





Secondary School Students' Perceptions of Autonomy, Competence, and Relatedness in Digital Learning: A Qualitative Study

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ABSTRACT

We explored secondary school students' perceptions of digital educational tools in relation to basic psychological needs as outlined in Self-Determination Theory: autonomy, competence, and relatedness. Within a qualitative research design, we used a self-designed semi-standardized questionnaire to gather insights from a sample of 41 schoolchildren aged fifteen to seventeen from a school located in Aljustrel, in Baixo Alentejo, an economically modest region in southern Portugal. The findings reveal that students perceive the digital tools as effective in supporting their autonomy and competence, enabling self-paced, self-directed, and engaging learning experiences. However, students expressed mixed views on the fulfillment of relatedness, often preferring the interpersonal interactions and comprehensive explanations provided by in-person teaching. Based on the responses, digital tools may foster autonomy and competence, but their impact on relatedness is more context-dependent and less consistent. While digital tools can be effective for extracurricular interest development, students demonstrate a preference for teachers' personal attendance in formal school settings, especially when engrossed in a schedule of examinations.

KEYWORDS

Digital educational tools; digital learning; basic psychological needs; self-determination theory

1. Introduction

1.1. Digital learning

Digital learning can be defined as the use of information and communication technology (ICT) in education (Kumar Basak et al., 2018). The integration of digital technology into the instructional process fosters its accessibility (Qahmash, 2018), boosts student engagement (Bond & Bedenlier, 2019; Rizk & Hillier, 2022), self-efficacy (Dong, 2025), interest (Balalle, 2024), and academic performance (Kumi-Yeboah et al., 2020).

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Digital tools offer numerous solutions for promoting students' equal participation (Friedrichs-Liesenkötter, 2022) and may contribute to their comprehensive development across academic, social, and emotional domains (D'Elia et al., 2025). However, the effective implementation of ICT in education is contingent upon various factors, including the availability of technical resources (Welsandt et al., 2024), teachers' self-efficacy (Casale et al., *submitted*; Georgiou et al., 2023; Scherer & Teo, 2019), teachers' technological competences (Ng et al., 2023), teachers' characteristics and beliefs (Antonietti et al., 2025; Peretti et al., 2024; Stalmach et al., 2024), as well as students' self-regulation skills (Limniou et al., 2021; McNaughton & Jesson, 2023; Stalmach et al., 2023), motivation to learn (Börnert-Ringleb et al., 2021) and digital literacy (Kure et al., 2023).

Digital learning tools often incorporate elements of gamification, wherein game mechanics are employed within a non-game context (e.g., Christopoulos & Mystakidis, 2023; Hellín et al., 2023; Leiss et al., 2025; Toda et al., 2019; Zeybek & Saygı, 2023), which represents an effective strategy for supporting the satisfaction component of motivation (Baah et al., 2023) and students' perception of autonomy and relatedness (Li et al., 2024). Its success, nonetheless, depends on tool design (Sailer et al., 2017) and alignment with an individual's personality traits (Xiao & Hew, 2024); for instance, Smiderle et al. (2020) demonstrated that gamification benefits introverts more than extroverts. A notable example of a gamified tool is mobile or web-based applications (apps) designed for use on personal devices (Tang, 2019), with research indicating their potential to enhance students' self-regulation skills (Baars et al., 2022; Breitwieser et al., 2023) and emotion regulation (Fage et al., 2019; Nicolaidou et al., 2022).

Recent technological advancements have enabled the development and implementation of innovative educational solutions designed to support the fulfillment of psychological needs. These solutions incorporate robotics (e.g., Papadopoulou et al., 2022; Syriopoulou-Delli & Gkiolnta, 2021), immersive technologies (e.g., Molloy & Farrell, 2024), and artificial intelligence (e.g., Deng et al., 2025; Yan et al., 2024); for instance, integrating principles of psychological needs into human-robot interaction has been shown to enhance users' well-being (Janssen & Schadenberg, 2024).

1.2. Basic psychological needs

Self-Determination Theory (SDT), formulated by Deci and Ryan (1985, 2000; Ryan & Deci, 2000), identifies three basic psychological needs: autonomy, competence, and relatedness, that form the foundation for personal growth (Martela et al., 2023; Sheldon & Niemiec, 2006). The system of fundamental needs should “be understood as working holistically” (Krapp, 2005, p. 385) as they are interrelated, collectively contributing

to the overall development and happiness of an individual. From the perception that one's needs for autonomy, competence, and relatedness are fulfilled, intrinsic motivation, meaning the innate drive to undertake activities (Ryan & Deci, 2000, 2020), is elicited.

1.2.1. Autonomy

The need for autonomy refers to the feeling of being in control of one's actions, coupled with the capacity to make decisions that are consistent with personal aspirations (Ryan & Deci, 2000). Personalized learning opportunities within digital tools enable students to take control over their educational path (Schmid et al., 2023), for example, by selecting content tailored to their real-time needs (Hong et al., 2024). Grabner-Hagen and Kingsley (2023), who examined the use of gamification in a blended learning, revealed that students reported increased satisfaction with their psychological needs in this environment, with 70% indicating a strong sense of autonomy. Further, Rashed Ibraheem Almohesh (2024) demonstrated that ChatGPT had a positive impact on students' perceptions of autonomy, while an experimental study with multimedia engineering students (Ting, 2015) highlighted that digital literacy contributes to the enhancement of autonomy in learning. Nevertheless, it is crucial to differentiate between technologies that boost autonomy and those that diminish it; for example, rigid surveillance systems that monitor and control every action can reduce autonomy (Pérez-Verdugo & Barandiaran, 2023).

1.2.2. Competence

Competence is conceptualized as the need to feel capable of achieving desired outcomes (Ryan & Deci, 2000). Bandura and National Institute of Mental Health (1986) argues that people are motivated primarily by their own expectations regarding their competence. Students with high self-efficacy, defined as the belief in their ability to navigate specific situations (Bandura, 1977), are more likely to engage in challenging tasks. To address this need, digital tools can provide targeted feedback (Öztürk et al., 2025), set customized goals, and give rewards, thereby enhancing learners' sense of self-efficacy (Chen & Tu, 2021). At the same time, providing feedback may be insufficient unless individuals also experience autonomy (Ryan, 1982). Interactive educational tools can positively influence students' sense of accomplishment; additionally, an option of checking history of the activities helps users monitor their achievements, which both have the potential to support the fulfillment of need for competence (Grasse et al., 2022; Villalobos-Zúñiga & Cherubini, 2020).

1.2.3. Relatedness

Relatedness refers to the feeling of being intrapersonally connected (Ryan & Deci, 2000) and included in the group (Sheldon & Bettencourt, 2002). In this context, the performance-sharing feature in apps may support relatedness by enabling students to disclose their scores to peers (Villalobos-Zúñiga & Cherubini, 2020). Furthermore, several digital tools allow users to connect with other learners through discussion forums, online learning communities of inquiry, or teamwork assignments (Garrison, 2007; Steenkamp & Brink, 2024), which can enhance their sense of belonging (Peacock & Cowan, 2019; Zamiri & Esmaili, 2024). A survey study ($N=114$) found that app features fostering a sense of relatedness also increased students' learning motivation; however, this research also demonstrated that the app's effectiveness may depend on whether students accept the learning technologies (Molina et al., 2022).

Digital tools have been widely demonstrated to support the satisfaction of basic psychological needs in higher education settings (e.g., Babenko et al., 2023; Chacón-Cuberos et al., 2019; Hsia et al., 2025) and workplace contexts (e.g., Kadović et al., 2022; McAnally & Hagger, 2024). However, their impact within school environments remains comparatively underexplored.

1.3. Aim of the study

Psychological research in pedagogy provides empirical insights into learning processes and instructional design, which can inform the development of effective educational practices. This study explores students' perceptions of digital learning tools in relation to basic psychological needs: autonomy, competence, and relatedness, with the aim of presenting practical recommendations for teachers and tool developers.

The following research questions guide this study:

RQ1: What are students' perceptions of the influence of digital educational tools on their autonomy, competence, and relatedness?

RQ2: Which fundamental psychological needs do students perceive as most supported by digital tools and which do they perceive as less supported?

2. Methods

2.1. Contextual background

We applied self-designed semi-standardized questionnaires, which were distributed in the secondary school of the Aljustrel School Cluster

(“Agrupamento de Escolas de Aljustrel”), a school system where multiple schools from kindergarten to secondary level are grouped under a single administrative unit. The School Cluster of Aljustrel, located in the Municipality of Aljustrel in the Baixo Alentejo region of southern Portugal, serves students from pre-school to high school. With ~1100 students and 115 teachers, the school is part of the Educational Territory of Priority Intervention (TEIP), a National Education Project designed to address educational inequalities (Dias, 2014). The school board follows a strategic vision focused on fostering high-quality education, including family support programs and extracurricular activities. Additionally, school participation in eTwinning and Erasmus+ projects promotes collaborative, international, and project-based learning, reinforcing a pedagogical framework that integrates practical skills and community engagement. The specific digital approaches include the School Management Software (available at <https://schoolmanagementsystem.co.in/pages/software/aljustrel/>; recently accessed on June 17, 2025), interactive whiteboards, online classrooms, and blended learning that combine traditional and digital teaching methodologies. This contextualization strengthens the relevance of the study and enhances its implications for pedagogy, particularly in understanding how educational environments characterized by diverse socioeconomic factors implement innovative teaching strategies. The findings offer insights for similar educational settings seeking to improve learning experiences through technological advancements.

2.2. Survey

The survey (*Annex 1*), developed by the authors specifically for this study, included sociodemographic questions, items on the use of digital tools, such as internet access stability, and six open-ended questions exploring students’ experiences with digital learning. Although the questionnaire was not formally piloted before data collection, its design was grounded in the theoretical constructs of Self-Determination Theory and followed a semi-structured, phenomenological approach to elicit students’ lived experiences. As the questions were open-ended and directly aligned with core psychological needs, they were intended to prompt authentic reflections; for instance, those related to autonomy included: “In what ways do digital learning tools allow you to set your own path/pace in learning?” The research was conducted in January 2025 by an experienced mathematics teacher who was well known by the students, and with whom we established contact as part of the activities within the Erasmus+ Project SLIDE (Supporting Successful Learning in Digital Learning Environments, Reference: 2020-1-DE03-KA226-SCH-093694). Parental consent forms were collected by the teacher from each child,

along with the students' own informed assent. Data was then collected online using Google Forms, where children answered anonymously. The convenient overall sample comprised 41 schoolchildren from Portugal (36.5% female, 63.5% male) with a mean age of 15.68 years ($SD = 0.64$, $Mdn = 16$, range = 15–17). The response rate was 100%, as all invited students took part in the study.

The responses were examined using Thematic Analysis (Kuckartz, 2019), with main categories derived from the questionnaire through a combination of deductive and inductive coding methods. Deductive coding was guided by the Self-Determination Theory framework, structuring categories for autonomy, competence, and relatedness based on predefined indicators aligned with the framework's constructs, including *own path*, *own pace* for autonomy; *challenge* and *confidence* for competence, as well as *learning together* and *collaboration* for relatedness. To analyze how the responses reflected the fulfillment of autonomy, competence, and relatedness, the first author compiled text passages and formed categories inductively; assigning fragments to the categories (e.g., need of autonomy fulfilled/not fulfilled) and counting percentages of need fulfillment responses, as outlined in Table 1. Additionally, subcategories, such as intrinsic motivation, were identified, with corresponding indicators, e.g., *no grades*. The subcategories (subthemes) were systematically derived from coding, leveraging the flexibility of thematic analysis to interpret meaning within data (Braun & Clarke, 2006; Clarke & Braun, 2016). All text passages relevant to the research questions were coded to facilitate consensus on the interpretation of statements. The results are organized around the three basic needs and supported by illustrative quotes, as introduced in Table 2. Most of the students answered in English (36 out of 41; 87.8%); therefore, their comments may be cited directly. The original wording has been left and corrected only in case of misprints. Some of the responses were provided in Portuguese and were translated into English using Google Translate. Furthermore, certain participants either skipped questions or responded with "I don't know." We labeled participating students as "S" and assigned them numbers corresponding to the order in which they filled out the questionnaire (e.g., S3). Table 3 provides a summary of the SDT-dimensions, including illustrative student quotes and the percentage of responses corresponding to each category.

Table 1. Percentage distribution across categories.

Category	Percentages of need fulfillment responses
Autonomy	56.1
Competence	73.17
Relatedness	21.95

Table 2. Categories and subcategories.

Category	Subcategory	Example
Autonomy	Own path	<i>It helps me to learn on my own schedule</i>
	Intrinsic motivation	<i>Learning without being tied to grades was so good!</i>
Competence	Learning extracurricular topics	<i>Learn about sports</i>
	Confidence and challenges	<i>I feel confident but at the same time I'm a bit insecure</i>
Relatedness	Learning together	<i>I think digital classes are good, because we learn together</i>
	Preference for in-person learning	<i>I prefer a real person explaining to me the exercises</i>
	Healthy competition	<i>A fun experience that makes people bond together and have healthy competition</i>

Table 3. Summary of self-determination theory dimensions, percentage coverage and example student quotes.

SDT-dimension	Percentage of responses	Example student quote
Autonomy	56.1	<i>It helps me to learn on my own schedule</i>
Competence	73.17	<i>I feel confident but at the same time I'm a bit insecure</i>
Relatedness	21.95	<i>I think digital classes are good, because we learn together</i>

3. Results

Eighty-two point nine percent (82.9%) of the participants declared good familiarity with technology, 17.1%—average, 0%—bad. Furthermore, 97.6% declared that they use social media and 92.7% rated their access to digital devices and stable internet as good. We also surveyed students who reported using social media to assess their motivations, allowing for multiple response selections. The answers indicated a tendency to use social media for entertainment (90.2% of participants), social interaction (68.3%), information seeking (56.1%), self-expression (14.6%), and other purposes (9.8%). The declared average time spent daily on social media was 3.41 h ($SD=1.62$, $Mdn = 3$, $range = 0-7$).

3.1. Autonomy

The questions are:

1. In what ways do digital learning tools allow you to set your own path/pace in learning?
2. What is it about digital learning that you enjoy the most, especially when it is not tied to grades?

Twenty-three (23) out of 41 answers (56.1%) clearly indicated the need for autonomy to be fulfilled in a digital learning environment. Only one answer was “No” (the need not fulfilled), while some responses were unclear, e.g., including just the word “YouTube.”

3.1.1. Own path

The phrases “my own,” “our own,” “more independent,” “own pace,” or “my pace” were repeated, suggesting that students may perceive digital learning as highly individualized and autonomy-supportive. Students said: *It allows you to learn at your own pace and makes the information more digestible* (S5), *It helps me to attend and organize my way of working, looking for information to study* (S33), *It helps me to learn on my own schedule and at my own speed* (S38). There was also an opinion: *Digital learning tools allow us to define our own learning path, as we can study at our own pace and research information beyond what our teachers tell us* (S39). The formulations regarding school projects were also repeated: *it helps me when doing school projects* (S31), *It helps me research for school work* (S15).

3.1.2. Intrinsic motivation

The answers indicated that students express a preference for teachers’ presence when grades are involved, mostly due to concerns regarding potential confusion stemming from the ambiguous nature of exam requirements: *When it is tied to grades, I tend to prefer a real teacher over a digital learning app. When it is not related to grades, I love using apps, once I can actually take my time learning, I don’t feel obligated to do it, I just want to do it, for example, learning a language, so that motivates me a lot. I love using Kenhub* (S32), *Learning is always useful. But! Learning without being tied to grades was so good! I wouldn’t feel as stressed. It would be relieving knowing that I could learn and respond to a test without being so stressed to get a question wrong* (S2). Overall, digital learning can facilitate a more self-directed approach to knowledge acquisition; however, it may not always ensure the reliability required to meet formal educational standards.

3.1.3. Learning extracurricular topics

Most positive statements, expressing enhanced motivation and enjoyment, are more closely associated with extracurricular activities than with academic subjects: *Learn about sports and body, nothing in school* (S1), *I was watching a video about the cosmos and learned about black holes and how they work* (S15), *You can learn a lot of stuff about things like the job you want to apply to* (S9), *I like vlogs and podcasts about life experiences and living abroad. I usually watch videos about improving our skills and how to react in some situations, so I would say emotional intelligence videos* (S32). Furthermore, six participants identified “Kahoot” as an attractive tool, suggesting its perceived appeal. The findings indicate that students

predominantly associate digital tools with the enhancement of personal interest development rather than with formal education.

3.2. Competence

We asked students:

3. How confident do you feel when using digital programs and apps for learning? Are there specific features that make you feel either comfortable or challenged?
4. When you encounter technical issues during digital learning, how do you usually react?

Thirty (30) out of 41 answers to question 4 (73.17%) clearly indicated the need for competence to be fulfilled, ranging the answer from “pretty confident” to “very confident.”

3.2.1. Confidence and challenges

The responses revealed that while many students feel confident using digital tools: *I feel confident and there are no specific features that make me feel challenged* (S2), *I feel confident because digital programs are basic and easy to comprehend* (S20), they often struggled with technical failures: *It is usually very irritating, because the school internet fails many times and it's slow* (S10), *When a technical problem happens, I feel frustrated because we can lose work* (S17), *When I have a digital problem, I feel sad without wanting to do anything* (S34), *I truly hate internet problems when I'm doing something, it stresses me a lot, I just give up doing what I was doing that day if that problem is happening a lot (...)* *Using a digital device to learn is a big distraction* (S32). Some students find these challenges very bothersome and exhibit a preference for traditional learning methods, such as writing by hand on paper. While some attempt to resolve technical issues independently and are willing to continue using digital tools, many perceive analog learning as more reliable: *When I find problems related to the internet I try and can easily solve any type of problem related to it, and a tool that helps a lot is Artificial Intelligence because it can give me resolutions of any topic* (S41), *I feel confident but at the same time I'm a bit insecure about what people post on the internet. Not everything we see is actually true, but most of the sites I visit are actually honest, true and not random fake news, trying to make us believe in something that is not true* (S30). According to the students surveyed, teacher presence serves as a decisive factor in minimizing the risk of misinformation exposure. In this context, instruction also may play a vital role in fostering students' critical thinking (Abrami et al., 2015).

3.3. Relatedness

Questions:

5. Can you describe a time when you felt supported during a digital class?
6. Can you describe any moments when digital learning made you feel especially positive or, on the other hand, stressed?

Opinions regarding perceived relatedness in the digital environment were the most divided compared to other needs. Only 9 out of 41 answers to question 6 (21.95%) clearly indicated the need for relatedness to be fulfilled.

3.3.1. Learning together

There were statements clearly pointing out learning together in the digital environment: *When I don't know how to use any digital platform, I ask for help from my classmates and my teacher, and in those moments, I feel like we're learning together* (S8), *I think digital classes are good, because we learn together, for example when we do Kahoots, I think we all learn together, when we make mistakes and when we get things right* (S7). Students emphasized the collaborative nature of digital learning, where interactive activities foster shared knowledge and growth.

3.3.2. Preference for in-person learning

Many students prefer in-person learning for interaction and in-depth explanations from teachers: *I think I prefer in person. It's better because you can better express what you want to say* (S28), *I don't feel motivated because there is little interaction and there is no coexistence between people* (S40), *I don't feel a close connection with online or digital classes, I prefer a real person explaining to me the exercises, especially because a teacher explains the same thing in different ways and an app explains a subject in just one way* (S32), *I never felt stressed, the teacher was always really open to help us when we needed* (S16). Some students perceive digital learning as a source of stress and, consequently, seek assistance from teachers. This perception may be attributed to factors associated with managing digital tools, such as the lack of personal interaction, technological difficulties, and the increased cognitive load (Skulmowski & Xu, 2022).

3.3.3. Healthy competition

Digital learning, especially through interactive platforms, such as Kahoot, has the potential to enhance student motivation and promote constructive

competition: *When we use Kahoot, it's always a fun experience that makes people bond together and have healthy competition* (S24), *In the classes where we use Kahoot, everyone is attentive and learning with fun and competitiveness!* (S27), *For example, apps for learning a language make me interested because there's kind of a competition between players, which motivates me to try to do more lessons in a day* (S5).

In summary, many schoolchildren prefer in-person learning due to human interaction and the opportunity for teachers to provide detailed, reliable, and varied explanations. However, they also appreciate digital learning for its enjoyable nature, as it offers a more relaxed, encouraging and flexible learning experience: *The digital tools make learning more funny* (S28), *During digital learning that does not count toward the grade, such as Kahoot, we can learn in a fun and relaxed way* (S11).

4. Discussion

Our study was conducted in Aljustrel, Portugal, and this should be explicitly stated to ensure the transparency of the results. The Agrupamento de Escolas de Aljustrel is located in a rural, economically modest region of southern Portugal, and many students come from low-income families. The school plays a pivotal role in advancing equity and inclusion, actively engaging in national and European Union initiatives that foster digital literacy and sustainability, including the “IN as in INclusion,” which places a strong emphasis on inclusive education.

Regarding Research Question 1, students generally perceive digital educational tools as fostering their autonomy and competence. The fulfillment of the need for autonomy is reflected in students' ability to shape their own learning path (Schmid et al., 2023) and engage with extracurricular topics (Wanwan & Khairani, 2025) driven by intrinsic motivation. Students' fulfillment of the need for competence relates particularly to their sense of confidence in facing challenges (cf. Di Domenico & Ryan, 2017). The fulfillment of the need for relatedness might be reflected in their engagement in healthy and friendly competition (Zamiri & Esmaeili, 2024), however, only one-fifth of the respondents indicated the perceived fulfillment of this need. Students highlighted that integrating digital tools with teacher instruction is more effective than relying solely on digital platforms (cf. Raave et al., 2024; Stalmach et al., 2024). Further, they reported increased cognitive load and stress when faced with unreliable information, technical challenges, or complex navigation interfaces. These issues may hinder the learning process, elicit negative emotional responses, and compel students to disengage from tasks or revert to conventional learning approaches. Overall, while the digital environment promotes autonomy and competence, in-person education is still valued for its supportive and

reliable nature. In the literature, some students also exhibit a critical stance toward the integration of digital media in educational settings (e.g., Friedrichs-Liesenkötter & Karsch, 2018).

With regard to RQ2, the analysis of the percentage of positive responses explicitly indicating the perceived fulfillment of specific needs reveals that digital tools predominantly support the need for competence (73.17%), followed by the need for autonomy (56.1%). The most divided opinions were regarding the need for relatedness. Some students felt that they were learning together (21.95%), but others missed the support of teachers and personal contact with their classmates. The majority of schoolchildren perceive digital tools as most effective for pursuing hobbies and personal interests during leisure time, while in-person tutoring is considered more beneficial for boosting confidence in preparation for tests and exams. The responses regarding motivation for social media use also indicated a tendency to engage with digital tools primarily for entertainment (90.2%), suggesting a stronger perception of these tools as sources of enjoyment rather than learning resources. Some students perceive digital platforms as unreliable because they often provide a one-dimensional approach to explaining concepts, which may impede a comprehensive understanding of the material. Overall, digital tools may have the potential to positively impact fundamental psychological needs, but with the extent of this influence being moderated by variables, such as contextual factors (e.g., formal *vs.* informal educational settings), the design quality of the tools, the reliability of internet infrastructure, the degree of alignment with teachers' requirements and the user traits.

4.1. Practical recommendations

To enhance the efficacy of digital tools and address fundamental psychological needs, either these tools require better integration into formal curricula, or the educational framework itself should evolve, embedding assessments rooted in the content and capabilities of digital resources. Teachers can support the least fulfilled in digital learning environments need—relatedness—by fostering collaborative activities, such as digitalized group tasks or interactive games, like Kahoot or Kenhub. A blended approach that integrates digital tools with in-person instruction (Daskan & Yildiz, 2020) could enable students to benefit from the clarification provided by teachers in conjunction with digital environments (Altenburger et al., 2024). Schools may also integrate online platforms and gamified materials into the teaching process, enhancing tuition as well as student collaboration (Meier & Kaspar, 2024). The newest research reinforces the importance of teachers prioritizing cooperative learning environments (Becker & Börnert-Ringleb, 2025) as well as culturally responsive content

(Zou et al., 2025). Creating a supportive, humanized (Boz & Uçar, 2025) online environment with virtual classrooms and technology-enhanced shared projects can strengthen peer interaction, thereby fulfilling the fundamental need for relatedness.

The strategic design and organization of features within digital learning tools, informed by principles of user experience, can substantially improve learner engagement and academic outcomes. Digital tools could offer diverse approaches to concept explanation, incorporating private feedback mechanisms to alleviate students' anxiety about making mistakes. Designers might also consider emphasizing intuitive navigation, ensuring that digital tools are accessible and stable across various internet conditions, which holds special significance in less developed regions.

5. Conclusions, limitations, and future research

Our research was conducted in a public school cluster located in Aljustrel, a small city in Portugal. Public schools in Portugal often face resource disparities, and while digitalization efforts have increased, challenges, such as internet connectivity (Carvalho et al., 2023), can affect students' engagement with digital tools. The specific socioeconomic context of Aljustrel may not reflect the diversity of experiences in private schools, special schools, or international educational systems, limiting the generalizability of the findings. Furthermore, student characteristics and cultural influences may affect their views on participation in digital environments (Yang et al., 2010). Future research should explore the perceived impact of digital learning in a variety of cultural, demographic, economic, and educational contexts to provide a more comprehensive understanding of its effectiveness.

The students mostly answered in English, which is not their mother tongue, potentially resulting in inaccuracies in word choice. Further, some fragments were translated from Portuguese using Google Translate. Nevertheless, the statements are conveyed in a straightforward manner, employing fundamental grammatical structures and a basic lexicon, minimizing the risk of confusion with other words.

The qualitative analysis of the answers was conducted by only one researcher; hence, no intercoder reliability was considered (O'Connor & Joffe, 2020). The absence of intercoder reliability may have introduced subjectivity into the qualitative analysis, potentially leading to inconsistent interpretation of participant responses. To mitigate analytical bias, the researcher adhered to a predefined coding framework and engaged in ongoing reflexive practice (Olmos-Vega et al., 2022) to set aside personal assumptions throughout the analysis.

To enhance the trustworthiness of the study, multiple strategies were employed across the dimensions of credibility, confirmability, dependability,

and transferability (Leung, 2015). Credibility, which parallels internal validity, was strengthened through the use of open-ended questions rooted in Self-Determination Theory. This approach encouraged participants to share authentic narratives that aligned closely with the study's research questions. Confirmability was addressed by maintaining an audit trail (Bowen, 2009), ensuring that interpretations were grounded in participant responses. Dependability was supported through comprehensive documentation of the research process, including data collection procedures and coding decisions. Stating the location enhances the contextual transparency of the study and supports the transferability of findings to similar educational settings. Nonetheless, inherent subjectivity in the interpretive nature of qualitative research (Lim, 2024) may still influence the credibility and confirmability of the findings.

As previously stated, the majority of literature concerning the fulfillment of basic needs in digital learning pertains to the university context. Therefore, there is a need to broaden research to encompass the school education sector, where particularly vulnerable are students with special educational needs. Further research is needed to advance the development of more inclusive learning environments (Graham et al., 2024; Page et al., 2024), ensuring that digital assets meet the needs of all learners (Sato et al., 2024). It would also be important to examine the role of the family in the use of digital interventions (Kißler et al., 2024), as cooperation between family and school may contribute to the educational achievements of students (Duhanaj & Đurišić, 2024).

A new study suggests that children tend to link relatedness and competence with their well-being, while placing less emphasis on autonomy (Klemp et al., 2025). This aspect should be explored in future, identifying which specific needs are most crucial for children's happiness, while acknowledging that the experiences of need fulfillment and frustration are intertwined (Huang et al., 2025). Bearing in mind that excessive focus on modern technology, particularly on AI tools, may lead to superficiality in learning (Darwin et al., 2023), its careful and creative use is of great importance (Hoehe & Thibaut, 2020). Furthermore, AI-tools can result in discriminatory outcomes (Varsha, 2023), which also needs to be considered while using such tools. Our research highlighted the significant role of teachers in avoiding fake news, warranting further study on their views and impact on students' ability to discern misinformation.

In the literature, there are opinions that the distinction between "digital" and "analog" learning is becoming obsolete, emphasizing the need for digitalization to be central in contemporary discourse (Kerres, 2023). However, we acknowledge that maintaining a distinction between digital and analog formats remains essential for scholarly dialog.

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Ethical approval

The research project has received a positive vote (file number: SK/AE 240530) from the Ethics Committee of Bergische Universität Wuppertal.

Author contributions

All authors have accepted responsibility for the entire content of this manuscript and consented to its submission to the journal, reviewed all the results, and approved the final version of the manuscript. A.S. performed the analysis and wrote the original draft of this article.

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Annex 1. Questionnaire

What do you think about digital learning at school?

Dear students,

Welcome to our study!

We're living in a world where digital tools are becoming a big part of how we learn. This study is all about *you*—your thoughts, your experiences, and your opinions on using digital tools in school. The feedback you give will allow us to understand what works well, what doesn't, and what could be changed to make learning more enjoyable and motivating.

So, whether you love digital learning or find it challenging, we want to hear from you!

Please take 15–20 min to share your thoughts in our survey. We would be very happy to have you join us in this study!

Let's start!

Remember there are no wrong answers.

Your Age

Gender

Familiarity with technology

Good, average, bad

Do you use social media?

If yes, what is your motivation for using it

Entertainment, social interaction, information seeking, self-expression, other

Hours on social media a day

Access to digital devices and stable internet

Good, average, bad

1. In what ways do digital learning tools allow you to set your own path/pace in learning?
2. What is it about digital learning that you enjoy the most, especially when it is not tied to grades?

3. How confident do you feel when using digital programs and apps for learning? Are there specific features that make you feel either comfortable or challenged?
4. When you encounter technical issues during digital learning, how do you usually react?
5. Can you describe a time when you felt supported during a digital class?
6. Can you describe any moments when digital learning made you feel especially positive or, on the other hand, stressed?