comparisons were carried out. Only *p* - p-values are presented in Table 3. Even if differences are small there exist some patterns when individual items are pairwise compared. Statistically significant differences between the three focus groups occur in six statements (see Table 3), as follows:

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a) For teaching purposes in any school subject (χ^2 = 10.38; *df* = 2; *p* < .05), where students and teachers are statistically more in agreement with the item than parents.
b) In biology class (χ^2 = 11.17; *df* = 2; *p* < .05), where biology teachers are statistically more in agreement with the item than students and parents.
c) For schoolwork at school (χ^2 = 11.16; *df* = 2; *p* < .05), where students and biology teachers are statistically more in agreement with the item than parents.
d) For laboratory work (χ^2 = 9.39; *df* = 2; *p* < .05), where biology teachers are statistically more in agreement with the item than students and parents.
e) To test your knowledge (χ^2 = 13.46; *df* = 2; *p* < .05), where biology teachers and students are statistically more in agreement with the item than students and parents.
f) To participate in distance learning (video conferences) (χ^2 = 13.64; *df* = 2; *p* < .05), where parents are statistically more in agreement with the item than students and biology teachers.
g) For field work, after reviewing results pairwise, find that all three focus groups share similar thoughts about the use of smartphones for fieldwork.

In summary, it can be said that the disagreement in wishes between students and parents is the greatest (4 points), followed by the disagreement in wishes between parents and teachers (3 points) and teachers and students (2 points).

Table 3
Differences between Students, Parents, and Teachers (N = 934; n students = 465; n parents = 281; n teachers = 188) Regarding Their Wishes to use Smartphones and Tablets for Various Purposes in Class and for Schoolwork in the Coming School Year

		Students		Parents		Teachers		Kruskal-Walis test				p- DSCF		
Code	Item	*Me*	*Mo*	*Me*	*Mo*	*Me*	*Mo*	χ^2	*df*	*p*	ε^2	Stud – par	Stud – teach	Par – Teach
Q15h	To participate in distance learning (video conferences).	5	6	5	5	4	4	13.63	2	.001	0.01	.898	.002	.003
Q15a	For teaching purposes in any school subject.	4	4	4	4	4	4	10.38	2	.006	0.01	.005	.477	.200
Q15b	In biology class.	4	4	4	4	4	4	11.17	2	.004	0.01	.199	.114	.001
Q15c	For homework.	4	4	4	4	4	4	5.283	2	.071	0.01	.086	.990	.153
Q15d	For schoolwork at school.	4	4	4	4	4	4	11.16	2	.004	0.01	.003	.457	.173
Q15e	For field work.	4	4	4	4	4	4	0.80	2	.671	8.55e-4	.905	.811	.642
Q15f	For laboratory work.	4	4	4	4	4	4	9.39	2	.009	0.01	.034	.033	.990
Q15g	To test knowledge.	4	4	4	4	4	4	13.46	2	.001	0.01	.002	.883	.015

Note. The values of *p* < .05 are printed in bold; *Me*- Median, *Mo*- mode; *p* DSCH = *p*-values of the Dwass-Steel-Critchlow-Fligner pairwise comparisons.

Discussion

Looking back at the results of the study, in which students, parents and teachers were asked about their wishes to use smartphones and tablets for educational purposes in the next school year, it can be concluded that smartphones have already become an integral part of their educational experience and will continue to be so. It is evident that the increasing use of digital technologies, including smartphones, for online distance learning purposes is a consequence of the COVID-19 pandemic (Misirli & Ergulec, 2021) and is creating new contexts of use. The results show that all the smartphone use suggestions listed in Table 1 were above the median (occasionally) of the scale, with anchors at the never and very often values. Only a minority of respondents (1.9 %) do not wish to use smartphones for educational purposes in the next year. Interestingly enough, there is a finding that all of them were students, violating the assumption of students as digital natives and teachers as digital immigrants (Prensky 2001). This reasoning stems from an assumption that information literate students will use digital tools for knowledge enrichment even if they are not directly instructed

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to do it by teachers. In addition, it is known that smartphones, outside their role as communication tools, are among adolescents mainly used for entertainment rather than for education and self-education (Akdim et al., 2022; Boyd, 2014; Dolenc & Šorgo, 2020).

Respondents in all three groups wish to use smartphones and tablets mainly for video conferencing, homework, and schoolwork in various subjects, with wishes to use smartphones specifically in biology classes lagging somewhat behind general use. This result can be interpreted to mean that the practical skills acquired in laboratory and field exercises, as well as the 3D models and specimens used in biology classes, cannot simply be replaced by these pocket-sized devices. At the end of the predicted uses of smartphones that accompany laboratory and field work is also the assessment and testing of knowledge. The open-ended stays question of why the wish for smartphones to be used as an alternative to questioning in formative assessment during a lesson (Conejo et al. 2016) is relatively low. From the teacher's point of view, this result might indicate that preparing online tests and assignments involves a lot of work. An additional explanation may be whether being online is an obstructive necessity when assignments are part of the lesson and whether this opens the door for online misbehavior by students. A possible explanation is also that homework based on testing is rare in biology compared to, for example, mathematics or foreign languages.

The results of the polychoric correlation analysis provide insights into the relationships between different variables related to wishes for smartphone and tablet use in educational settings. The analysis highlights several strong positive correlations indicating, for example, a moderate to strong relationship between the wishes to use smartphones and tablets for teaching other school subjects and for teaching biology. This suggests that individuals who express a preference for using these devices for educational purposes are more likely to desire their use specifically in biology classes, as well as for schoolwork within the school environment and for completing homework assignments. Coefficients for these correlations ranged from 0.72 to 0.79. Wishes to use smartphones and tablets for schoolwork in biology, both in the school setting and for homework, also have strong correlations. This indicates that individuals who express a propensity to use these devices for school-related tasks are particularly interested in using them for biology-related tasks. The moderate to strong correlation of 0.76 between the intention to use smartphones or tablets for laboratory and field work indicates a potentially positive relationship. Thus, Lang and Šorgo (2022) could indicate that students who express a stronger intention to use smartphones or tablets for practical activities such as laboratory and field work find applications such as Pl@ntnet and the similar application iNaturalist (Rode & Torkar, 2023; Schmidthaler et al., 2023) useful for species identification. The correlation coefficient of 0.76 indicates a robust relationship, suggesting that as the intention to use these devices for practical work increases, so does the likelihood that they will see value in applications designed for educational purposes.

In addition, the analysis shows a moderate to strong correlation (coefficient of 0.76) between the desire to use smartphones and tablets for laboratory and field work. This suggests that individuals who show a preference for using these devices for educational purposes are more likely to express a desire to use them specifically for practical activities.

On the other hand, the correlation coefficient of 0.44, the lowest among the obtained results, means that participants are least likely to want to use smartphones and tablets to participate in distance education in biology classes. This indicates that respondents do not consider these devices to be particularly suitable or desirable for participation in distance education in biology classes.

The results of the non-parametric Kruskal-Wallis test show statistically significant differences between the focus groups for six statements. However, the effect sizes between the groups are small or even negligible. Compared to parents, students and teachers showed somehow higher wishes to use smartphones for schoolwork, which was expected. However, biology teachers expressed a greater wish to use smartphones in biology classes than students and parents. This may suggest that biology teachers found the use of smart wearable technologies more meaningful and useful as students and parents. Nevertheless, it should be borne in mind that, according to the results in practice, the use of smart devices is only sporadic in the majority of cases. Therefore, further research should follow two tracks. Despite the significant growth and possibilities of mobile technologies, there is little empirical evidence on teachers' perceived barriers to using mobile technologies in the classroom (Nikolopoulou et al., 2022), and basically no studies about their role as a supportive self-educational tool to establish learning methods. The use of mobile technologies could foster innovative pedagogical approaches to support/improve student learning; for this, the role, perspectives, and practices of teachers are very important (Nikolopoulou et al., 2022), however educational impact must be assessed when comparing with "traditional" school practices. Overall, the use of smartphones and tablets in biology classrooms can be a valuable tool to enhance the student learning experience and a tool to make lifelong learning an anytime-anywhere experience after formal education is over.

Parents expressed the highest level of agreement with the wishes to use smartphones and tablets to participate in distance learning, especially for video conferencing. The finding most probably resulted from their involvement in remote education during the pandemic (Misirli & Ergulec, 2021). Nevertheless, they also expressed some reservations.

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The small effect sizes suggest that these differences may not be significant, but they do suggest that further discussion and consideration are needed to address the concerns expressed by parents.

When taken from a broader perspective, the knowledge about wishes must be enriched by studies and the preferences and attitudes of these three groups because they may play an important role in shaping educational practice and policy. As students are the primary beneficiaries of technological advances, they can provide valuable insight into their comfort level, expectations, and preferences for integrating smartphones and tablets into their daily learning activities. Parents, in turn, have important views on the potential benefits, concerns and impact of technology on their children's education. Finally, teachers, as facilitators of learning, have important knowledge and experience in integrating technology into their teaching strategies, and the good news of the study is that differences in wishes to use smartphones for educational purposes between all three groups are small or even negligible in terms of effect sizes. Open ended stays a discussion of a finding that mode and median of four (4 = occasionally) in all offered options except for online lectures, where numbers fall in median 5 (often) and mode 6 (very often), is optimal. Additionally unanswered and out of the scope of a recent study stays a question of whether the use of smartphones adds something positive to the development of lifelong learning skills, such as learning to learn, information, media, digital literacies, and problem-solving from a list of 21st Century skills and competences.

In summary, smartphones and tablets found their path in education. Therefore, it would not be a smart idea to stop them in front of the school doors. However, their use inside schools must be purposeful in order to teach students lifelong learning skills which is improbable to be learned through self-education. Maybe the way suggested by a teacher on one of the internet social network platforms can be by banning personal devices in classrooms and teaching what should be taught by the use of tablets in a controlled environment, and in such way reducing distractions and misuse of smart devices. And one of the ways can be to teach students how to use smartphones as data-collecting devices in biology laboratories and fieldwork.

Conclusions and Implications

The study analyses the intentions and wishes of students, teachers, and parents regarding the use of smartphones and tablets in biology lessons. The results indicate a generally positive attitude towards the use of these devices. The most desired use is for participation in distance learning, while other uses are categorized as occasional. The study finds that the use of sensors integrated into the devices during field and laboratory work is an interesting area for promotion. Only a minority of students expressed a desire not to use smartphones and tablets in the specified teaching scenarios. No teachers or parents fell into this category. Small but statistically significant differences were found between the focus groups, but students and teachers generally expressed greater agreement than parents. This is seen as positive as it suggests that the benefits and potential of smart devices in biology education could be better recognized.

The suggestion is that school authorities should give teachers and students the opportunity to explore the potential of smart devices in a controlled environment. Direct bans are not recommended as they could do more harm than good. Overall, the study emphasizes the importance of evidence-based decision making and encourages further research into the potential benefits of integrating smartphones and tablets into the school environment. It recognizes the need for a balanced approach to avoid outright bans that could compromise educational opportunities.

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Declaration of Interest

The authors declare no competing interest.

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