Analytical Report

ON THE TECHNICAL AND EDUCATIONAL CHALLENGES, CAPACITIES AND READINESS OF SCHOOLS TO USE THE POTENTIAL OF DIGITAL INNOVATIONS AND AI

2022

JOINT REPORT BY

UNESCO Institute for Information Technologies in Education

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1. Introduction

This analytical report contributes to the project entitled 'Promoting ICT Capacity Building and Open Education in the Era of Artificial Intelligence and Digital Technologies.' The aim of this project is to harness the potential of Information and Communication Technologies (ICT), particularly interactive and online tools, to enhance teaching, learning and inter-cultural dialogue, so that young people become active learners, knowledge constructors and global citizens who participate fully in society. It also aims to help to improve understanding among educators of the potential, benefits, and limitations of advanced ICTs, such as artificial intelligence (AI), for schools and other educational institutions; to support teacher training and networking in this field; and to develop monitoring and evaluation approaches throughout the value chains of AI influence on education. Accordingly, the project is contributing to UNESCO activities focused on achieving the Education 2030 agenda and SDG4 for education through promoting ICT capacity building and Open Education in the era of AI and digital technologies, to strengthen quality in education and lifelong learning including digital citizenship education.

The project is also contributing to the joint UNESCO IITE and HEDU Group project 'Connecting schools online for inter-cultural teaching and learning'. Accordingly, it is focused on the ASPnet community of schools from Shanghai Cooperation Organization (SCO) countries and aims to provide schools worldwide with a model for the way education might best be organized in the present and for the future.

The intended outcomes of the project, 'Promoting ICT Capacity Building and Open Education in the Era of Artificial Intelligence and Digital Technologies,' include guidance on using digital tools and executing open educational practices at universities. One particular focus is the application of AI in educational contexts, such as the use of AI-assisted speech to text (voice recognition) and text to speech, especially for learners who have a disability. Intended beneficiaries of the project include school leaders, teachers, and students from UNESCO ASPnet and beyond.

In spite of their potential for school and digital citizenship education, advanced ICTs such as AI remain uncommon in schools and other educational institutions due to a number of challenges typical to all countries. Technological advancements in the area of AI bring both new possibilities and difficult challenges for sustainable development and societal change. For example, AI might help expand accessibility, automate management processes, augment teaching and learning, and create enabling environments. Such technologies might also be harnessed to help develop teacher capacity and achieve better learning outcomes of all students. However, this potential remains underexplored and poorly understood, while the

development and use of such technologies might instead undermine teacher agency and reduce student outcomes. Accordingly, it is likely that a transformational approach to teacher education and continuous support to teachers is required in order to help them work in an AI-rich education environment.

With all of this in mind, UNESCO IITE undertook a survey of more than thirteen thousand ASPnet teachers from around the world. This survey sought to understand the potential, benefits, and limitations of advanced information technologies, such as artificial intelligence, for schools and other educational institutions through the lens of ASPnet teachers. This report summarizes and explores the outcomes of that survey. The teachers' responses help identify key issues in the field of digital innovations in education. The findings will inform local, community and national initiatives to further strengthen and develop a more effective educational environment, taking into account the post-pandemic situation.

The concluding part of the report comprises recommendations for consideration by policy-makers and school leaders, helping to ensure that the development and application of ICT in education, especially of advanced ICT technologies such as artificial intelligence, are genuinely in support of teachers and students and for the common good.

In future work, issues raised by teachers in the survey reported here, along with the recommendations, will inform the development of future digital education-related resources, training courses and webinars for educators.

2. Executive Summary

This analytical report contributes to the project entitled 'Promoting ICT Capacity Building and Open Education in the Era of Artificial Intelligence and Digital Technologies', which aims to harness the potential of Information and Communication Technologies (ICT) in education. To inform the project, more than thirteen thousand ASPnet teachers from around the world were surveyed. This sought to understand the potential, benefits, and limitations of ICT, including advanced ICT such as artificial intelligence, for schools and other educational institutions from the perspective of ASPnet teachers. This report summarizes and explores the outcomes of that survey.

In multiple ways, the survey confirmed that, despite teachers' willingness to engage, ICT and especially advanced ICTs such as artificial intelligence are not used to their full potential, due to a number of challenges typical to all countries. In particular, access to technologies remains a key challenge across the globe, with around a quarter of respondents noting that they had no digital technologies in their schools or classrooms, while more than two thirds noting that they had insufficient computers for their students. In addition, many in rural areas noted that their schools suffered from a lack of electricity and Internet connectivity, making any use of ICT in teaching and learning either impracticable or impossible. Accordingly, in many schools, teachers are often asked to bring and use their own devices, to teach with and to access the Internet, while in others the few computers that are available are only used for administrative purposes (such as for monitoring attendance) or to project teaching materials onto smart boards (thus supporting the frequently criticized transmission model of education) rather than for innovative pedagogical purposes or for enhancing student autonomy or self-actualisation.

The survey also confirmed the need for concerted efforts to enable access to ICT for the most marginalized and the disadvantaged in order to address inequalities. However, while access to ICTs remains critical, the focus now needs to shift to the appropriate use of those technologies to promote the goals and purposes of education for the common good. For example, in the teaching of artificial intelligence, there needs to be an emphasis on both the technological dimension (how AI works and may be created) and the human dimension (the possible impact of AI on people and society), while the use and teaching of ICT needs to go beyond ICT classes to be integrated across the curriculum. This will require major realignments and rethinking, enabling policies and strategic funding investments, to ensure that ICTs are used in harmony with the Sustainable Development Goals, maintaining and enhancing the roles and rights of teachers and students.

Finally, the survey also revealed teachers' needs and wishes to have access to appropriate in-depth training and professional development in the use of ICT, especially advanced ICTs

such as AI, to support teaching and learning (a requirement noted by more than 80% of respondents). Alongside typical topics such as coding, cybersecurity, and practical applications, other suggested topics included digital citizenship, ICT and climate change, and the ethics of using ICT in education. While some countries and schools do offer such training, the survey revealed that many teachers still have either unrealistic hopes for or misunderstandings of what advanced ICTs can actually achieve, and how they might support or undermine teaching and learning. Accordingly, professional development for teachers should involve both pre-service and in-service teachers, at both a local and national level, taught by experts in the genuine potential of ICT in education, while ensuring that teachers are not further overburdened with work. Otherwise, with ICTs developing so quickly, it will never be possible for teachers to take full advantage of the opportunities brought by ICT to enhance teaching and learning for their students, or to address the digital gap between rural and urban areas, and between schools in the global north and the global south.

3. Methodology

Present analytical report is built on the basis of the results of the survey conducted online between December 2021 and March 2022. The key purpose of the survey was to collect the teachers' perception feedback on the perspectives of ICT use, including AI, new ICT solutions for teaching and learning and to identify what topics in the field of digital innovations in education teachers and teacher trainers consider to be most important and interesting for them. The questionnaire targeted the global teaching community of the ASPnet association and beyond: teachers and teacher trainers working at the levels of basic education (primary and secondary schools, including special education schools), higher and vocational education (secondary vocational schools and institutions/centers for professional training and development for businesses) were requested to participate in the survey. All these educational institutions were invited to contribute via email.

The questions in the survey were formulated in a way that would contribute to the aim of "inspiring and supporting the elaboration of local, community and national initiatives to further strengthen and develop appropriate educational environment, taking into account post-pandemic situation and teacher's opinions." To that end, the survey comprised 15 closed questions (which were therefore open to descriptive quantitative analysis) and 13 open/free text questions. The questionnaires were available in English and Chinese.

The closed questions focused on two parametres: 1) the basic data on the teaching staff as well as on the type of educational insitution where they were teaching in, its location (the country, and whether the school was located in the urban or rural area), the professional tasks that the respondents perform on a daily basis, and the position they occupy in the educational institution; and 2) the technical and pedagogical aspects of connecting the educational institutions to the Internet, such as whether the educators were accessing the Internet for professional purposes via computers or mobile devices; by which means the school was connected to the Internet; how the school was ensuring the educators use ICTs in teaching and learning; in what ways the educators consider ICTs and AI help them to improve the quality of teaching and learning; their assessment of the security of using ICTs and AI for educational purposes; and finally, in which areas in education the educators assume AI and advanced technologies can improve the effectiveness of the teaching and learning process.

Open questions referred to the type of information for which it is difficult or impossible to provide more or less standardised answers, taking into account the global scope of the survey. They compelled the respondents to ponder on a number of issues ranging from the availability of accessible advanced technologies at school for teaching and learning purposes, the currently employed best practices and how effectively, in the educators' view, they were using

AI and digital innovations in the educational process to the challenges their schools were experiencing regarding the use of advanced ICTs in education, the available opportunities for the teachers to develop and enhance their ICT-competencies (advanced training courses, qualification sessions, workshops, etc.), and how the use of advanced ICT and AI has contributed to their teaching research and professional growth.

The open questions generated free text comments/quotations from the respondents. The answers to the open questions were text-mined: cleaned, language standardized to English, merged as appropriate, quantified (converted to numbers), and interpreted to enable descriptive reporting of broad indicators. Those direct comments that are included in this report are presented in call-out boxes and have only been edited for length and to correct minor typographical errors.

The data obtained through the survey were considered analysable on the condition of the completeness of the responses. Thus, the replies that lacked replies to open questions or which were left unfinished, were not liable for the consequent analysis. This, in turn, translated into the elimination of the large bulk of responses: only about 29% of all responses were included into the report.

The following text mostly represents descriptive analysis of the obtained data which, however, allows to get a glimpse of the global state of the art regarding the use of ICTs and AI in educational settings. The collected information also allowed to develop policy recommendations (see Chapter 8 of the present Report).

4. Respondents

The survey involved 13,415 teachers drawn from ASPnet schools globally. Of all the respondents, 3,836 provided almost complete responses (as is typical of surveys, later questions were answered by fewer respondents), which comprise the basis of this report. The teachers were from 59 countries, from all 5 global regions: Africa (2937 respondents from 16 countries), Arab States (51 respondents from 7 countries), Asia and the Pacific (139 respondents from 7 countries), Europe and North America (569 respondents from 22 countries), and Latin America and the Caribbean (140 respondents from 7 countries).

Table 1. Number of respondents by country and region

AFRICA	
Angola	1
Burkina Faso	4
Côte d'Ivoire	3
Djibouti	7
Ghana	12
Kenya	7
Mozambique	1
Namibia	9
Niger	1
Nigeria	964
South Africa	1909
Tanzania	3
Tunisia	1
Uganda	12
Zambia	2
Zimbabwe	1
	2937

ARAB STATES	
Bahrain	3
Egypt	10
Jordan	1
Kuwait	2
Lebanon	26
Oman	2
Qatar	7
	51

ASIA AND THE PACIFIC	
China	66
India	1
Japan	30
Korea	1
Laos	6
Malaysia	2
Mauritius	33
	139

EUROPE AND NORTH AMERICA	
Austria	3
Azerbaijan	1
Belarus	1
Canada	1
Croatia	1
Denmark	2
Estonia	1
Georgia	462
Greece	34
Italy	1
Luxembourg	2
Malta	4
Montenegro	2
Netherlands	4
Portugal	11
Romania	4
Russia	9
Serbia	1
Slovakia	1
Slovenia	12
Spain	11
Turkey	1
	569

LATIN AMERICA AND THE CARIBBEAN	
Aruba	10
Barbados	7
Brazil	41
Costa Rica	53
Curaçao	4
Sint Maarten	23
Trinidad and Tobago	2
	140

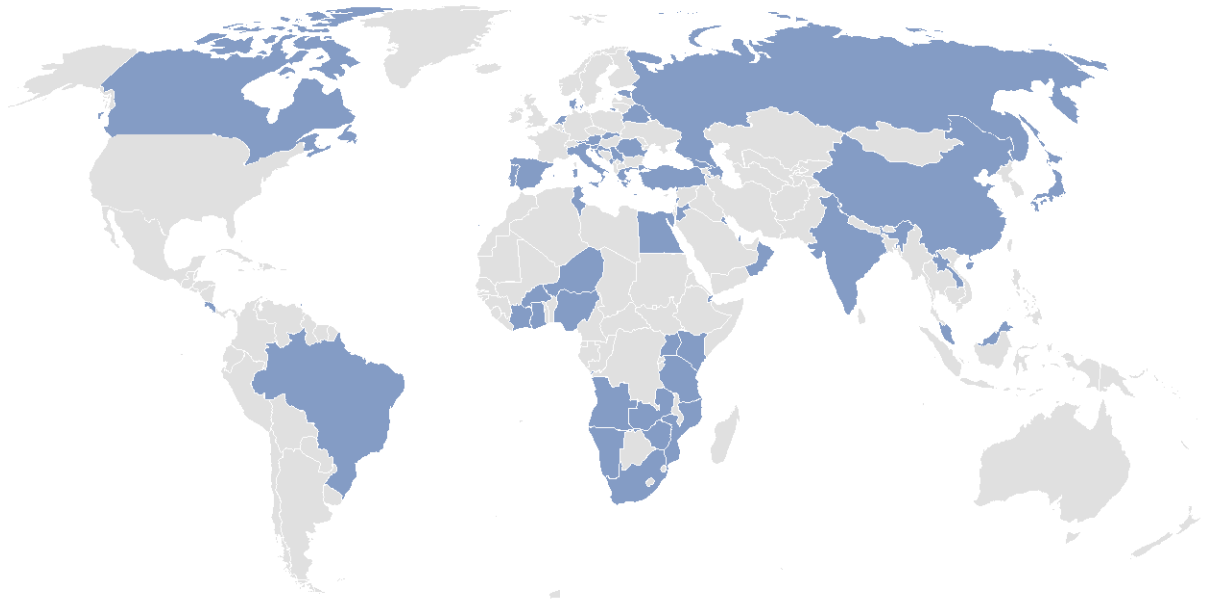

Figure 1. Distribution of respondents around the world.

As can be seen in Table 1 and Figure 1, the geographical spread of respondents is wide (covering 59 countries across all regions of the world). However, it is important to note that, as can be seen in in Table 1 and Figure 2, the respondents are not evenly spread around the world.

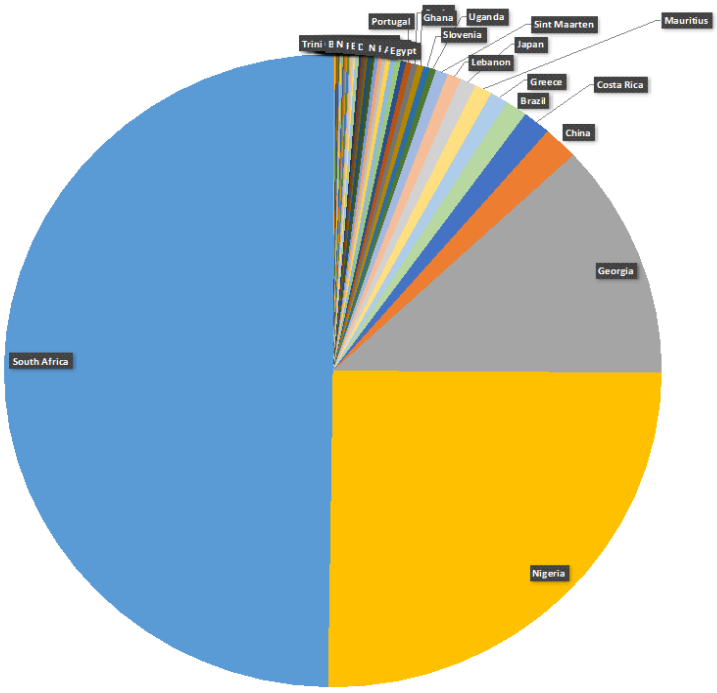

Figure 2. Number of respondents by country

In fact, as shown in Figure 2, around half of the respondents are from South Africa, around a quarter of the respondents are from Nigeria, and around an eighth of the respondents are from Georgia. The remaining ~6% of respondents are spread across the other 56 countries.

Table 2. Respondent countries by region

Region	Countries
Africa	16
Arab States	7
Asia and the Pacific	7
Europe and North America	22
Latin America and the Caribbean	7

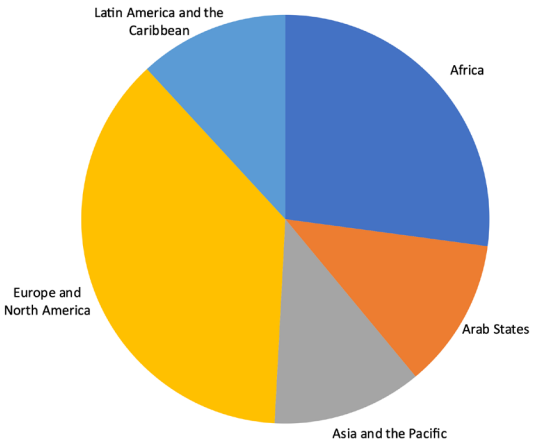

Figure 3. Respondent countries by region

Similarly, while as shown in Figure 1, Table 2 and Figure 3, the countries in which respondents are based are broadly spread around the regions of the world, the number of respondents by region, as shown in Table 3 and Figure 4, is heavily skewed to Africa. This is unusual as Africa is frequently poorly represented in research.

Table 3. Respondents by region

Region	Respondents
Africa	2937
Arab States	51
Asia and the Pacific	139
Europe and North America	569
Latin America and the Caribbean	140

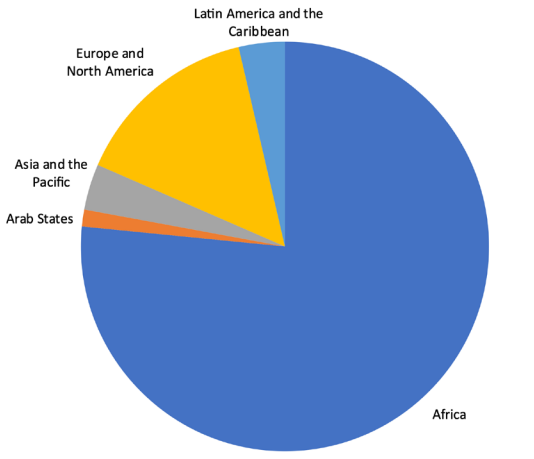

Figure 4. Respondents by region

For these reasons, while the views expressed by all respondents in this survey are informative and worthy of consideration, because of the skew (to the country of South Africa and, hence,

to the region of Africa), we must acknowledge that they do not directly or proportionally represent the views of teachers in the ASPnet schools globally.

4.1 Type of represented institutions

In naming the type of institution that they were representing, respondents inevitably gave a wide range of descriptions (as each jurisdiction arranges education as appropriate for their area). However, for clarity in this report, based on text mining of the free text data (the data had to be cleaned, the language standardized to English, descriptions merged as appropriate, and the result quantified and interpreted to enable descriptive reporting of broad indicators), the types of institution have been grouped as follows (see Table 4 and Figure 5). By far, the most populous type of institutions is schools (catering for children aged from ~5 to 18: n-2991, ~78% of the total), followed by colleges or universities (n=615, ~16%), vocational institutions (n=91, ~2%), lifelong learning (e.g., adult education, arts, and sports: n=53, ~1.5%), special needs institutions (n=51, ~1.5%), and "other" (e.g. kindergarten, teacher training, or none given: n=16, ~1%).

Table 4. Type of institutions

Type	Respondents
Schools	2991
Colleges/universities	615
Vocational institutions	91
Lifelong learning	53
Special needs institutions	51
Other or none given	35

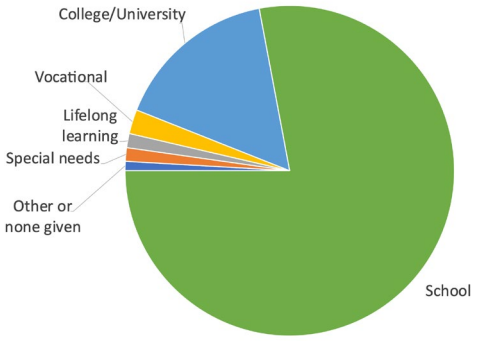

Figure 5. Type of institutions

An alternative way to group the respondents' institutions is by level of provided education (see Table 5 and Figure 6). Inevitably, there are some similarities/overlaps with the previous categorisation, but also some slight differences (because of the different grouping). By far, the largest categorisation is basic level of education (n=3141, ~84% of the total), followed by higher level of education (n=563, ~15%), lifelong learning (n=42, ~1%), and other or none given (n=7, negligible %).

Table 5. Level of education provided

Level	Respondents
Basic	3141
Higher	563
Lifelong learning	42
Other or none given	7

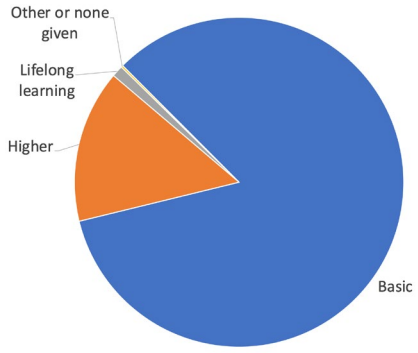

Figure 6. Level of education provided

While the original intention of the survey was to focus on schools and schoolteachers and other basic level education providers, a not insignificant number of the respondents are from higher education institutions or are involved in lifelong learning. Nonetheless, those from higher education institutions provided broadly similar and informative responses and so have been integrated in this report.

4.2 Size and location of represented institutions

More than three quarters of the institutions represented by respondents who answered this question (n=3727) had fewer than 50 teaching staff (n=2572, ~69% of the total), while around a quarter of institutions had between 50 and 100 teaching staff (n=869, ~23%) (see Table 6 and Figure 7). The remaining institutions had between 101 and 1000 teaching staff (n=230, ~7%), or more than 1000 teaching staff (n=53, ~1%). In summary, most of the institutions may be considered relatively small/ medium in size.

Table 6. Number of teaching staff in institution

Number of teaching staff	Respondents (n=3727)
Fewer than 50	2575
50-100	869
101-300	177
301-500	28
501-1000	25
More than 1000	53

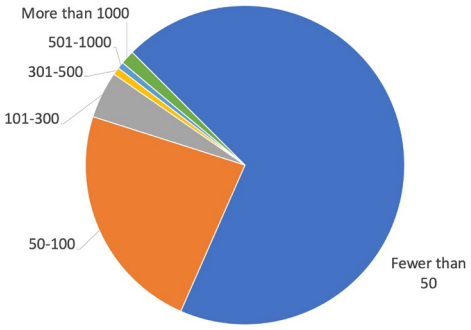

Figure 7. Number of teachers

Meanwhile, the number of students in the institutions represented by respondents was much more evenly distributed (see Table 7 and Figure 8). Only around one in ten institutions had

fewer than 100 students (n=413, ~11%); while around a quarter of the institutions had 100 to 300 students (n=939, ~25%), or 500 to 1000 students (n=873, ~24%), or more than 1000 students (n=879, ~24%); and the remaining institutions had 300-500 students (n=605, ~16%).

Table 7. Number of students in institution

Number of students	Respondents (n=3709)
Fewer than 100	413
100-300	939
301-500	605
501-1000	873
More than 1000	879

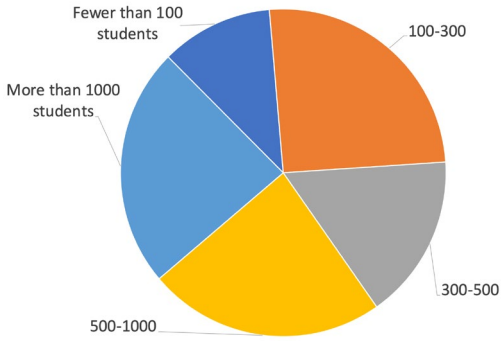

Figure 8. Number of students

Finally in this section, as shown in Table 8 and Figure 9, almost two thirds of respondents (n=2251, ~59%) stated that their institutions were situated in an urban area, while just over a third (n=1585, ~41%) stated that their institutions were in a rural area. This distinction has been instructive in some of the analyses below.

Table 8. Respondents by urban/rural area

Region	Respondents
Urban area	2251
Rural area	1585

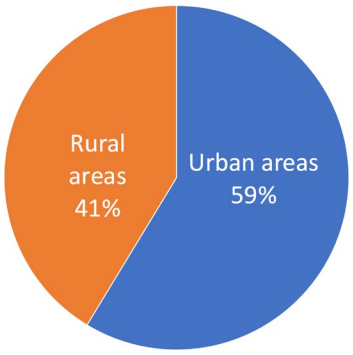

Figure 9. Respondents by urban/rural

4.3 Respondents' main roles and duties

As shown in Table 9 and Figure 10, just over half of the respondents self-reported as subject teachers (n=2022, ~53%), while around a quarter were Principals or Heads of the institution (n=873, ~23%). The remainder were Senior Teachers or Directors of Studies (n=379, ~10%), Teacher Trainers or Mentors (n=152, ~4%). Around one in ten of the respondents either did not answer or gave an answer that could not be categorized (n=410, ~11%).

Table 9. Respondents' main roles

Region	Respondents
Subject teacher	2022
Senior teacher/ Director of studies	379
Teacher trainer or mentor	152
Principal/ Head of institution	873
No answer	410

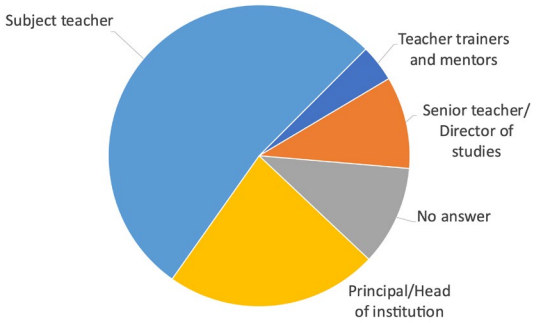

Figure 10. Respondents' main roles

Respondents were also given five options from which to identify their main duties and were able to choose more than one duty. As shown in Table 10 and Figure 11, approximately two thirds of respondents selected 'Prepare lesson plans and facilitate learning in a classroom' (selected by 2547 respondents, ~66% of all respondents). Approximately one third selected each of the other options: 'Provide guidance to students and share knowledge based on lived experience' (n=1421, ~37%), 'Supervize teaching staff and monitor day-to-day school operations' (n=1204, ~31%), 'Provide curriculum guidance and set goals for teaching staff' (n=1158, ~30%), 'Provide advice, constructive feedback and support to peer teachers' (n=1095, ~29%).

Table 10. Respondents' duties

Respondents' Duties	Respondents
Prepare lesson plans and facilitate learning in a classroom	2547
Provide guidance to students and share knowledge based on lived experience	1421
Supervize teaching staff and monitor day-to-day school operations	1204
Provide curriculum guidance and set goals for teaching staff	1158
Provide advice, constructive feedback, and support to peer teachers	1095

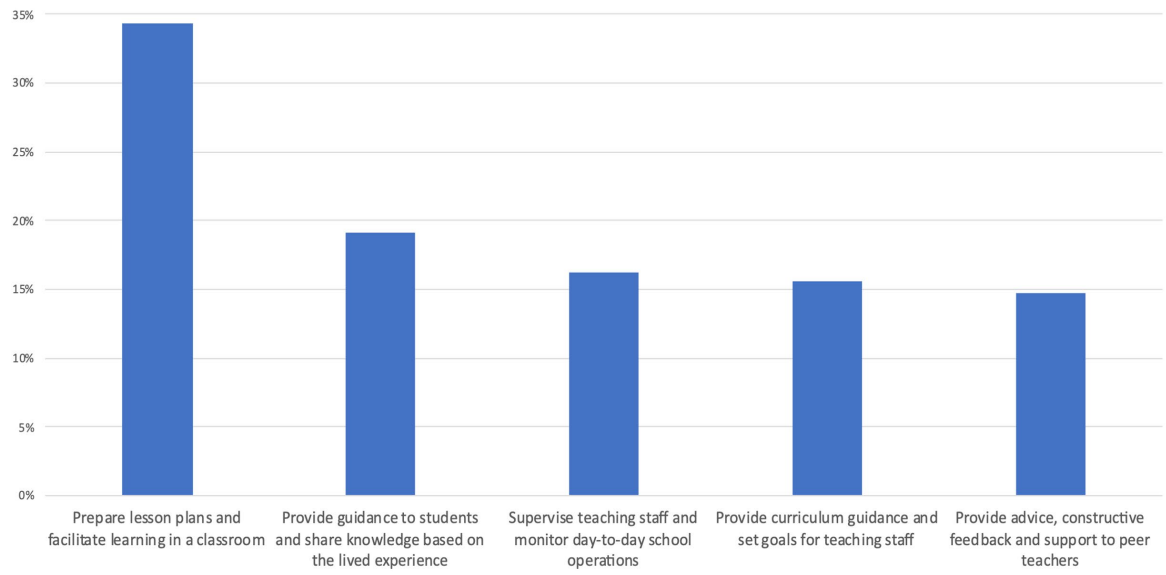

Figure 11 Respondents' duties

In summary, while around half of the respondents were subject teachers, their duties were not restricted to teaching (preparing for and facilitating learning). Instead, even these teachers were involved in a range of complementary tasks, such as providing guidance to students and teacher colleagues.

4.4 Subjects taught by respondents

Respondents reported the teaching of a wide range of subjects (see Figure 12) across all curriculum areas.

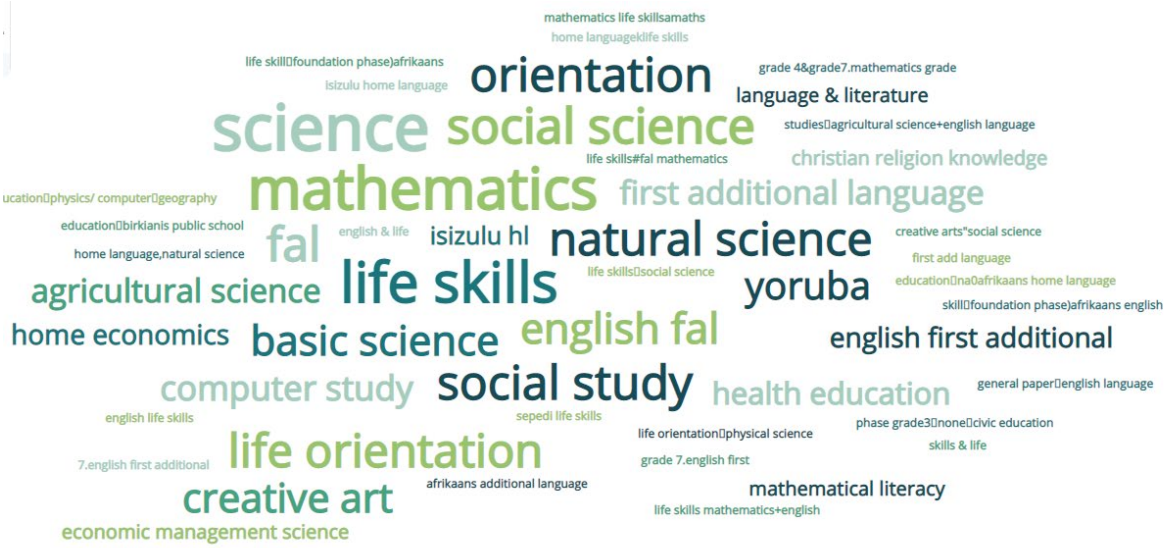

Figure 12 Word cloud of subjects mentioned by respondents

Inevitably, respondents gave a wide range of descriptions (e.g., "English" and "Engels") as each jurisdiction uses different subject titles as appropriate for their local needs. In addition, sometimes a different language was used in the responses. Accordingly, based on text mining of the resulting free text data, for this report the more than 2000 individual descriptions were grouped into around 250 subjects. The subject groups mentioned by at least 100 respondents (see Table 11 and Figure 13) were English (1043 respondents, ~27% of all respondents), Mathematics (948, ~25%), Life skills (641, 17%), Natural sciences (470, 12%), Social sciences (294, ~8%), Afrikaans (241, ~6%), Technology (220, ~6%), Languages (175, ~5%), Computing (144, ~4%), the Arts (135, ~4%), Geography (124, ~3%), and Economics (100, ~3%). The inclusion of Afrikaans in this list is likely due to the fact noted earlier that around half the respondents were from South Africa. It remains unlikely that Afrikaans is taught more widely. Table 11 and Figure 13 also include the subjects Citizenship and/or Civics Studies (n=93, ~2%) and History (n=93, ~2%), both because they were mentioned by almost 100 respondents, Citizenship because of its increasing profile around the world (it is frequently mentioned as a key component of SDG4).

Table 11 Subjects mentioned by at least 100 respondents (plus Citizenship and History)

Subjects	Respondents
English	1043
Mathematics	948
Life skills	641
Natural sciences	470
Social sciences	294
Afrikaans	241
Technology	220

Subjects	Respondents
Language	175
Computing	144
Art	135
Geography	124
Economics	100
Citizenship and/or Civics Studies	93
History	93

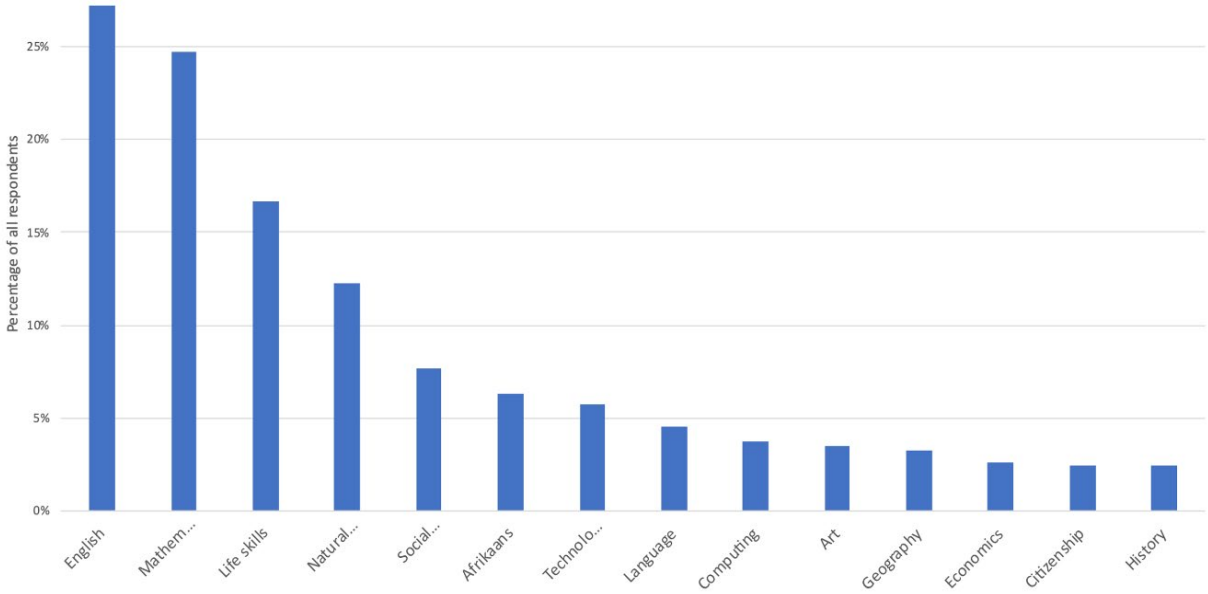

Figure 13. Subjects mentioned by at least 100 respondents (plus Citizenship and History)

In summary, the subjects taught by respondents were mostly conventional, focusing on English (~27%) and Mathematics (~25%), and the natural (~12%) and social sciences (~8%). This allows us to reasonably infer that our respondents are actually broadly representative of all teachers. Simultaneously, the fact that only about a quarter or fewer of respondents mentioned each of these subjects points to the wide range of subjects mentioned across the survey. Nonetheless, the relatively large number of respondents to mention that they taught 'life skills' is notable (~17%), while the number of those who taught Afrikaans is probably a statistical artefact (~6%) as mentioned earlier. Perhaps most notably, given the global push over recent years to promote the teaching of Citizenship and/or Civic Studies, the number of respondents to mention such subjects was very low (~2% of all respondents).

5. ICT and digital tools in the educational institution

5.1 Availability of computers in the institution

Respondents were asked to comment on whether their institution had sufficient personal computers and other digital tools (respondents were left to define 'sufficient' according to their local needs). Based on text mining of the resulting free text data, around more than half of ALL respondents (see Table 12 and Figure 14) reported that they did not have sufficient computers (or other digital tools) (n=1953, ~54%), while around a quarter reported that they did have sufficient computers (n=847, ~23%), and around a quarter gave no response (n=819, ~23%). Of the 2800 respondents who reported either insufficient or sufficient computers, in other words excluding those who made no comment, more than two thirds (~70%) reported that they did not have sufficient computers (see Table 13 and Figure 15). Such a lack of available computers has frequently been commented upon and is clearly some way from being resolved.

Table 12 Availability of computers (ALL respondents)

Availability	Respondents
Insufficient computers	1953
Sufficient computers	847
No comment	819

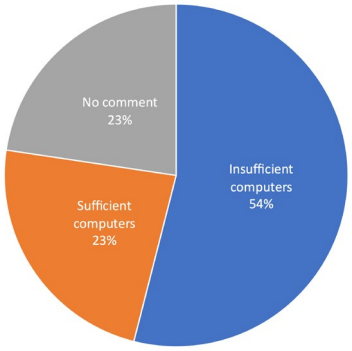

Figure 14 Availability of computers (ALL)

Table 13 Availability of computers (respondents who commented)

Availability	Respondents (n=2800)
Insufficient computers	1953
Sufficient computers	847

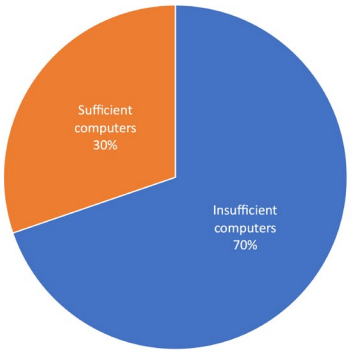

Figure 15 Availability of computers (subset)

"Yes, our educational institution has enough computers and other digital tools for education." (Georgia)

"Our educational institution does not have enough personal computers and digital tools for education. At the moment majority of the educators do not have access to a computer in their classrooms. Majority of the classrooms are not connected to the Internet. Educators find it difficult to use technology such as projectors and whiteboards to teach, because the teachers go from class to class which would disadvantage some learners because their classes are not equipped with the tools to receive the same digital lesson." (South Africa)

5.2 Internet connection

Respondents were asked by what means their institution mainly accessed the Internet. The responses given by respondents can be seen in Table 14 and Figure 16, with many respondents giving more than a single response (which is why the total of responses is greater than the total number of respondents, and why percentages are inappropriate). As can be seen, most respondents reported that their institutions either had no connection to the Internet (n=801) or that they did not know (n=900). Of the remaining respondents, most reported that their institution used either cable (n=508) or fibre optic (n=579) connections, while fewer reported ADSL (n=291) or satellite (n=136) connections.

This was one of only two survey questions to elicit markedly different responses between those in rural and those in urban areas. As can be seen most easily in Figure 16, notably fewer rural respondents than their urban counterparts reported that their institution used ADSL (rural n=69, urban n=222) cable (rural n=182, urban n=326) or fibre optics (rural n=82, urban n=497). Meanwhile, the number of rural and urban institutions that access the Internet by means of satellites was broadly similar. However, notably more rural respondents had no Internet access (rural n=480, urban n=321). In fact, when the numbers are recalculated in proportion to the ratio of urban/ rural respondents (41:59 – see Figure 9 and the 'Proportional' columns in Table 14), the number of institutions in rural areas with no Internet access is around twice that of those in urban areas (see Figure 17). Clearly, if schools and other educational institutions are to make progress in taking advantage of the potential of digital technologies, this infrastructure problem in rural areas is a long way from being addressed.

Finally, it is important to also comment on the number of respondents who chose Wireless LAN as the means by which their institution is connected to the Internet. While the large

numbers who chose this option are correct in that they probably do access the Internet (e.g., on their laptops or tablet computers) via Wireless LAN, this does not explain how the Wireless LAN (also often referred to as WiFi) itself connects to the Internet.

> *"Our learners do not have access to ICT or Internet at all. Some don't even have smart phones, it makes no sense for us to be teaching using online teaching when the majority of our learners are still disadvantaged."* *(South Africa)*

> *"Technology has been a useful tool for us teachers during pandemics. Students receive their classwork even if they are at school or at home."* *(Costa Rica)*

Table 14. Internet connection

Connection	Rural respondents		Urban respondents		All respondents
	Actual	Proportional	Actual	Proportional	
Satellite	70	[85]	66	[56]	136
ADSL	69	[84]	222	[188]	291
Cable	182	[222]	326	[276]	508
Fibre optic	82	[100]	497	[421]	579
None	480	[585]	321	[272]	801
Don't know	365	[445]	535	[453]	900
Wireless LAN	477	[582]	714	[605]	1191

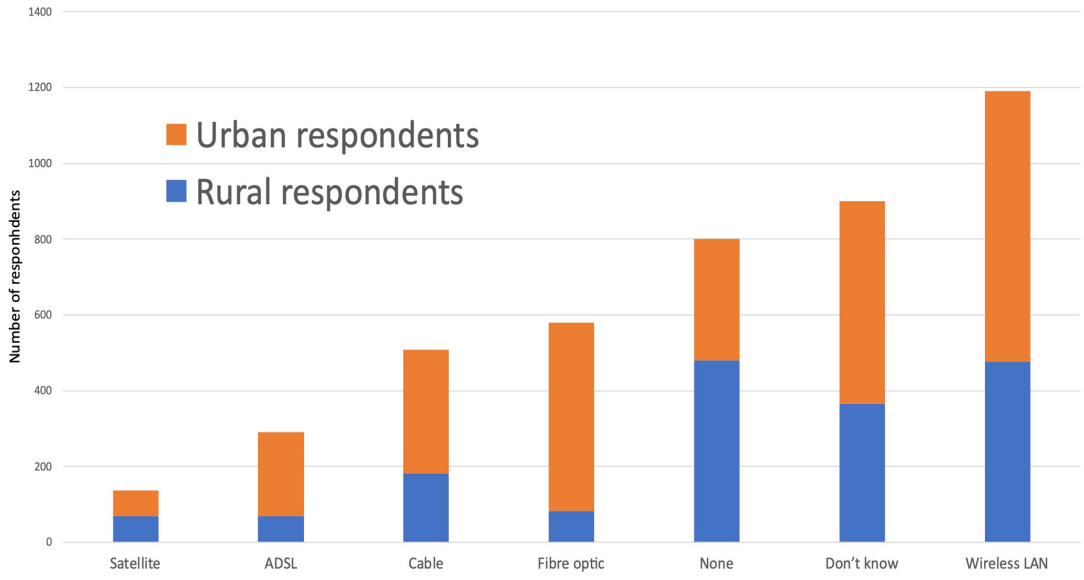

Figure 16. Internet connection

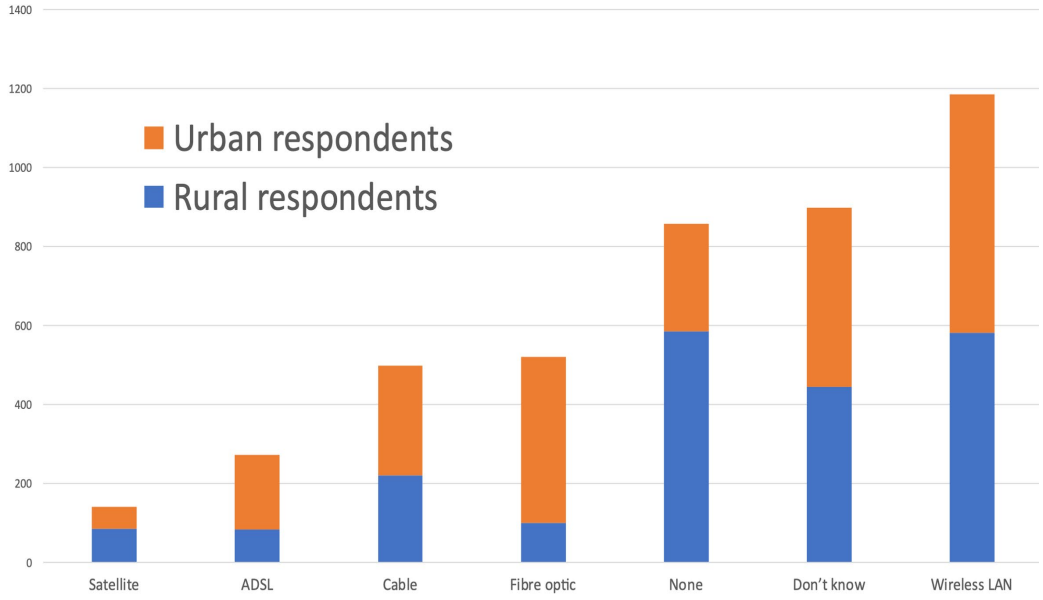

Figure 17. Internet connection (proportional)

Respondents were also asked with what devices (computers or mobile device, such as a mobile phone) they mainly accessed the Internet. The responses given by respondents can be seen in Table 15 and

Figure 18, with around half of respondents choosing computers (n=1959, ~52%,) and half choosing mobile devices (n=1843, ~48%). However, this was the second survey question to elicit markedly different responses between those in rural and those in urban areas.

As shown in Table 15 and Figure 18, while in rural areas around a third chose computers (n=592, ~38%) and around two thirds chose mobile devices (n=980, ~62%), in urban areas the proportions were reversed, with around two thirds choosing computers (n=1367, ~61%) and around one third choosing mobile devices (n=863, ~39%).

Table 15. Accessing the Internet

Device	Rural respondents	Urban respondents	All respondents
Computer	592	1367	1959
Mobile device	980	863	1843
TOTAL	1572	2230	3802

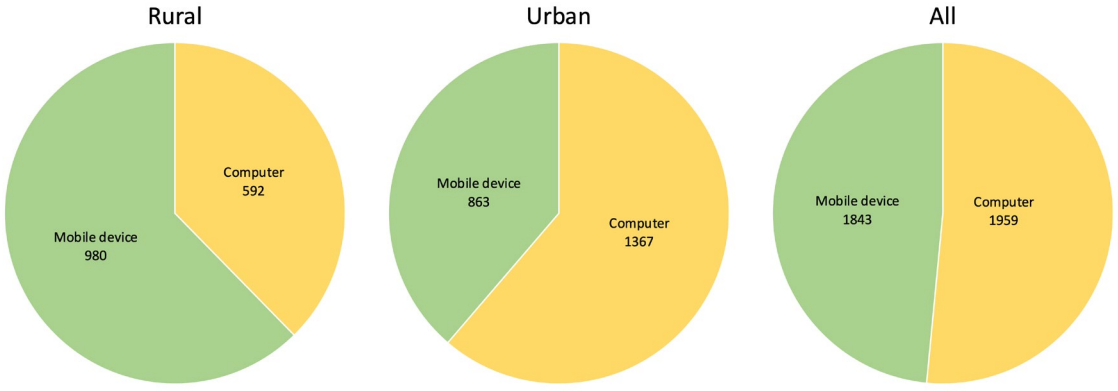

Figure 18. Accessing the Internet

This is a particularly interesting outcome. While respondents in rural areas mostly use mobile devices (such as mobile phones) to access the Internet, respondents in urban areas mostly use computers. This might be because while some rural areas do have access to the Internet via the mobile/cellphone network, far fewer have the wired access via which a computer typically connects to the Internet.

5.3 Types of digital devices available in the institution

In a related question to that reported in 0, respondents were asked to comment on what types of digital devices they had available in their institution. Inevitably, respondents gave a wide range of descriptions (e.g., "Smart board" and "IWB"). Accordingly, based on text mining of the resulting free text data, for this report the more than 5000 individual descriptions were grouped into around 100 technologies (which is why showing percentage is inappropriate).

The technologies mentioned by at least 100 respondents, plus those who noted that no digital equipment was available (n=~930) or that they only had access to their own personal digital equipment (n=~140), are shown in Table 16 and Figure 19. The most commonly mentioned available technology was computers (n=~1530, including personal computers, laptop computers and tablet computers), smart boards (or interactive white boards, n=~910), projectors (n=~800), mobile phones (~290), televisions (~100), and the software Microsoft Office (n=~120).

> *"It rather unfortunate that some teachers and students cannot afford personal computers thereby leaving gaps in the teaching and learning process."* *(Nigeria)*

Table 16. Digital equipment mentioned by respondents

Other comments	Mentions
No digital equipment available	~930
Only personal digital equipment	~140

Digital technologies	Mentions
Computers	~1530
Smart boards	~910
Projectors	~800
Mobile phones	~290
Televisions	~100
Microsoft Office	~120

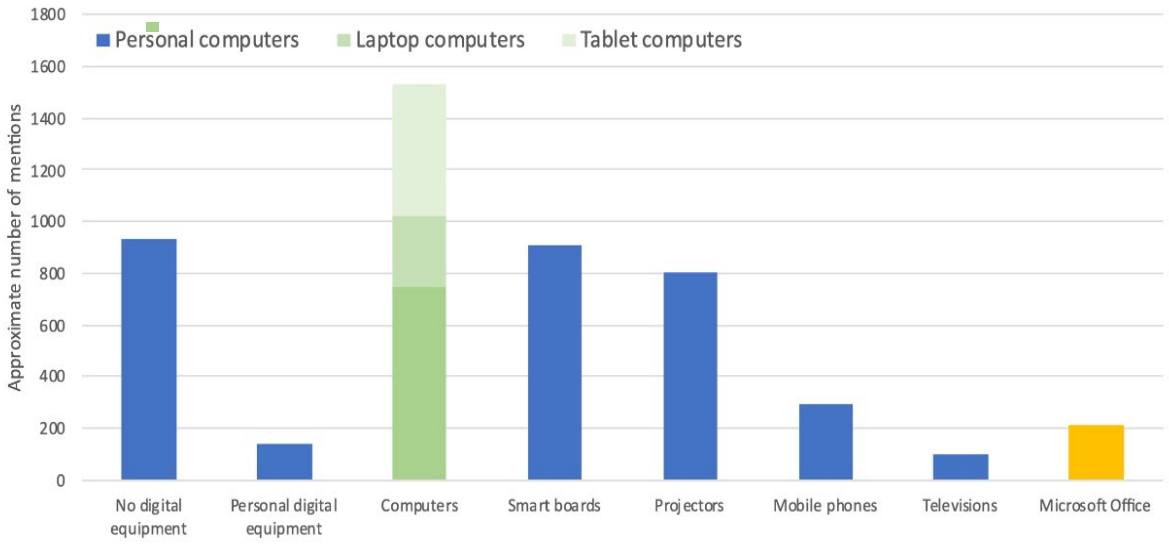

Figure 19. Digital equipment mentioned by respondents

In summary, computers were the most common digital technology (hardware) in classrooms, followed by smart boards/ projectors. It is worth noting that, while in the correct hands computers can be digital technologies that open student learning to wider possibilities, smart boards in the wrong hands can reinforce the traditional but frequently criticized delivery/ banking/ transmission model of education (transmitting knowledge from teacher to student). However, most importantly, more than 900 respondents (around a quarter of all respondents) noted that they had no digital technologies in their schools or classrooms. Two final comments: first, the number of televisions mentioned is unexpected low, although that might be because many might not consider a television to be a digital technology; second, Microsoft Office was the computer software (rather than hardware) mentioned most frequently (but only by a relatively small number of respondents).

"The only equipment that is there, besides the few computers are projectors that were installed in some of the lecture rooms (4 out of 7). At the moment only one lecture room has a functioning projector, the other three are no longer working or the settings were disturbed. There's also a mobile projector which of late hasn't been functioning as it needs to be serviced." *(South Africa)*

"All lessons were done through google meets with effective results, we hosted private e-meetings as well to prepare students for exams, we used digital platforms for revision and evaluation like padlets and we even hosted competitions online to make students understand that life doesn't stop, education can never stop even during COVID19 era." *(Greece)*

"Teachers have to use their personal laptops and mobile phones for work related purposes. These devices are not funded nor co-funded by the school. There is Wi-Fi in our classrooms at school, but we are often required to work after school and in the evenings to get through our unmanageable workload and preparation. Personal/home Wi-Fi needs to be used. We do not receive any subsidy from the school/cannot claim back these expenses. The school does not equip us with the required tools and resources for a digital era." *(South Africa)*

5.4 Opportunities to use ICT

Respondents were asked to confirm (using a Likert scale ranging from 'strongly agree' to 'strongly disagree') whether they had opportunities to use ICT or artificial intelligence in the workplace. As shown in Table 17 and

Figure 20, around half of respondents agreed ('strongly agreed' n=573, ~15%; 'agreed' n=1434, ~37%; total agreeing n=2007, ~52%); just under a quarter disagreed ('strongly disagreed' n=389, ~10%; 'disagreed' n=405, ~11%; total disagreeing n=2007, ~21%); and around a quarter either gave a neutral or no response ('neutral' n=902, ~24%; 'didn't answer' n=133, ~3%; total n=1035, ~27%).

> *"Our school principal has really tried to bring engineers to check on the computer system several time, maybe the fact that the system has been installed for long (i.e., is now old) and needs to be changed."*
>
> *(Nigeria)*

> *"We try to be as effective as we can. Curricula limits us. We try to implement the use of online classroom, interactive tasks, clips, quizzes, etc. in our daily routine. In the pandemic time we combined online classroom. In the pandemic time we combined online classroom with zoom conferences and other already mentioned ICT. Some pupils preferred audio or even video records of lessons."*
>
> *(Slovenia)*

Table 17. I have opportunities to use ICT and/or artificial intelligence in the workplace

Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Didn't answer
573	1434	902	405	389	133

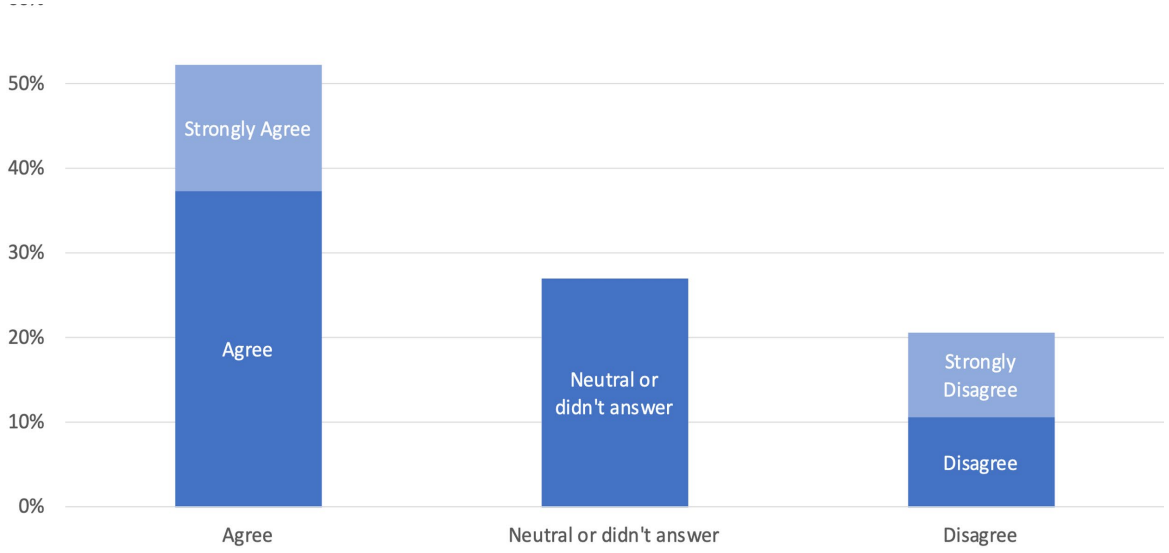

Figure 20. I have opportunities to use ICT and/or artificial intelligence in the workplace

5.5 Views on how ICT might help education

Respondents were given twelve options from which to choose areas in education that they believed ICT might help improve and were able to choose more than one option. Table 18 and Figure 21 show the number of respondents who chose each option, with Figure 21 showing this as a percentage of all respondents. In summary, around half of respondents chose each of teacher professional development (n= 2008, ~52%), curriculum development and delivery (n= 2002, ~52%), online education (n= 1931, ~50%), development and adaptation of the learning materials (including for special needs education) (n= 1834, ~48%), assessment of learning results, including self-assessment (n= 1790, ~47%); while around two in five chose 'support and consultations for teachers', 'students and their parents' (n= 1627, ~42%), 'school administration and management' (n= 1591, ~41%), 'assessment of teachers' professional competencies' (n= 1479, ~39%), 'accessibility in education' (n= 1454, ~38%), 'networking' (n= 1450, ~38%), and 'development, coordination and management of learning competencies' (n= 1443, ~38%); while finally around a quarter chose 'human-centered learning' (n= 921, ~24%).

> *"Our students engage in projects which enhance their digital skills. They are ready to get the new approaches and challenges. They're eager to share ideas. They create videos where they show their digital skills and motivation."* (Georgia)

Table 18. Areas in education in which ICT can improve effectiveness of the teaching/ learning process

Areas of education	Respondents
Teacher professional development	2008
Curriculum development and delivery	2002
Online education	1931
Development and adaptation of the learning materials (including for SEN)	1834
Assessment of the learning results, including self-assessment	1790
Support and consultations for teachers, students, and their parents	1627
School administration and management	1591
Assessment of the teachers' professional competencies	1479
Accessibility in education	1454
Networking	1450
Development, coordination, and management of learning competencies	1443
Human-centered learning	921

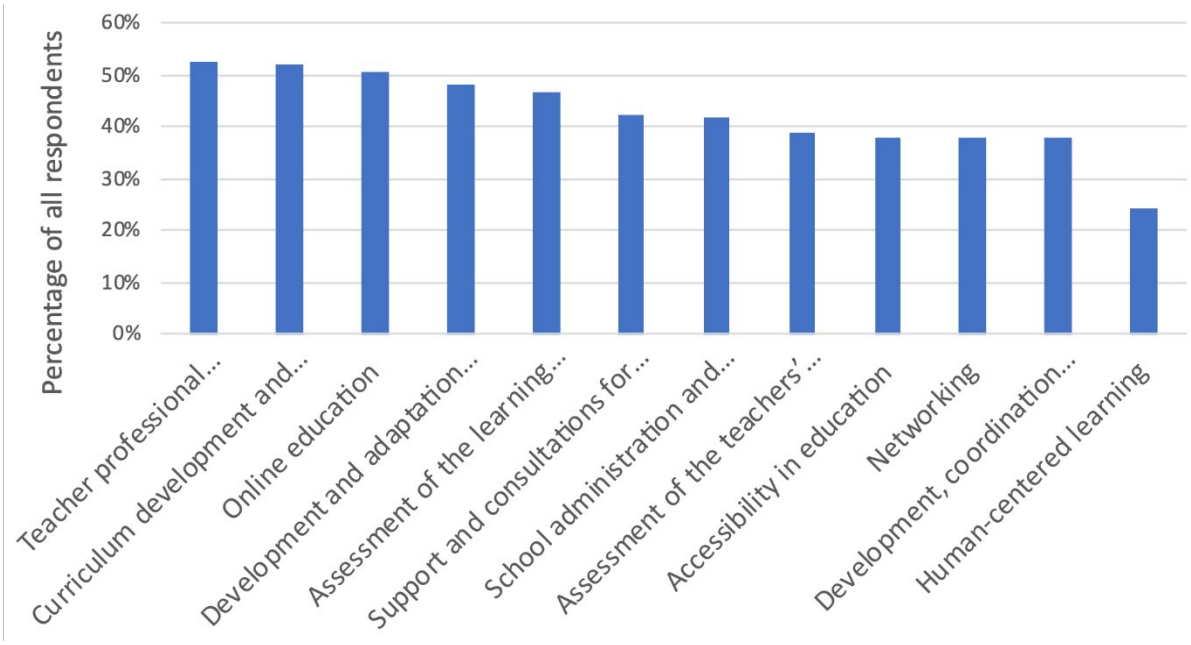

Figure 21. Areas in education in which ICT can improve effectiveness of the teaching/learning process

Given that respondents chose each possible answer to a broadly similar extent (almost all options were chosen by between 30% and 50% of respondents), further research is necessary to understand exactly what they meant by their choices. For example, is it true to

say that all of the options are broadly equally open to improvements by the use of ICT? And, if so, how? It is also possible that respondents had widely different understandings of the options (for example, what exactly is understood by 'human-centred learning'?).

5.6 Views on how artificial intelligence might help education

Respondents were given a list of possibilities that artificial intelligence (AI) might improve in education. As shown in Table 19 and Figure 22, around half of respondents suggested that AI might improve each of 'curriculum development and delivery' (n=2078, ~54%), 'teacher professional development' (n=2074, ~54%), 'online education' (n=2008, ~52%), 'adaptation' (n=1904, ~50%), 'assessment' (n=1853, ~48%), 'support for teachers' (n=1684, ~44%), and 'school administration' (n=1636, ~43%); while around a third chose 'teacher assessment' (n=1531, ~40%), 'accessibility' (n=1502, ~39%), 'networking' (n=1492, ~39%), 'development of learning competencies' (n=1485, ~39%); and finally one quarter chose 'human-centered learning' (n=952, ~25%).

Table 19. Artificial Intelligence can improve…

AI can improve…	Respondents
…curriculum development and delivery	2078
…teacher professional development	2074
…online education	2008
…adaptation	1904
…assessment	1853
…support for teachers	1684
…school administration	1636
…teacher assessment	1531
…accessibility	1502
…networking	1492
…development of learning competencies	1485
…human-centered learning	952

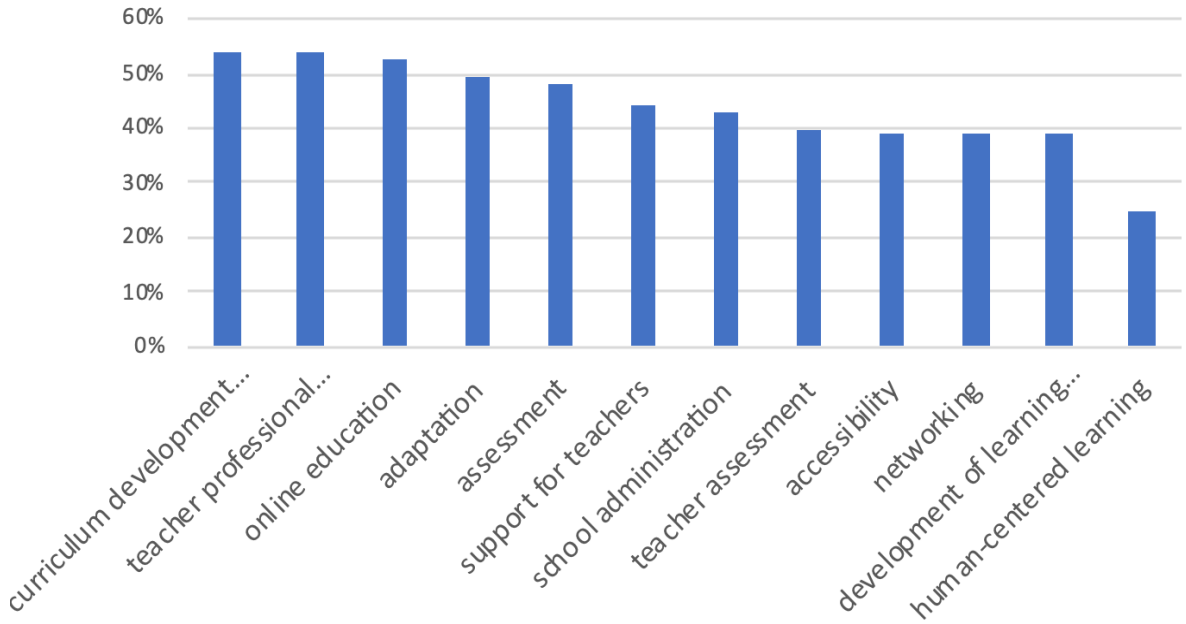

Figure 22. Artificial Intelligence can improve…

As in Section 0, respondents again chose each possible answer to a broadly similar extent (almost all options were chosen by between 30% and 50% of respondents). Accordingly, again further research is necessary to understand exactly what they meant by their choices – especially given that most people have little experience of the application of AI in education, and so understand little about how AI functions, its potential, what it might achieve, its dangers, or where or how it might productively be applied. It is also possible that respondents had widely different understandings of the options. What does remain clear is the need for teachers to be provided with high quality professional development in both the human and technological dimensions of artificial intelligence, to empower them both to make good choices and to make good use of AI in education.

5.7 Use of ICT

Respondents were asked to choose how they mainly used their ICT in their institutions. Around a half of respondents chose each of 'visualization' (e.g., projection of computer output on a screen, n=2082, ~54%) and 'for assessment' (n=1793, ~47%), while around a third chose each of 'for adjusting for student needs' (n=1456, ~38%), 'for monitoring enrollment' (n=1319, ~34%), and 'for timely feedback' (n=1234, ~32%).

Table 20. Use of ICT

Use	Respondents
For visualization	2082
For assessment	1793
For adjustment for student needs	1456
For monitoring enrollment	1319
For timely feedback	1234

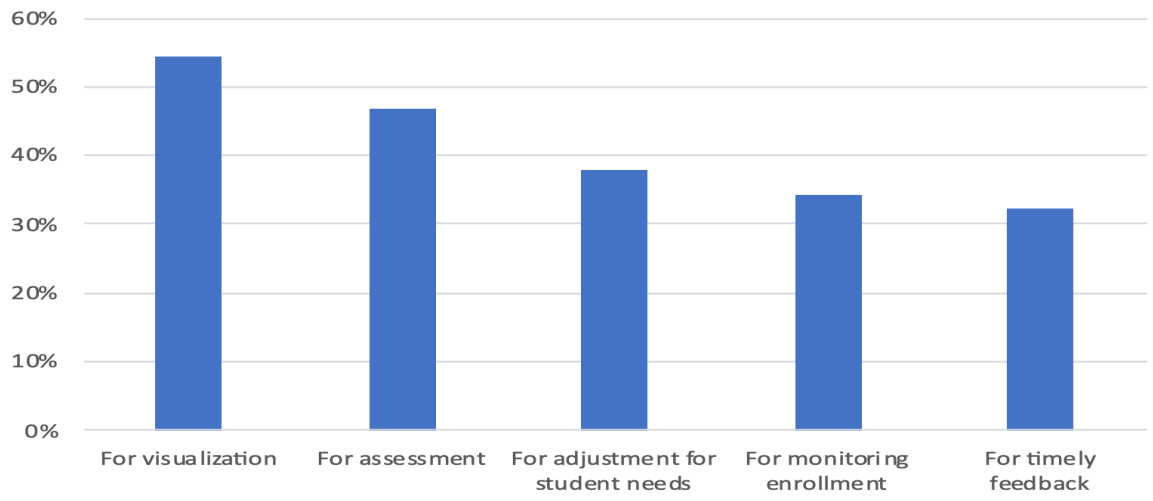

Figure 23. Use of ICT

As noted earlier, the use of visualization technologies such as smart boards and projectors reinforces a frequently criticized knowledge transmission model of education. However, the wide use of ICT to support individual student needs and for timely feedback (although, both of these options cover a wide range of possibilities) is particularly encouraging. Monitoring enrollment is the use of ICT to support an educational administrative task rather than for teaching or learning.

5.8 Promoting/supporting the use of ICT in teaching and learning

Respondents were asked about what their institutions were doing to promote/support the use of ICT in teaching and learning. As shown in Table 21 and Figure 24, they were given four choices. Around half of respondents chose 'training/retraining of teachers' (n=1948, ~51%), two in five chose 'ICT integration into curriculum' (n=1600, ~42%), around a third chose 'purchase of special equipment' (n=1237, ~32%), and one in six chose 'other' (n=624, ~16%).

Examples of 'other' are: 'nothing' (which represented ~50% of the 'other' responses, i.e., ~8% of the total respondents), 'conducting workshops', 'introducing coding and robotics', and 'encouraging teachers to make use of their own devices'.

Table 21. What is your school doing to ensure that ICT are used in teaching and learning?

Activity	Respondents
Training/retraining of teachers	1948
ICT integration into the curriculum	1600
Purchase of special equipment	1237
Other	624

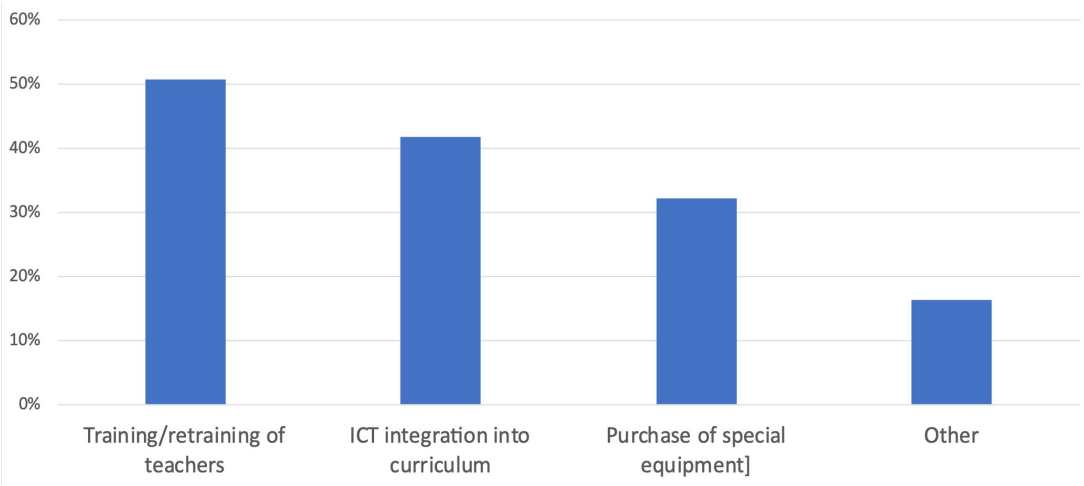

Figure 24. What is your school doing to ensure that ICT are used in teaching and learning?

It is especially encouraging to note the emphasis on training for teachers, as it has long been known that the best technology in the world will not be effective if teachers (because they have not been properly trained) are unable to use those technologies effectively in classrooms. It is similarly encouraging to note that the integration of ICT into the curriculum is increasingly becoming 'normal', although with only ~40% choosing this option there clearly remains some way to go.

"We need to conduct workshops on how to use ICT into the teaching and learning. The challenge being the lack of computers to be used by both teachers and learners." (South Africa)

The word cloud in Figure 25 illustrates the topics suggested by respondents that might usefully be included in the professional development of teachers.

Figure 25. Some topics suggested for professional development for teachers

5.9 Activities to develop student digital literacy skills

Respondents were asked how ICT and advanced ICT were integrated into teaching and learning in their institution. As shown in Table 22 and Figure 26, almost two thirds of respondents chose 'ICT as a subject' (n=2317, ~60%), while around a half chose 'none' (n=1852, ~48%), which unfortunately does not compute (i.e., some respondents chose both 'ICT as a subject' and 'none'). Meanwhile, two in five chose 'ICT Clubs and extra-curricular activities' (n=1564, ~41%), a third chose 'ICT and AI integrated in other subjects' (n=1285, ~33%), while only one in a hundred chose 'robotics and other AI technologies as subject (n=53, ~1%).

Areas of education	Respondents
ICT as a subject	2317
ICT Clubs and extra-curricular activities	1564
ICT and AI integrated in other subjects	1285
Robotics and other AI technologies as subject	53
None	1852

Table 22. Activities to develop student digital literacy skills

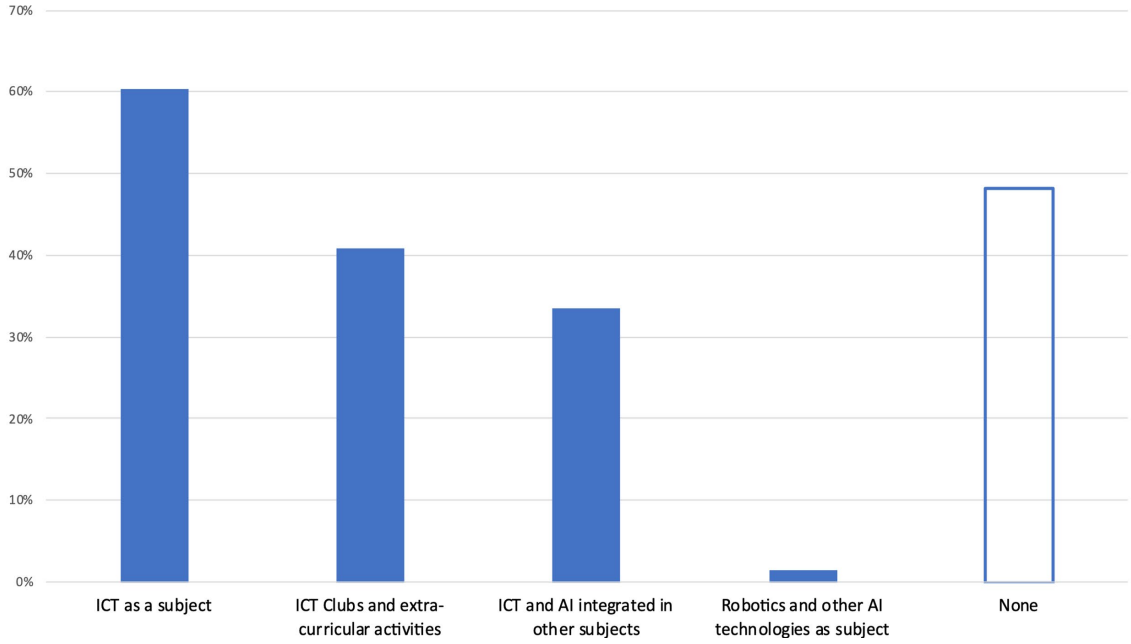

Figure 26. Activities to develop student digital literacy skills

These responses are notable for several reasons. First, leaving aside the contradictory overlap, just over half of respondents noted that ICT was taught as a subject in their institution, while the remainder noted that ICT was not taught at all. This encouragingly suggests that ICT is beginning to be seen as an important school subject, but there remains some way to go. Meanwhile, only around 30% noted that ICT and AI were integrated in other subjects, which is something that is frequently argued as being particularly important for AI, as AI has the potential to impact on all subjects, so again there is some way to go. Finally, only a very small number of respondents (~2%) noted that AI and/or robotics was taught as a subject.

> "There are projects on medical science, cyber security. Which are implemented by chemistry and English teachers."
>
> (Georgia)

"We do Coding, celebrate Internet Safety Days, we participate in e-twinning and utilize a lot of websites to enrich our pupils' experiences." (Malta)

"We are partnering with local Library where our learners are encouraged to visit weekends and after school in order to do research for projects and get opportunities to learn more about the use of ICT to broaden and enhance knowledge."
(South Africa)

"With the pandemic, digital literacy cannot be taught through traditional means. The trend to access to learning has been shifted to an online mode. Online learners should be able to explore the digital resources on their own, which emphasizes the real-world applications of this vital skill. A learner must use online tools to solve a common problem. This also involves Internet netiquette. For example, they use social media to broaden their understanding and interact with peers." (Mauritius)

6. Challenges

6.1 General challenges

Respondents were asked about what challenges they experienced in using ICT for teaching and learning. As shown in Table 23 and Figure 27, three quarters for respondents identified 'lack of equipment (n=2850, ~74%), while two in five chose 'connectivity challenges' (n=1560, ~41%), around one in five chose 'lack of energy supply (n=680, ~18%), one in ten chose 'attitude of learners/teachers' (n=321, ~8%), while only three in a hundred chose 'skills gap in teache r competencies' (n=120, ~3%).

Table 23. Challenges

Challenges	Respondents
Lack of equipment	2850
Connectivity challenges	1560
Lack of energy supply	680
Attitude of learners/teachers	321
Skills gap in teacher competencies	120

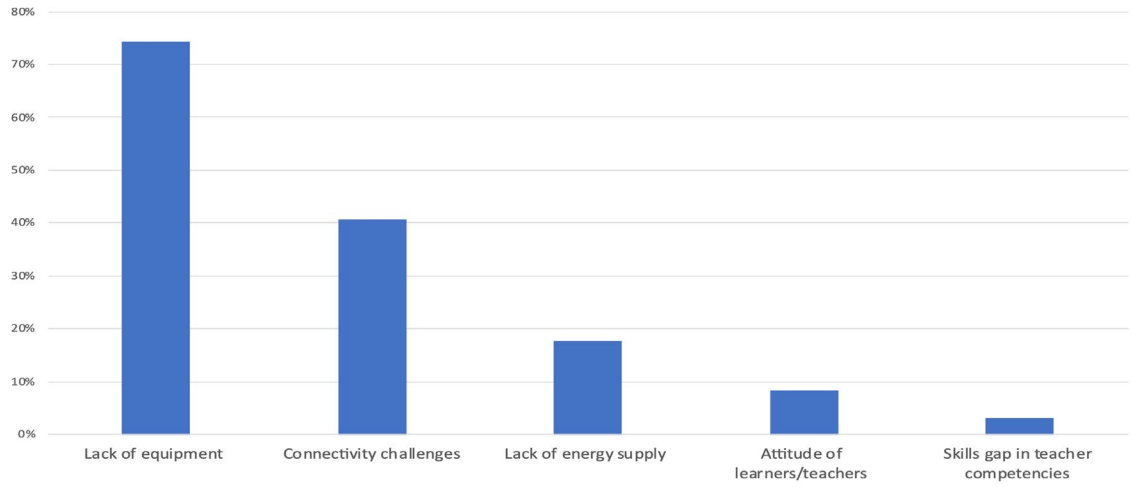

Figure 27. Challenges

The fact that around three quarters of respondents identified 'lack of equipment' while just under half identified 'connectivity challenges' supports the widely held belief that equipment and connectivity are the most common challenges that prevent educators leveraging in education the full potential of ICT. On the other hand, it was encouraging to note that attitudes and skills were thought to be the least important challenges – however, the possibility of self -

selection bias should be acknowledged: the teachers who chose to be respondents in a survey about ICT and education are likely to be predisposed to, and more experienced in, the application of ICT in educational contexts. It also raises the question that, if teachers have few skills gaps, why are so many institutions prioritising the training of teachers (see Section 5.8, Table 21 and Figure 24) and why did so many respondents note that more training was needed (see Section 6.3, Table 25 and Figure 29 below)?

> "My school curriculum has activities for the development of student's digital literacy skills, although depends on the teacher skills to do so." (Brazil)

> "An interactive board was purchased but none of the lecturers, including the IT guys had an idea of how it is used or how to take care of it. I had to ask for it to be pulled down and safely kept until all staff members were trained on the use of such a board. The IT department doesn't seem to have any skills or knowledge to solve the issues highlighted." (South Africa)

6.2 Security on the Internet

Respondents were also asked about how safe they feel on the Internet. Around two in five chose each of "I feel that technologies and Internet are absolutely secure" (n=1482, ~40%) and "Sometimes I prefer to have additional mechanisms to protect data privacy" (n=1578, ~43%), while under a fifth of respondents chose the third option "I try to avoid using my personal data and content on the Internet because it is not safe" (n=616, ~17%).

Table 24. Security on the Internet

Statement	Respondents
I feel that technologies and Internet are absolutely secure	1482
Sometimes I prefer to have additional mechanisms to protect data privacy	1578
I try to avoid using my personal data and content on the Internet because it is not safe	616
No response given	160

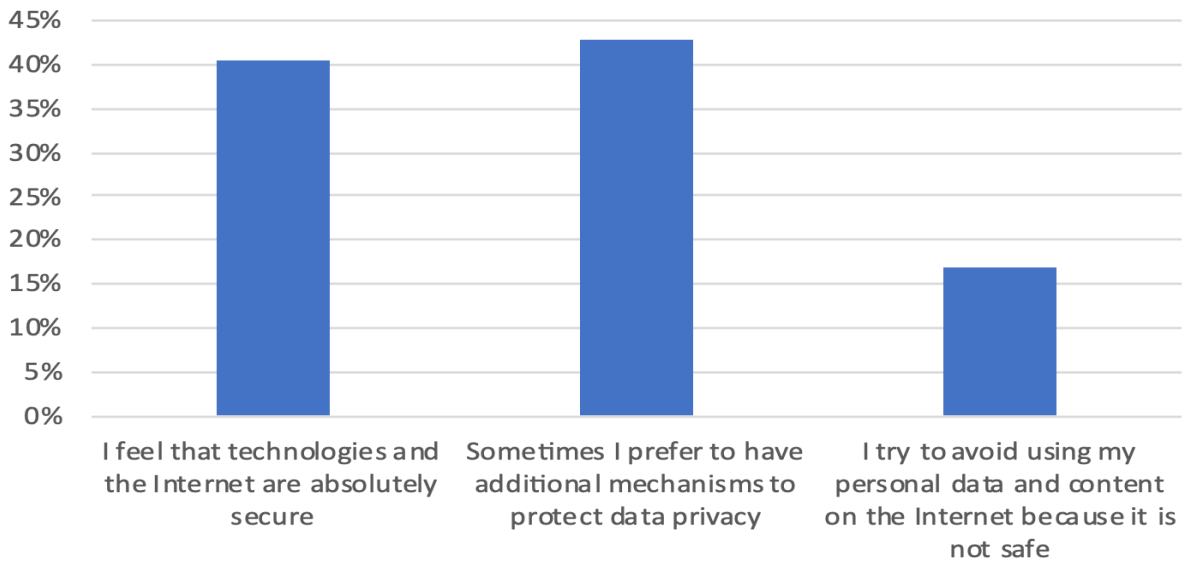

Figure 28. Security on the Internet (n=3676)

In summary, while around half of respondents noted that they felt safe using technologies such as the Internet, a similar number either thought there needed to be additional mechanisms to protect data privacy or that the Internet was unsafe. These attitudes need to be taken for what they are. It is possible that many people are unaware of the dangers of sharing data online, on the other hand, many people may be overly cautious. Again, further research would be welcome, together with more information for teachers on how the use of the Internet and other digital technologies can be made safer.

6.3 Support needed from the institution and/or government

Respondents were asked about what support they needed from the institution and/or government. As shown in Table 25 and

Figure 29, they were given six choices. Almost ninety percent chose each of 'providing software/hardware' (n=3308, ~86%) and 'training' (n=3224, ~84%); while around two thirds chose 'funding and investment' (n=2507, ~65%), around half chose each of 'access to the Internet' (n=1798, ~47%) and 'maintenance and technical support' (n=1513, ~39%); and around a third chose 'providing digital learning resources' (n=1238, ~32%).

> "I think I have enough help from my school. A good fact is having many experts of ICT and AI in my team, so they can help me solve daily doubts, making me improve my abilities. (Spain)

"Governments can create incentives for R&D on innovative uses of ICT in education, including for instance making software and hardware more affordable and relevant for students. Rigorous evaluation studies on ICT effectiveness can provide evidence -based justification for transforming the education sector to embrace ICT." (Mauritius)

"The motivation from the directors of the school and also the Minister of education for the changes that have to happen in the mindset of the teachers. If the directors and the Ministers do not believe in these changes, it is very difficult to change the mindset of the teachers to make use of the advanced ICT and IA in their classrooms." (Aruba)

"I hope the government presents us with greater opportunities, including improved quality and quantity of teacher training concerning digital technologies , support for the digitalisation of teaching methods and pedagogies and the provision of infrastructure required for providing inclusive and resilient remote learning." (Japan)

Table 25. Support needed from the institution and/or government

Areas of education	Respondents
Providing software/hardware	3308
Training	3224
Funding and investment	2507
Access to the Internet	1798
Maintenance and technical support	1513
Providing digital learning resources	1238

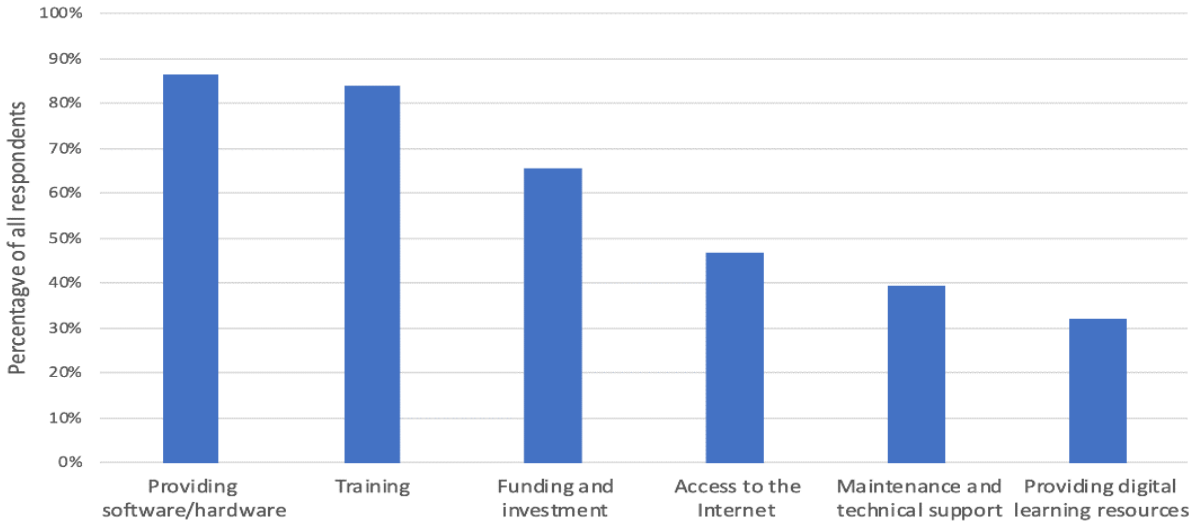

Figure 29. Support needed from the institution and/or government

The various types of support that respondents believed that they need from their institution or government reinforce most earlier findings (e.g., the need for more equipment, better access to the Internet and appropriate technical support). However, as noted, the fact that more than 80% called for more training slightly contradicts Section 0, where skill gaps was not seen as an important issue (see Table 23 and Figure 27).

"Governments can create incentives for R&Don innovative uses of ICT in education, including for instance making software and hardware more affordable and relevant for students. Rigorous evaluation studies on ICT effectiveness can provide evidence-based justification for transforming the education sector to embrace ICT." (Mauritius)

7. Summary of the open question responses

7.1 Teacher use of ICT

- Teachers reported that ICT has a role in all aspects of teaching and learning.
- Teachers are actively using ICT and technologies in classroom instruction (synchronously and asynchronously) and in assessment of student performance.
- Most teachers use basic ICT tools (such as standard office tools or learning management systems); while a few use complex tools (such as AI tools, learning analytics, or apps for learners with special needs).
- Many teachers reported that they used learning materials/resources for visualizations (including projecting onto screens), student assessment, adjusting learning materials to make them appropriate for particular student needs, monitoring student enrollment, and providing timely feedback.
- Some digital technologies enable networking between students and across schools. For example, some teachers and students communicate by Zoom, email and other technologies. Most of these communication tools set up during the COVID-19 pandemic are still in use.
- While most respondents did not believe that there were teacher skill gaps, they still identified a need to be trained on how best to use ICT.
- Many respondents undertook self-training by using freely available online videos (which first took off during the COVID-19 pandemic). Most of the resources are introductory courses on the Internet, including some provided as part of the UNESCO Global Teacher Campus under the Global Education Coalition.
- Very few schools or ministries have organized in-service training on the use of ICT in education (a few countries, such Mauritius, have organized professional training on ICT in education, most during school holidays; while some teacher training college's included ICT as part of the teacher education curriculum). There is little evidence that there is any available training for teachers on the application of AI in education.
- Some respondents expressed the need for more partnerships with private technology companies involved in ICT in education, while there is also concern that this represents the commercialisation of education by stealth.

7.2 How the use of advanced ICT and AI can contribute to teaching

- ICT tools can if used properly facilitate learner autonomy, stimulate interest in the subject, and address the diversity of student educational needs.
- ICT tools can facilitate the adaptation of teaching materials for students with different educational needs.
- ICT tools can simplify and enhance the quality of assessment, and the tracking of student performance over time.
- There is concern that ICTs might increase the widening digital divide.

7.3 What training around the use of ICT would be welcome?

- Respondents reported the following topics for which many would like training:
    - Assessment.
    - Climate change awareness
    - Coding and Robotics.
    - Computer programmes (such as Excel and Corel Draw).
    - Course design and classroom management.
    - Cybersecurity
    - Education for sustainable development
    - Ethics of using artificial intelligence.
    - Global Citizenship and digital citizenship education
    - ICT and AI technologies.
    - Innovative pedagogies using ICT.
    - Learning management systems.
    - Lesson plans.
    - Media literacy (e.g., disinformation/misinformation)
    - School administration.
    - Specific programmes that pique student interest.
    - Teaching and pedagogy.

- In addition, there are concerns that some training is too theoretical with little practical application in the classroom.
- There is also concern that teachers might be overwhelmed by the need to underta ke training in additional to their already heavy workload. Given their meagre remuneration and the cost of the Internet in most developing countries, the opportunity cost of undertaking professional development in ICT and AI might be too high.

7.4 School environment, policies and enabling factors to use ICT and AI technologies

- Most ICT training efforts are ad hoc and undertaken by individual teachers with little institutional support.
- Policies on cybersecurity and privacy of learner information remain weak or, in some countries, non-existent causing anxiety about safety online.
- Teachers are unaware of the potential and challenges of AI for education, while incentives to use applications of AI in education remain low, especially for teachers.
- Very little investment has been made into ICT and AI for education. Where it does exist, most of the investment is for hardware, with little or no investment in training or support and little budget for maintenance.
- The deployment of ICT and AI technologies is piecemeal; none of the respondents described any national level rollouts of ICT or AI in education.
- Policy guidelines on ICT in education are non-existent in most countries, with only a few teachers mentioning some recommendations from their countries, most of which are impractical given the overloaded curriculum, lack of facilities and capacity needs .

8. Recommendations to address the technical and educational challenges, capacities and readiness of schools to use the potential of digital innovations and AI[1]

Policy -makers, school leaders and/or other stakeholders should:

1. Agree and adopt a system -wide vision for the application of ICT/AI in educational settings, defining strategic objectives to ensure that it genuinely enhances learning and student development, while being inclusive and equitable.

It is essential that ICT and advanced ICTs such as AI are developed and used strategically in educational contexts, addressing issues of inclusivity and equity (e.g., between nation states, genders and for students with disabilities), with the emphasis always on using the ICTs to support student learning and self -actualisation through empowering teachers.

2. Support the pilot testing, monitoring and evaluation against measurable targets of the application of ICT/AI in education, covering efficacy and impact, diversity, and equity, to build an evidence base for future development.

At present, there is insufficient independent research to support the wide -scale uptake of many ICTs in education (almost all the evidence is small -scale, undertaken by the develope rs, or anecdotal). Governments should facilitate more robust research before ICT, especially advanced ICTs such as artificial intelligence, are implemented in schools.

[1] The recommendations presented in this document are also informed by other UNESCO publications, including: Beijing Consensus on Artificial Intelligence and Education (2019), Artificial Intelligence and Education. Guidance for Policy -makers . (2022); and Guidelines for ICT in Education Policies and Masterplans (2022).

3. Adopt a humanistic approach as an overarching principle towards protecting human rights and equipping teachers and students with the values and skills needed for sustainable development.

We need to recognise that technologies must only be developed and implemented if they will genuinely serve human needs, address human rights, and be within the constraints of sustainable development.

4. Ensure that people remain at the core of education as an implicit part of the ICT/AI design.

Technologies must be designed to support people, rather than expecting people to change to address the needs of techno logy. In education, this means prioritising the role of teachers over the role of ICTS.

5. Ensure the equitable and inclusive use of ICT/AI in education , by ensuring the relevant infrastructure (e.g., power, Internet, and technical support) is widely availab le, robust and affordable.

It has been long understood that, with education increasingly depending on ICT, the gap between those in areas with appropriate infrastructure and those in areas without continues to grow exponentially. These infrastructure gaps fundamentally undermine the human rights of those who are discriminated against, such that serious efforts need to be taken to address them.

6. Ensure that ethical issues raised by the use of ICT/AI in education are both investigated and properly mitigated.

To date, around the world, no universal principles and no regulations exist to address the ethics of ICT applied in educational settings. Accordingly, serious efforts are need to ensure that the introduction and increase of ICT in education does not make things worse.

7. Mobilize interdisciplinary, inter-sectoral and multi-stakeholder expertise to inform policy planning and delivery.

> The issues raised throughout this and the parallel documents are so complex that they cannot be addressed without people from multiple disciplines and with multiple areas of expertise working together. Governments need to facilitate such dialogue.

8. Facilitate open debates on issues related to data privacy and security, leading to the establishment of data protection laws (informed by the EU's GDPR) which make educational data collection and analysis visible, traceable, private, auditable by teachers, students, and parents, and fair.

> Countries outside the EU are encouraged to carefully consider the EU's GDPR, to ascertain which elements could usefully and effectively address local contexts. A key issue is that data is transnational, such that if data privacy and security is to be assured, we need data protection laws and international cooperation.

9. Protect the rights of teachers and the value of their practices. Conduct consultations with educators to ensure their rights are protected and their opinions are properly addressed when deploying ICT/AI technologies.

> It is well-understood that the most important resources in any school are the teachers and their experience and expertise. Accordingly, we need to guard against claims that teachers are either replaceable by technology or might become facilitators rather than teachers, and we must ensure that teachers participate in decision-making about ICTs at the highest level.

10. Define the skill sets that teachers need in order to evaluate and deploy ICT/AI tools in their design and organization of learning activities and in their own professional development.

> ICTs do make new approaches to pedagogy possible, but teachers are not able to take advantage of the opportunities if they do have the appropriate skills, both to decide which ICTs are appropriate for their teaching, and how best to use them.

11. Ensure that teachers are properly supported (by means of both funding and professional development) so that they are best able to both understand and make best use of ICT/AI technologies in their classrooms

Teachers need opportunities to develop their skills and to experiment with implemen ting ICTs in their classrooms, all without further overburdening them, and recognising and rewarding their increased skill sets.

12. Provide evidence -based guidance that allows teachers to navigate the private - sector offerings of ICT/AI technologies and devel op criteria to help them make informed decisions on what tools are most suitable for their needs.

The use of ICT in education remains a 'cottage industry', with many schools either experimenting with multiple different ICTs or implementing a set of tools promoted by Big Tech. Governments need to provide evidenced -based tools and guidance to enable teachers easily to cut through the hyperbole in order to select and implement effectively ICT that will genuinely support their students while not undermining the teacher/student human relationship.

9. Conclusion

9.1 Access to and use of AI and digital technologies

Access to technologies remains a key challenge across the globe, with around a quarter of respondents noting that they had no digital technologies in their schools or classrooms. Lack of electricity, devices and Internet connectivity exacerbates already existing learning gaps and leads to lost opportunities to use digital technologies and AI in the classroom. Most schools that have good connectivity are in urban areas (while teachers in rural areas more frequently depend on mobile phones for their Internet connectivity). There is need for concerted efforts aimed with a priority for the most marginalized and the disadvantaged to bridge inequalities. Further research is needed to account for geographical, regional and in country (rural/urban) variation in access to the Internet. In any case, teachers are often asked to bring their own devices to school due to the lack of equipment in the school. In some circumstances, students are asked to bring their own devices, which many cannot afford. The most common software mentioned was the Microsoft Office suite, and that was only mentioned by a few respondents.

9.2 Teacher competencies in use of advanced ICTs and AI in Education

Competencies in the use of advanced ICTs in education remains low, while knowledge and understanding of the potential and challenges of AI are extremely low (teachers like most citizens typically are only aware of what they read in the media, rather than from any direct personal experience). This is perhaps why opportunities afforded by ICT technologies and the innovative pedagogies that they can make possible are underused. In fact, where ICT technologies are used in the classroom, they are mostly not innovative but are simple tasks such as projecting presentations or administrative tasks (what has been called 'perpetuating poor pedagogic practices').

9.3 Teacher professional development in ICT and digital technologies

There is a general desire for teachers to be provided appropriate training in ICT and AI as part of professional development programmes. Stronger efforts should be focused on a national level to support pre-service and in-service teachers. In particular, national level policies and support systems aimed at embedding ICT and AI in teacher training curriculum and continual professional development for in-service teachers.

9.4 School environment, policies and enabling factors to use ICT and AI technologies

The key focus of ICT and AI in education should be less on the technologies themselves and more on the goals and purposes for education. Major realignments and rethinking about pedagogical innovations and the role of technologies are needed to accelerate transformation. In this sense therefore, there is need to avoid techno-solutionism, the belief that technology can solve social problems, and instead to focus on the opportunity that technology offers in transforming the education system while examining structural issues and potential negative impacts. To this end, critical enabling policies and investments need to be put in place at different levels to unlock the potential of technologies and AI in education.

9.5 Funding, training, and support

Schools frequently have very limited budgets, which leads to a lack of training and a lack of equipment, which is exacerbated by the commonly inadequate infrastructure (e.g., to power and access to the Internet). Similarly, teachers have a lack in the competencies needed for the use of digital devices, artificial intelligence, and innovative pedagogies. This poses a challenge to the adoption of ICT. In a few schools, intermittent failures in electric supply were identified as a key challenge. However, in a few schools (around 5%), facilities are sufficient for each student. Financial constraints were noted as the main cause of the lack of facilities in schools. Most teachers expressed desire to use digital technologies but were hindered by either unavailability of appropriate technologies or deficiencies in skills to use them. Some teachers expressed frustration at the typical device to pupil ratios.

9.6 The use of ICT and AI

In some schools, the few computers that are available are only for administrative use rather than pedagogical purposes. In most schools, ICT equipment is only available for specific ICT lessons, rather than being for use throughout the curriculum as a tool for teaching and learning. When it is being used to support teaching and learning, it is mostly to project onto smart boards and therefore to support the frequently criticized transmission model of education.

9.7 The teaching of ICT and AI

While ICT is a subject noted by almost two thirds of respondents, there are two issues. First, there is very little emphasis on teaching either the human or technological dimensions of AI. Second, the potential of teaching ICT across the curriculum (given that ICT and AI affect all aspects of modern life) is only taken up by around a third of respondents' institutions. Finally,

it is encouraging to note that more than a third of institutions provide extracurricular opportunities for students to learn about ICT, which is something that perhaps ought to be encouraged more.