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Abstract

Youth's digital skills are of growing interest to scholars and policymakers. This paper reports on a performance test in which over 600 youth from six European countries tested their skills by undertaking tasks measuring information, communication, and content creation digital skills. The findings question whether youth have the skills needed to reap the benefits from online information provision and social interactions. They struggle to understand whether websites are trustworthy, to distinguish advertising from information, with online meeting and conversation etiquette, and with content creation. This applies to both girls and boys, although some gender differences were observed depending on the skill examined. The problems identified could lead to negative outcomes in using technologies in youth's learning and other everyday activities. While individual skills training offers part of the solution, designing platforms and algorithms in ways that are suitable for the cognitive development and literacy of youth is also important.

Keywords

Digital skills; Youth; Tasks; Performance Tests; Europe; Gender

Introduction

Developing digital skills is essential for young people to flourish, providing them with the tools and knowledge necessary to participate in education, work, and broader society (Buckingham, 2015; Davies & Eynon, 2018; Livingstone et al., 2023; Nascimbeni & Vosloo, 2019). Digital skills facilitate connections with friends, family, and others, promoting cultural awareness, collaboration, and the exchange of ideas. Besides digital skills being required for everyday tasks such as finding information, checking news, hanging out with friends, or entertainment, they are integral to education since effective use of online resources, apps, and platforms enhance learning experiences (Haleem et al., 2022). The term 'digital natives' suggests that youth acquire such skills spontaneously, without the need for interventions (Kirschner & De Bruyckere, 2017; Reid et al., 2023). However, this idea has been critiqued as young people may not only lack valuable digital skills (e.g., Pedaste et al., 2023), they also struggle to translate these skills into tangible outcomes, particularly in situations of socioeconomic disadvantage (Helsper & Eynon, 2010). Since lacking digital skills might limit positive experiences across various aspects of everyday life (Blumberg & Brooks, 2017; Downey & Gibbs, 2020), understanding the extent and limitations of youths' digital skills has become of growing importance among scholars and policymakers.

Scholars generally consider digital skills to comprise a spectrum of operational (or technical), information navigation, communication and interaction, and content creation and production skills (Helsper et al., 2021; Van Deursen et al., 2016). Given the abundance of information available online, it is important for youth to navigate the environment and cultivate skills in assessing and confirming the accuracy and reliability of information. Furthermore, proficiency in communication through digital platforms is essential for building relationships with peers, family, and other adults, alongside an understanding of what is responsible, appropriate, safe, and ethical online behavior. Additionally, self-expression, creativity, and online representation are fostered through engaging in digital photography, computer programming, and other creative activities.

Most studies on digital skills face methodological limitations due to their reliance on self-assessments. A more robust approach involves task-based measurements (Aesaert & Van Braak, 2015; Van Laar et al., 2020; Siddiq et al, 2016), a labor-intensive method typically referred to as performance testing. This is considered the "golden standard" because it more accurately captures the dimensions of digital skills through tasks that mirror everyday practices (Hobbs, 2017). This approach yields a detailed understanding of specific skill gaps and challenges. However, due to its labor-intensive nature, performance testing is rarely applied in large-scale studies. The current study is unique in its scope as it (1) reports on a large-scale performance test involving over 600 youth, (2) across six European countries, and (3) measures a broad range of digital skills, involving both functional and critical skill dimensions. To our knowledge, no prior large-scale performance testing covering various skills in different national contexts has been conducted. This paper serves

as an initial exploratory attempt to address the following question: RQ1. *What proportion of youth are able to successfully complete tasks involving: (a) digital information navigation and processing, (b) communication and interaction, and (c) content creation and production?*

Additionally, this study examines gender disparities in digital skills among youth. Self-assessments consistently show that boys rate their skills higher than girls, a trend that extends to their interest and enjoyment in using digital gadgets, especially when it comes to technical skills. These gender differences emerge at very early stages and persist throughout the life span (Hatlevik et al., 2018), negatively impacting girls' digital self-efficacy, access to ICT-related education and labor market opportunities (Unicef, 2017). However, the results of task-based performance tests do not reveal differences to the same extent as self-assessments do. This may be due to the method being less prone to overrating by boys (Van Deursen, van Dijk & Peters, 2015). This study is the first to use performance tests to measure gender differences amongst young people for a variety of skills. The question addressed is: RQ2. *What differences exist between girls and boys in their completion of tasks related to digital information navigation and processing, communication and interaction, and content creation and production?*

Theoretical background

Conceptualization of digital skills

A substantial body of literature has emerged to define and assess digital skills. Initially, these conceptualizations were one-dimensional, focusing primarily on technical aspects such as software installation, device operation, and programming, often referred to as 'computer literacy' (Richter et al., 2001; Robinson & Thoms, 2001; Selber, 2004). As the internet became more pervasive, the definition expanded to include information navigation (Bawden, 2001; Kolle, 2017; Saranto & Hovenga, 2004). With the advent of the interactive web 2.0, communication and content creation skills were included (Van Deursen et al., 2016). Despite widespread recognition of the multidimensionality of digital skills, there is a notable lack of studies measuring communication and content creation skills (e.g., Siddiq et al., 2016).

Furthermore, across all skill dimensions, both functional aspects (commonly discussed in policy and computer science) and critical, evaluative aspects (emphasized in pedagogical and media literacy literature) are present (Helsper et al., 2021). Recognizing both the functional and critical dimensions of digital skills is crucial when integrating them into the broader study of well-being in increasingly digital societies (Cortesi et al., 2020). Functional and critical aspects are often intertwined in practice (Haddon et al., 2020; Polizzi, 2020). Possessing functional skills—such as understanding how technologies function and how to use them—is associated with more passive, consumptive participation, while critical skills—understanding how and why technologies are designed and how content is produced—are indispensable for more active and constructive participation (Helsper et al., 2021).

The conceptual novelty of the current study lies in its focus on both functional and critical aspects of information navigation and processing, communication and interaction, and content creation and production skills:

- Information navigation and processing skills involve the ability to find, select, and critically evaluate digital sources of information. This includes navigation (searching for and orienting within information), interpretation and understanding (comprehending hyperlink structures and symbols, selecting relevant information), and evaluation of digital sources (verifying trustworthiness).
- Communication and interaction skills refer to the ability to use various digital media and technological features to interact with others and build networks, as well as critically evaluate the impact of mediated interpersonal communication. Subcomponents include affordances (matching media, managing contacts), privacy (sharing information about oneself and others), and netiquette (understanding normative and non-discriminative behavior).
- Content creation and production skills relate to the ability to create high-quality digital content, understand how content is produced and published, and comprehend its impact. Subcomponents include affordances (using multimodal formats), quality (reaching audiences, attracting attention), and ownership (persuading others, protecting intellectual rights).

Contrary to the myth of 'digital natives' (see, e.g., Helsper & Eynon, 2010), few children report confidence in assessing the reliability of online information or selecting the right keywords for online searches, with these skills being unevenly distributed across EU countries. The same holds true for content creation skills (Siddiq et al., 2016; Smahel et al., 2020). Young people primarily excel in functional communication skills (Smahel et al., 2020). This study aims to determine whether these patterns are reflected in performance tests and to explore why these differences exist—specifically, identifying the skill aspects that some young people lack.

The role of gender

The difference in confidence between girls and boys in digital skills is a common finding in studies that use self-efficacy measures. For instance, in the International Computer and Information Literacy Study (ICILS), a computer-based assessment conducted across 21 countries, girls consistently reported significantly lower self-efficacy for advanced ICT tasks (Fraillon et al., 2014). Similarly, longitudinal analyses of 15-year-old adolescents found that, while no significant gender differences were observed initially, boys demonstrated higher digital skill levels than girls after three years (Gnambs, 2021). Although research has often indicated lower self-confidence and perceived digital skills among girls (Hatlevik et al., 2018), EU Kids Online surveys show that, in most countries, differences in digital skills between boys and girls are negligible (Smahel, et al, 2020). There are only slight gender differences in information navigation skills, with more boys

reporting high levels of proficiency. Similarly, a meta analysis by Haddon et al. (2020) confirmed that gender differences in digital skills are often negligible. Where differences do exist, they tend to favor girls. This is further supported by research using task completion tests, the method employed in the current study. Prior performance-based assessments indicate that girls tend to outperform boys (Aesaert & van Braak, 2015; Kim et al., 2014; Siddiq & Scherer, 2019). For example, the ICILS test showed that, despite girls reporting lower self-efficacy, they scored significantly higher than boys on actual task-based digital skills tests in all participating countries, with the exception of Thailand and Turkey where no statistically significant differences were found (Fraillon et al., 2014). This divergence emerges as early as fifth grade and is particularly pronounced for more complex skills, such as locating specific information online or creating multimedia presentations (Hatlevik et al., 2018). Kaarakainen et al. (2017) found that boys scored significantly higher on technically oriented skills, while girls outperformed boys in schoolwork-related and social interaction-related skills. Additionally, Aesaert & van Braak (2015) observed that girls excel in delivering digital information in a socially acceptable manner, making content understandable for the receiver, using unstructured formats, responding on forums, assessing the relevance of information, and sending emails to known contacts. These differences in performance suggest that skill levels differ between boys and girls depending on whether information navigation and processing, communication and interaction, and content creation and production are considered. In contrast to previous research, this study combines test results for all types of skills in comparing performance between boys and girls. Based on the corresponding fields model—which posits that people develop skills in line with societal norms about the kinds of activities individuals like them are expected to excel in (Helsper, 2012)—and the aforementioned research, we expect that boys may be more skilled in technical content creation tasks, while girls may perform better in information evaluation, communication, and interaction tasks.

Method

Performance test development

The development of the test was guided by the Youth Digital Skills Indicator (yDSI), a theoretically grounded and empirically validated survey instrument that categorizes digital skills into four dimensions: operational, information navigation and processing, communication and interaction, and content creation and production skills. The yDSI dimensions are based on a comprehensive review of relevant academic and grey literature on both survey and performance test measures (Cortesi et al., 2020; Haddon et al., 2020). Each dimension distinguishes between the ability to use the functionalities of information and communication technologies (functional aspects) and the understanding of why these tools are designed and content is produced in certain ways, as well as the ability to apply this knowledge to manage interactions within and across digital spaces (critical aspects). Guided by the literature review and detailed conceptualizations provided by the yDSI framework, performance tests featuring real-life tasks were developed.

The development followed an iterative process that included expert consultations (to establish face validity), 60 cognitive interviews (to explore how youth interpret the tasks and ensure content validity), and 2,438 pilot surveys (to assess construct validity) conducted with young people across seven European countries: Estonia, Finland, Germany, Italy, the Netherlands, Poland, and Portugal. Measures were taken to ensure that the selected topics resonated with the online experiences of young people, with the goal of replicating real-life situations to motivate them to successfully complete the tasks. Additionally, universal themes for search tasks (e.g., climate change) were chosen to ensure their relevance in an international context. Sufficient time was allocated for thorough discussions of the tests with the research teams in the six partner countries involved in the study. To reduce cognitive load, the test was divided into two modules: the first focused on information navigation and processing skills as well as content creation and production skills, while the second targeted communication and interaction skills. The performance tests developed for this study do not address operational skills separately through a specific task because operational skills are necessary for performing all tasks. Both modules could be completed independently during different time slots. Further details on the test development and methodological challenges are available (Van Laar et al., 2025).

Sample

The large-scale performance tests involved 609 youth from six European countries: Estonia, Finland, Germany, Italy, Poland, and Portugal. These countries rank high, medium, and low on the Digital Economy and Society Index (DESI), a composite measure used by the European Commission to evaluate the digital performance of the EU countries.

In each of the six countries, researchers recruited youth via schools in specific regions, typically from the city and surrounding districts of the partner university. To ensure diversity in socioeconomic status, schools were selected from districts with varying levels of urbanization and wealth. In countries with different school systems (Germany and Italy), both professional / vocational schools and grammar schools were included, as these are typically attended by students with similar socioeconomic backgrounds (Waechter et al., 2023). Different incentives were used across countries to encourage school participation, ranging from letters of thanks to teachers to presentations of the anonymized results. In each of the six countries, performance tests were administered in two to five schools (see Table 1), with the number of classes ranging from four to eleven. In the selected classes, all present students who agreed to participate and whose parents had also agreed completed the test. Except for one school in Poland, both modules were administered on the same day with a break in between. In the exception, the second module was conducted one week after completion of the first module due to time constraints.

Table 1. School characteristics

	Estonia	**Finland**	**Germany**	**Italy**	**Poland**	**Portugal**	***Total***
# of schools	2	2	5	2	5	3	*19*
SES							
High	0	0	3	1	1	2	*7*
Medium	0	0	0	0	2	1	*3*
Low	0	1	2	1	2	0	*6*
Unknown	2	1	0	0	0	0	*3*
# of classes	8	11	10	5	7	9	*50*

Table 2. Sample characteristics

	Estonia	**Finland**	**Germany**	**Italy**	**Poland**	**Portugal**	***Total***
Gender							
Boy	48	20	89	62	32	42	*293*
Girl	43	32	82	40	37	69	*303*
Other	2	0	5	2	4	0	*13*
Age							
13	0	0	1	1	37	0	*39*
14	17	0	1	16	16	31	*81*
15	22	52	86	25	18	47	*250*
16	22	0	69	39	0	31	*161*
17	26	0	19	21	2	1	*69*
18	6	0	0	2	0	1	*9*
Total (N)	93	52	176	104	73	111	*609*

Table 2 shows the sample characteristics of the youth who participated. The sample size ranged from 52 in Finland to 176 in Germany. In Finland, a challenge arose in linking the demographic data collected in a prior survey with the performance tests results. Participants without background information (i.e., gender and age) were excluded from further analyses, resulting in the removal of 40 participants from the sample. In addition, 13 participants who indicated a gender identity other than 'boy' or 'girl' were not included in the analysis of gender differences due to the small sample size. Due to the non-representative nature of the sample, it was not possible in this exploratory study to draw conclusions about differences in digital skills between countries or schools. However, overall descriptives give an indication about the extent to which youth are able to complete the tasks developed and what gender differences exist across a range of different contexts.

Data collection and procedure

The project partners responsible for data collection in their respective countries applied for ethical approval in accordance with national regulations. Informed consent (active or passive) for participation in the project was obtained from both the youth and their legal guardians. According to the regulations in Germany, informed consent from legal guardians was not required for youth in grades 9 or higher. Similarly, in Finland, informed parental consent was required for elementary and lower secondary schools (grades up to 9), but not for upper secondary schools (grades 10 and higher). However, all parents were informed about the study.

Trained supervisors from the national teams conducted data collection during the Spring of 2022, with an extended duration in Finland due to delays in obtaining parental consent responses. All performance tests were administered in a classroom setting, standardizing the environment and controlling for variations in internet connection quality and hardware/software across participating students from the school. The time limit for both modules was determined by the length of a standard school class session (45 minutes). During the test, participants used a keyboard, mouse, and monitor. The PCs/laptops used were connected to the internet and equipped with popular browsers and slide creation software, enabling participants to replicate their typical internet use. Encouragement was deliberately withheld to mitigate the already heightened pressure to succeed in a classroom setting. If a correct answer was not found, the task was marked as incomplete. The test supervisor maintained a neutral role, refraining from influencing the participants' strategies. The measurement and scoring model was piloted and validated which is described in detail in a different publication (Van Deursen et al., 2023).

Results

Information Navigation and Processing Skills

Searching and selecting information. The first part involved information navigation tasks in which young people searched for fact-based information with one correct answer. These tasks assessed the youth's ability to find and select digital sources of information. The answers for Task 1 were immediately visible on the search engine's results page if the correct keywords were used. However, the second (Task 3) and third (Task 4) search tasks required participants to click through and visit a website to find the answers. Overall, 31% of participants successfully completed all three tasks, 39% completed two tasks, 27% completed one task, and 4% did not complete any tasks. A higher percentage of boys than girls completed the second and third search tasks (see Table 3).

The performance test also included a task (Task 5) that assessed the ability to specify a particular time range when searching. After noting the number of results that appeared, participants were asked how they limited the requested time range. Responses that were deemed incorrect included not accounting for the time range (18%) and adding the time range to the search query in the search bar (30%). No significant differences were observed between boys and girls (see Table 3).

Table 3. 'Searching and selecting information' assignment results

Task	Short description *(see Appendix for full task description)*	Correct answer	% Correct			
			All	Boys	Girls	Comparison
1	In 2020, an international documentary about Greta Thunberg appeared. Find the answer to the following question: What is the name of the director of this documentary?	Nathan Grossman	88	87	92	$X^2(2,593)=3.24$, $p=.20$
3	One of the awards Greta Thunberg has won is the so-called 'Alternative Nobel Prize'. With whom did she share this prize in 2019?	D (Jianmei, Kopenawa, and Haidar)	51	58	47	$X^2(2,582)=8.46$, $p=.02$
4	In what year was the first Alternative Nobel Prize awarded?	1980	58	59	50	$X^2(2,603)=8.64$, $p=.01$
5	Please use "Greta Thunberg" as your search query and limit the results to sources published between 2019 and 2021. How did you account for the requested time range?	Using search tools of a search engine of choice	44	50	42	$X^2(2,596)=2.70$, $p=.26$

Note: N=609. Non-responses omitted from analysis.

Evaluating information. After the first search task, a follow-up task (Task 2) assessed whether the participants were aware of the sources from which they obtained their information: 30% were able to recall the website used, 17% did not remember the source, and 56% directly extracted their answer from the search results page. Boys were more likely than girls to complete this task successfully (see Table 4).

In Task 6, participants were asked to assess the objectivity and reliability of presented search results and rank them accordingly. The response was considered correct when the two results most likely to present objective and reliable information were chosen: Wikipedia and the official website of the United Nations, as opposed to a personal blog and a Facebook post. Although the accuracy of Wikipedia entries are sometimes contested, it can be considered more reliable than personal opinions in a blog or Facebook posts. Among all the youth, 30% successfully identified the two more reliable sources. A significantly higher percentage of boys than girls completed this task successfully (see Table 4).

In Task 7, participants were asked what makes a website trustworthy. They were presented with several options. Indicators of trustworthiness were the inclusion of contact information (57%), the date the information was published (76%), the mention of an author or publisher (79%), and the display of a lock icon in the address bar (47%). All four criteria were selected by 22% of participants; 32% selected three of the correct criteria, while 13% did not select any of the correct criteria. There were no significant differences between boys and girls.

Task 8 involved the critical processing and evaluation of digital sources of information. Participants were asked to closely analyze the textual and visual content of three social media posts. After each post, they were questioned about the creator's intention (Advertisement, Fake news, Identity theft, News article, Opinion piece, Phishing scam, and Spam). Post 1 was

considered correct when "Advertisement" was selected (63%), Post 2 was "Fake news" (54%), and Post 3 a "Phishing scam" (50%). Overall, 24% successfully identified all three posts, 34% identified two posts, 29% identified one post, and 13% failed to identify any of the three posts correctly. There were no differences between boys and girls in identifying the purpose of all three social media posts (see Table 4).

Table 4. Results for 'Evaluating information'

Task	Short description *(see Appendix for full task description)*	Correct answer	% Correct			
			All	Boys	Girls	Comparison
2	What source did you use to obtain your information?	Recall the website	30	33	26	$X^2(1,593)=6.88$, $p=.03$
6	What two sources are most likely to provide objective and reliable information?	- Wikipedia - United Nations website	30	32	26	$X^2(1,582)=8.46$, $p=.02$
7	From the eight options provided, select four options that indicate that a website is trustworthy.	- Contact information - Date of information - Author or publisher - Lock icon	22	24	20	$X^2(1,596)=1.72$, $p=.19$
8	Read three social media posts and indicate the poster's intention.	1. Advertisement 2. Fake news 3. Phishing	24	29	20	$X^2(1,596)=2.70$, $p=.26$

Note: N=609. Non-responses omitted from analysis.

Communication and Interaction Skills

Receiving and sharing information of others. In Module 2, young people encountered tasks related to communication and interaction skills. In Task 1, participants were asked to indicate which of four posts should not be shared with others without obtaining permission: 79% chose the correct answer. No significant differences were observed between boys and girls (see Table 5).

Table 5. Results for 'Receiving and sharing information of others'

Task	Short description *(see Appendix for full task description)*	Correct	% correct			
			All	Boys	Girls	Comparison
1	Identify the post that is certainly not okay to share with others without asking.	Post 4 (prominently displaying the faces of two private individuals	79	78	79	$X^2(1, N=559)=0.02$, $p=.88$
2	Identify the *two best* recommendations for responding to nasty and sexist comments.	1. Block person 2. Warn teacher or parent	13	7	19	$X^2(1, N=559)=16.05$, $p<.001$

Note: N=609. Non-responses omitted from analysis.

Task 2 presented nasty and sexist comments received from an unknown person. Participants were asked to indicate which steps were best in reaction to this interaction from a list of eight options. The most appropriate steps were blocking the person who was sending nasty comments (68%) and warning a teacher or parent (28%). Among the participants, 26% considered ignoring the messages and 19% chose ensuring that posts are private as one of the two best options. More girls than boys selected the correct two options (see Table 5).

Interacting with others. In Task 3, participants were asked to envision a discussion with their teacher and classmates. They were prompted to select the platform that would be best suited for this discussion. Although preferred options varied by school, the researchers agreed the best choices were a videocall (43%) and using the school platform (20%), as these provide instant feedback, visual cues, and are typically moderated. E-mail was selected by 14%, WhatsApp by 14%, and Facebook by 8%. Other platforms, such as Instagram, Facetime, or a phone call, were hardly selected. Significant gender differences were observed, with girls performing better than boys (see Table 6).

Task 4 asked about contacting an expert via email about COVID-19. This task consists of five parts related to different sections of this email. For each part several options (see Appendix A) were given with one option being the most appropriate: Introduction (correct: 'Dear Sir, Madam'); Thanks (correct: 'Thank you for accepting my request to talk about the COVID-19 policy'); Exchange details (correct: 'I look forward to speaking to you soon. Perhaps we could communicate via email to set up a date and time for a meeting'); Date and time (correct: 'Could you please let me know your next availability? I am happy to meet online or in person, depending on your preferences'); and Conclusion (correct: 'Thank you in advance, and best wishes, [your name]'. 8% selected the correct options for all five parts, and 37% chose the correct options for four parts, 21% did not select correct any correct options. No significant differences between boys and girls were observed (see table 6). Additional analyses revealed that the highest level of difficulty was encountered in the 'Introduction' (only 26% of all youth selected the correct option) and in the 'exchange of details' section of the email (41% of all youth selected the correct option).

Table 6. Gender differences for 'Interacting with others' assignments (M(SD))

Task	Short description *(see Appendix for full task description)*	Answer	% Correct			
			All	Boys	Girls	Comparison
3	Identify the medium best suited for a teacher-class discussion.	Videocall or School platform	60	51	70	$X^2(1559)=21.17$, $p<.001$
4	Select the correct elements to construct an email to contact an expert on COVID-19	At least 4 of 5 correct options selected	45	46	44	$X^2(1,559)=0.17$, $p=.68$

Note: N=609. Non-responses omitted from analysis.

Intimate conversation with friends. In the third part of Module 2, participants were presented with two WhatsApp conversations about a school project. The tasks required them to critically evaluate the impact of mediated interpersonal communication and interactions on others. After both chat conversations, participants were asked whether there was anything problematic in these conversations. In the first chat between Thomas and Lucas (Task 5), the correct answers were messages 4 and 6 (64%). In the second chat between Charlotte and Sophie (Task 7), none of the messages were problematic (25% got this correct). When comparing the performance of boys and girls, no significant differences were observed in identifying problematic messages in the first chat 1, while boys performed better in the second chat (see Table 7).

After the chat between Lucas and Thomas, a follow-up task (Task 6) asked the participants how they should respond if a similar conversation occurred in a group they belong to. Among the provided options, the most appropriate actions were *writing a message asking Thomas to not say such things* (44%)*, telling a parent or teacher that this is going on* (29%), *and telling Lucas that Thomas' messages are not okay and that you support him* (36%). Additionally, 22% said they would throw Thomas out of the group and 17% would ignore the messages.

Table 7. Results for 'Intimate conversation with friends'

Task	Short description *(see Appendix for full task description)*	Answer	% Correct			
			All	Boys	Girls	Comparison
5	Was there anything problematic in the chat conversation between Lucas and Thomas?	- Message 4 (*God you're such a stupid idiot! Seriously, get with it. No wonder no one wants to hang out with you! You're ugly and stupid)* - Message 6 (*I don't like people who irritate me. And you know what will happen then. So, hurry up!)*	64	60	67	$X^2(1,559)=2.94$, $p=.09$
6	What would you do if this kind of conversation occurred in a group to which you belonged?	Any of the following: - Writing a chat asking Thomas to not say such things - Telling a parent or teacher that this is going on, - Telling Lucas that Thomas' messages are not okay and that you support him	61	67	64	$X^2(1,559)=2.10$, $p=.15$
7	Was there something problematic in the chat conversation between Charlotte and Sophie?	No	25	29	20	$X^2(1,559)=6.77$, $p=.01$

Note: N=609. Non-responses omitted from analysis.

Content creation and Production Skills

To assess the level of content creation and production skills, two tasks were designed. In Task 9 of the first module, participants were asked to create a slide on the causes of climate change.

They were provided with a to-do list that included using an image as a template for the slide, changing the color of an image to black and white, adding a title and a list of three important causes for climate change in bullet points, and incorporating a provided video into the slide. A maximum of 15 minutes was allocated. Among all participants, 76% uploaded a slide. The reasons for not uploading a slide were mostly related to technical issues with the devices used (e.g., uploading was disabled). Among the youth who uploaded a slide, 81% added a title and listed three causes of climate change in bullet points, 54% were able to add the provided video to the slide, 45% used an image as a template for the slide, and 75% changed the color of an image to black and white. Furthermore, 14% met all these criteria when designing their slides. Here, there was no significant difference between girls (13% met all the criteria) and boys (15%) (X^2 (1,419)=0.22, p=.64).

Discussion

Main findings

Digital skills of young people are of increased interest for scholars and policymakers, leading to a growing number of studies focusing on these skills. These studies tend to use self-assessments appropriate for large-scale research. In this contribution, we explore a more externally valid method—performance tests in which youth were asked to complete actual tasks online. While this approach is typical in smaller educational settings, we included a large sample of 609 youth from six countries, providing detailed information on the important skills they possess and whether there are differences between girls and boys. Another unique aspect is their broad scope, covering three main skill areas: information navigation and processing, communication and interaction, and content creation and production.

Youth's ability to successfully complete digital information navigation and processing, communication and interaction, and content creation and production tasks

With regard to the first research question, the overall finding is that the proportion of young people able to successfully complete tasks requiring digital skills is lower than might be anticipated, particularly in light of prevalent public discourse surrounding so-called 'digital natives' (for a critique of this concept, see, e.g., Helsper & Eynon, 2010). Indeed, the percentage of correct responses—ranging from 13 to 88 percent on tasks involving information navigation and processing, as well as communication and interaction—remains below 60 percent for the majority of tasks. This raises important concerns about whether young people possess adequate skills to navigate and participate confidently, competently, and ethically in online environments. A lack of such skills may hinder their educational, social, and identity development, while also increasing their vulnerability to negative outcomes in everyday life.

Having sufficient levels of information navigation and processing skills is important for young people, as these skills can be linked to several beneficial outcomes, such as increased civic participation (Kim & Yang, 2016), higher academic grades (Leung & Lee, 2012; Vandoninck et

al., 2013), and more information for homework (Eynon & Malmberg, 2012). The results raise questions about whether youth have adequate skills to benefit from online information. Even more basic information navigation tasks proved difficult: nearly half of the participating youth failed to find the correct answer in three searches and less than a third successfully completed all three search tasks. Therefore, it is not surprising that the use of advanced search tools, such as accounting for a specific time range, did not come easily to youth. Many young people take their answers directly from the search engine's results page.

Critical information navigation and processing skills are also important because of the proliferation of misinformation and unreliable sources online and the frequent overestimation of truthfulness (Einav et al., 2020; Flanagin & Metzger, 2008). Participating youth demonstrated a limited understanding of what makes a website trustworthy and struggled to identify whether social media posts were advertisements, fake news, or phishing scams. This suggests they are at risk of believing mis- and disinformation and the negative consequences that this lack of critical digital information literacy might have.

The results support previous survey research (Aesaert & Van Braak, 2015; Kroustallaki et al., 2015; Vanderschantz et al., 2014), indicating that there remains considerable room for developmental growth in digital information navigation and evaluation literacy—especially in the critical aspects of these skills, where only 22% to 30% of respondents completed the tasks correctly. This findings is consistent with ySKILLS survey results, which revealed that only 3 respondents answered all knowledge items correct and just 16% achieved a score above 75% (Helsper et al., 2020). Training is important to prepare youth to face the growing spread of fake news, particularly as it outpaces regulation (Diepeveen & Pinet, 2022). However, the design of websites and platforms is often inadequate for young people's skill development, and more can be done to improve alignment in this area (Livingstone & Pothong, 2022). While initiatives to address skills deficits are important, structural causes, such as the marketization of social media and market dynamics and their impact on youth's safe and positive engagement with the internet, should not be overlooked (Monsees, 2023).

The benefits of **communication and interaction skills** are rarely examined empirically. Existing studies suggest positive outcomes for online opportunities such as social engagement (Helsper and Eynon, 2013) and coping with online risks (Wegmann et al., 2015). Generally, it is considered important for youth to be aware of what is safe to share online and to exercise caution when dealing with information received from others (Abades-Barclay & Banaji, 2024; Jain et al., 2021; Stoilova et al., 2020). Our findings revealed that most youth have a reasonable understanding of the netiquette around sharing others' information. Nevertheless, approximately a quarter of them lacked the ability to identify social media posts that should not be shared without seeking permission. If the disclosure of personal information is not consensual or controlled this can result in interpersonal relationship breakdowns (Petronio, 1991). Of equal concern is how young people handle information received from others; for example, about one-third of the youth in our study

did not consider blocking unknown individuals who send offensive comments. Similar challenges arise in critical interaction skills; over 40% of participating youth did not perceive name-calling as problematic in a group chat with friends.

Concerning formal interactions with others, most youth do not inherently understand online meeting and conversation etiquette. Many lack the skills to select appropriate settings for online meetings or to send messages suitable to specific situations. Consequently, appropriate and courteous online behavior is not instinctive. These results are concerning, considering that school-aged youth intensely engage in various activities on social media, such as sharing knowledge, creativity, communicating with classmates and teachers, and creating a cohesive identity (El sharkawy et al., 2023). As the lack of skills around digital etiquette can lead to negative experiences for young people, they should be taught and have discussions about ethics in online interactions (Freestone & Mitchell, 2010).

The online environment provides youth with opportunities to use and **create digital content** in meaningful and responsible ways. Policymakers and educators are increasingly focused on enhancing their skills to creatively shape and distribute media content and to cooperate within digital environments. Among educational practitioners, fostering youth's content creation is seen as essential for enhancing media and information literacy as well as promoting democratic engagement (Drotner, 2020). Our findings demonstrated that these skills are underdeveloped, particularly regarding the use of the internet to create visual presentations. Of all participants, two-thirds did not know how to use an image as a template or change the color of an image to black and white. Overall, only a few were able to design a presentation slide according to the pre-established guidelines. The findings highlight that schools should consider making room for playful, non-directed, multimodal content creation, as this is a fundamental driver for more advanced creative skills as well as a critical understanding of how content gets produced (Drotner, 2020).

Differences between girls and boys in their completion of tasks

Although differences were observed depending on the specific skill examined, the overall findings count for both boys and girls. Boys performed better on the two search tasks that required more than just looking at the search result list. They also performed better in evaluating the sources of information. This contrasts with prior research indicating that girls excel in assessing and judging the relevance of information (Aesaert & van Braak, 2015). Our findings do show, however, that girls performed better in deciding the best action after a teenager is subjected to nasty online comments from a stranger. They also performed better in determining the best settings for a teacher-classmate discussion in a video meeting. Conversely, in one task, boys were better able to identify problematic messages in an online conversation. It is possible that results of performance tests are less prone to gender-based bias than self-reports where boys are consistently more likely to overclaim than girls (see Punter et al., 2017; Siddiq & Scherer, 2019; Van Deursen

& Van Diepen, 2013). The differences observed are more subtle and vary by skill. Although we did not study the causes for the observed gender differences, prior work suggests that social and gender norms may play a role in skill development where girls are more likely to develop critical interaction skills related to discrimination and boys more likely to develop skills related to technical, functional and learning contexts (de Paz Nieves et al., 2021). In households, girls and boys are socialized quite differently into digital practices (Talves & Kalmus, 2015). For instance, girls tend to receive more of all types of parental mediation except technical restrictions, and they attribute slightly greater authority to their parents in internet-related matters (Livingstone, Kalmus, & Talves, 2014). It is therefore important that future research takes a normative theorization of the development of digital skills into account, rather than generalizing across different types of skills. Through these processes skills are developed in correspondence with which types of activities are considered most appropriate for certain genders (Helsper, 2012). Future studies should investigate whether variations in gender norms across countries and contexts correspond to differences in the development of specific digital skills, and whether these differences manifest distinctly in self-confidence versus performance-based measures. Policy responses must be tailored accordingly: when the underlying issue concerns actual skill gaps, interventions should focus on differentiated skills training that reflects the predominant strengths and needs of boys and girls; conversely, when the issue pertains to self-perception and confidence, efforts should aim to transform prevailing social norms regarding gender-appropriate uses of ICT.

Limitations

A few limitations need to be considered. Firstly, while the study's strength lies in its inclusion of over 600 youth from six European countries, the nature of the sampling precludes generalizing and comparing results across nations. Although we included countries with varying levels of ICT development and schools with different socioeconomic backgrounds, participant numbers within each country were too low and skewed toward certain ages, making comparisons between regions or schools inappropriate since they represent different groups of young people and do not represent the country. In addition, the number of participants who identified as a gender other than boy or girl was too small to support meaningful analysis, necessitating a binary conceptualization of gender. As a result, analyses were conducted only on the overall sample, and comparisons were limited to boys and girls, excluding analyses by age group, country, or school. The primary objective was to enhance our understanding of youth's skill levels through task-based assessments, providing detailed insights into their performance in real life situations that were less subject to social desirability and other biases than survey research. Future research should test these with more representative samples. Another direction for research could involve combining survey questions with standardized performance-based assignments.

A second limitation is that the tasks may be constrained by the selected topics. Although timely and realistic tasks were chosen, it remains unclear whether the selection influenced participants' motivation. Additionally, some topics may be more relevant for some subgroups of

young people than the others (e.g., depending on SES). Conversely, the test conditions (classroom setting) might have induced pressure, potentially affecting the willingness to complete tasks.

Thirdly, during the development of the tasks, every effort was made to align them with various conceptual dimensions. However, the results inevitably depend on the limited number of different skills tested and the task difficulty. Future tests could benefit from the development of additional tasks at varying skill levels and types, as well as the exploration of other topics to determine the consistency of the results.

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