



'creating a level playing field'

An Assessment of Digital Literacy Skills Among Secondary School Teachers Using the Digcomp Tool

POTRAZ - RCZ RESEARCH REPORT 2024



Israel Mbekezeli Dabengwa¹, Sibonile Moyo¹, Tinashe Byron Gashirai¹, Daga Makaza¹, Paul Makoni¹, Notice Pasipamire¹, Goodwill Kudakwashe Chademana², Mafoti Mufudzi², Dzika-mayi Mandaza² and Stonard Mapfumo²

1. National University of Science and Technology, Bulawayo Zimbabwe

2. Ministry of Primary and Secondary education, Queen Lozikeyi Dlodlo House, Harare



Research Council of Zimbabwe

Table of Contents

Acronyms	5
Basic Project Information	6
Research Problem	7
Project Objectives	10
Methodology	11
Study Sites	11
Study Population	11
Sampling	11
Selection of Provinces	12
Stratified Sampling/Multi-Stage Purposive Sampling	12
Data Collection	12
Data Management and Analysis	14
Ethical Considerations	15
Project Activities	16
Activity 1: Formulation of Project Team	17

Table of Contents

Activity 2: Engaging Key Persons From The Ministry of Primary and Secondary Education (Mopse)	17
Activity 3: Design Of Data Collection Instruments	17
Activity 4: Engagement With Stakeholders	18
Activity 5: Acquisition of Equipment	19
Activity 6: Piloting the Instruments at Northlea High School	19
Activity 7: Evaluating the Results From Northlea High	20
Activity 8: A Second Pilot of the Instruments at Kwekwe High School	20
Activity 9: Mapping the Schools And Data Collection	20
Activity 10: Mid Project Review	21
Activity 11: Planning for the Data Analysis Stage	21
Project Outputs	22
Data Collection Instruments	22
Proposed Research Manuscripts	22
Capacity	23
Capacity Building	23

Table of Contents

Sustainability Strategies	23
Contributions to Capacity Building For Women And Marginalized Groups	24
Policy & Practice	25
Mopse-Specific Recommendations	25
Recommendations to the Ministry of Information, Communication and Technologies	27
Findings	28
Sociodemographics of the Quantitative Data	28
Results of the Digcomp 2.2 Survey	32
Test for Normality	32
Reliability	32
Content Validity	33
Principal Component Analysis	33
An Overview of the Digital Literacy Levels of Secondary School Teachers	34
Mann-Whitney U Test	38

Table of Contents

Qualitative Data Analysis of Interviews and Focus Group Discussions	39
Analysis of the Infrastructure/Observation Checklist	57
Recommendations	79
References	80
Annexes	83
Annex 1: Unpacking Each Dimension of Digcomp 2.2	84
Annex 2: An Example Competency Classification Within Digcomp 2.2	85
Annex 3: Digital Literacy Questionnaire Based on the Digcomp Framework	87
Annex 4: Infrastructure Assessment Tool	103
Annex 5: Interview Guide for Teachers	106
Annex 6: Fgd Interview Guide	107
Annex 7: Feedback from the Participants on Areas to Correct on the Digcomp Tools	108
Annex 8: A Guide to Intepreting the Cronbach Alpha	109

Acronymns

BEAM	Basic Education Assistance Module
CCTV	Closed-Circuit Television
DIGCOMP	Digital Competence Framework For Citizens
FGD	Focus Group Discussions
GOZ	Government Of Zimbabwe
HEXCO	Higher Education Examination Council
ICT	Information and Communications Technology
KII	Key Informant Interviews
MOPSE	Ministry of Primary and Secondary Education
NGOS	Non-Governmental Organisations
RCZ	Research Council Of Zimbabwe
POTRAZ	Postal & Telecommunications Regulatory Authority of Zimbabwe
ZIMSEC	Zimbabwe Schools Examinations Council

Basic Project Information

1. Abstract

“There is no benchmark to measure the digital literacy skills of Zimbabwean secondary school teachers”

The International Telecommunications Union's (ITU) Digital Skills Assessment Guidebook and the Digital Competence Framework for Citizens (DigComp) were used to conduct the national assessment. The study used a mixed methods approach. The latest version of DigComp (2.2) was selected for assessing secondary school teachers. Data was collected from 2,263 conveniently selected secondary school teachers from 150 purposively selected secondary schools spread over 10 provinces in Zimbabwe. The selection included private, public, boarding, day, night, urban, peri-urban, rural schools, boys

only and girls only and mixed sex schools. An ICT facility assessment was conducted at each school, 30 in-depth interviews were held with teachers, and 15 focus group discussions with secondary school learners from each province. Qualitative data was analysed in MaxQDA 24 for themes, while quantitative data was analysed in SPSS 27 for statistical inferences. It was found that the Zimbabwean secondary school teachers have Intermediate digital literacy. Most of the digital skills were on Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Problem Solving and Safety. There were

differences in the way that males and females completed the questionnaire, especially on the Communication and Collaboration dimension. The absence of school learning management systems had led teachers to rely heavily on social media to conduct flipped classroom teaching and learning. However, learners saw the shortage of devices and restrictive school device policies as a challenge to integrate ICTs tools in classroom and when learning is flipped. Policymakers are encouraged to support teachers with adequate ICTs devices, supportive infrastructure and supportive policies that encourage the development of digital competences within this sector.

Key words: Digital Literacy; DigComp 2.2; Information and Data Literacy; Communication and Collaboration; Digital Content Creation; Problem-Solving; Safety; In-service teachers; Secondary education; Zimbabwe

Research Problem

“Digital literacy is “the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship.”

It includes competencies that are variously referred to as computer literacy, Information Communication Technology (ICT) literacy, information literacy, and media literacy” (Global Alliance to Monitor Learning, 2018).

Digital literacy combines different literacies which are requisite for the effective and persistent usage of information.

Although various literacies exist, this study shows more recognition to digital literacy because the research team assumed that the other literacies crop up in the ICTs interactions of the education system and the world outside of it. This thinking aligns correctly as literacy practices and meanings are developed in culturally organized contexts. For instance, it is possible to learn some of the literacies from practice, for enjoyment or as part of a course delivered in formal settings. In the previous century, general literacy (the ability to read and write) had a huge impact on global citizens’ ability to participate in all spheres of life. As such, digital literacy is needed to use various digital technologies, such as smartphones, desktops, laptops and smart devices which use the Internet. Other uses of digital literacy include the ability to identify fake news as well as stop the spread of such news to protect persons whom it harms, protection of data, and dissemination of information using digital tools.

Although there is an increase in the number of Zimbabwean papers that assess online learning, thereby presenting an understanding of the landscape of digital literacy, there is a scarcity of studies that assess the level of digital literacy among secondary school teachers within the education system. A preliminary literature review found Zimbabwean studies assessing digital literacy in primary and secondary schools vis-a-vis the attitudes and perceptions of teachers towards the integration of Information Communication Technologies (ICTs) in the classroom, e.g., studies done by Dhliwayo & Muchemwa (2017), Hove & Dube (2021) and Chigama & Goronga (2022). Additionally, the Baller et al. (2016) provides data on Zimbabwe but does not show the level of digital literacy skills and develops its indicators from opinions of a panel of experts.

A weakness in these studies is the lack of homogeneity in the findings as they have used different instruments in their assessment, most of which do not measure digital literacy, determine where the gaps exist, and cannot forecast future trends.

In addition, measures such as learner's grades vis-à-vis national curricula are also inadequate in determining teacher's levels of digital literacy, as such skills are not centered around the classroom only, but also engage the environment outside of the classroom. Moreover, other determinants such as the teacher's level of digital literacy, the school's access to resources, and socioeconomic background can impede digital literacy. Hence there is an immediate need for a national study to assess teachers' digital literacy within and outside of the confines of the education system to evaluate relationships with other sociodeterminants and compare it with existing international evidence.

In support of the Ministry of Primary and Secondary Education (MoPSE), the Ministry of Information, Communication and Technologies developed the Zimbabwe National Policy for Information and Communications Technology (ICT) (Government of Zimbabwe, 2016) which recognizes that the education system is a lever to accelerate the country's technological use and digital literacy to build critical skill sets for human capital/national development. While the ministries cited above have set platforms for the support of ICT education in schools, there are few studies which report that secondary teachers have inadequate digital literacy skills to impart the skills to secondary learners (Mathende & Beach, 2022). One of the reasons attributed to the lack of digital competences include the fact that most schools, especially those in townships and rural areas are not equipped with ICT tools, and lack resources to buy 4IR necessary tools. (Zimbabwe National Statistics Agency [ZIMSTAT], 2017; The Sunday Mail, 2019)

Therefore, it is questionable whether the high number of school drop-outs and learners who fail to proceed to tertiary education have been adequately prepared for the job market, lifelong learning and everyday life using digital literacy skills developed from the education system. Moreover, the need for digital literacy has been recently brought to the forefront during the coronavirus (COVID-19) outbreak wherein

distance and online learning and flipped models of instruction have been used in primary and secondary education. Before the pandemic, these teaching models were largely practiced in higher and tertiary education and there was no evidence of their application in primary and secondary education.

Therefore, there is a need to assess the level of digital literacy among teachers as the country stirs toward the “decade of action” and fulfilment of the Sustainable Development Goals (SDGs), in particular, indicator 4.2: “percentage of youth/young adults (15-24 years old) who have achieved at least a minimum level of proficiency in digital literacy skills” (United Nations, 2017).

This indicator creates opportunities to assess how school settings lead to the acquisition of digital literacy skills for resource access, utilization, control, and management to fit into the country's national development agenda, lifelong learning and personal development.

Hence, the schoolteacher's level of skills can be seen as a supply to demand factors such as the curricula, tertiary education, and employment opportunities for their products (learners). In this way, a digital literacy skills assessment would point out whether teachers have more advanced abilities than the curriculum demands and or if their skills are sufficient to prepare learners for the present and future employment opportunities.

The beginning point in making any decisions regarding digital literacy among populations is to assess their current state to shed light on

the current needs and gaps. This is essential as decisions regarding teacher's level of digital literacy can impact must be informed from a strong evidence base. Once the current state of digital skills and ability to use technology in both the classroom and outside the classroom is known, then each gap must be matched to an indicative strategy that sustains the skills or fills the gaps related to the goal. This is

an "early detection" device for the learner's future contribution to national development. Take for instance, if teachers currently lack critical skill sets in using a technology, then it is doubtful how they can impart these skills to learners to contribute effectively to lifelong learning, national development, and personal development, as this skills gap will follow learners after completing their schooling.



Project Objectives

“ To assess the level of digital literacy skills among secondary teachers in Zimbabwe in line with DigComp 2.2 guidelines (See Annex 1 and Annex 2).”

The specific objectives of the study are to:



- a. To determine the teacher's level of knowledge of digital literacy on the five dimensions of the DigComp tool;



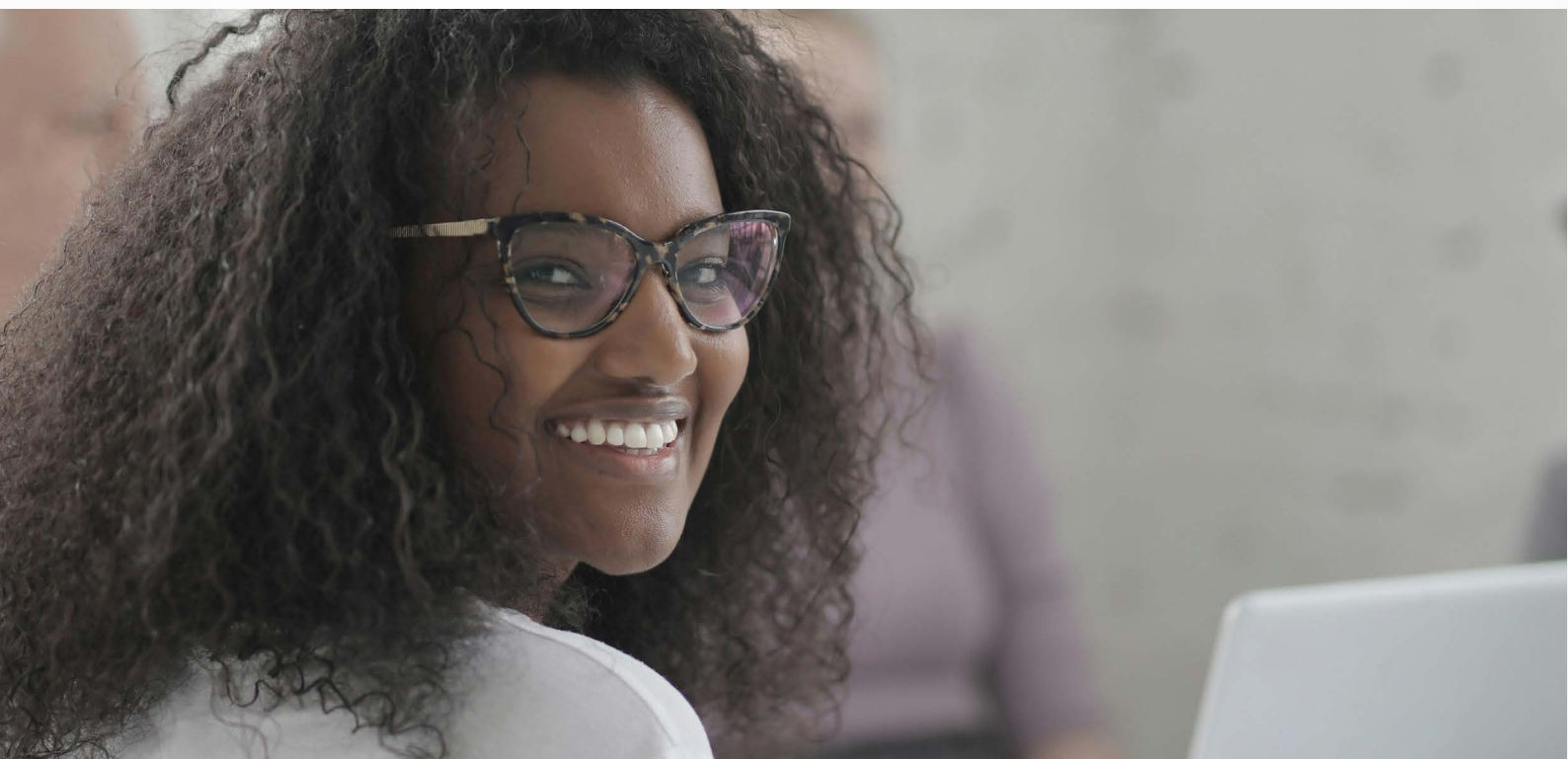
- b. To measure teacher's performance on digital literacy on the five dimensions of the DigComp tool;



- c. To establish teacher's attitudes towards digital literacy skills on the five dimensions of the DigComp tool; and



- d. To identify factors that affect digital skills acquisition in secondary schools.



Methodology

“ The research project used a mixed methods approach to collect data.” It was underpinned by the pragmatism research philosophy which combines both qualitative and qualitative data.

Study Sites

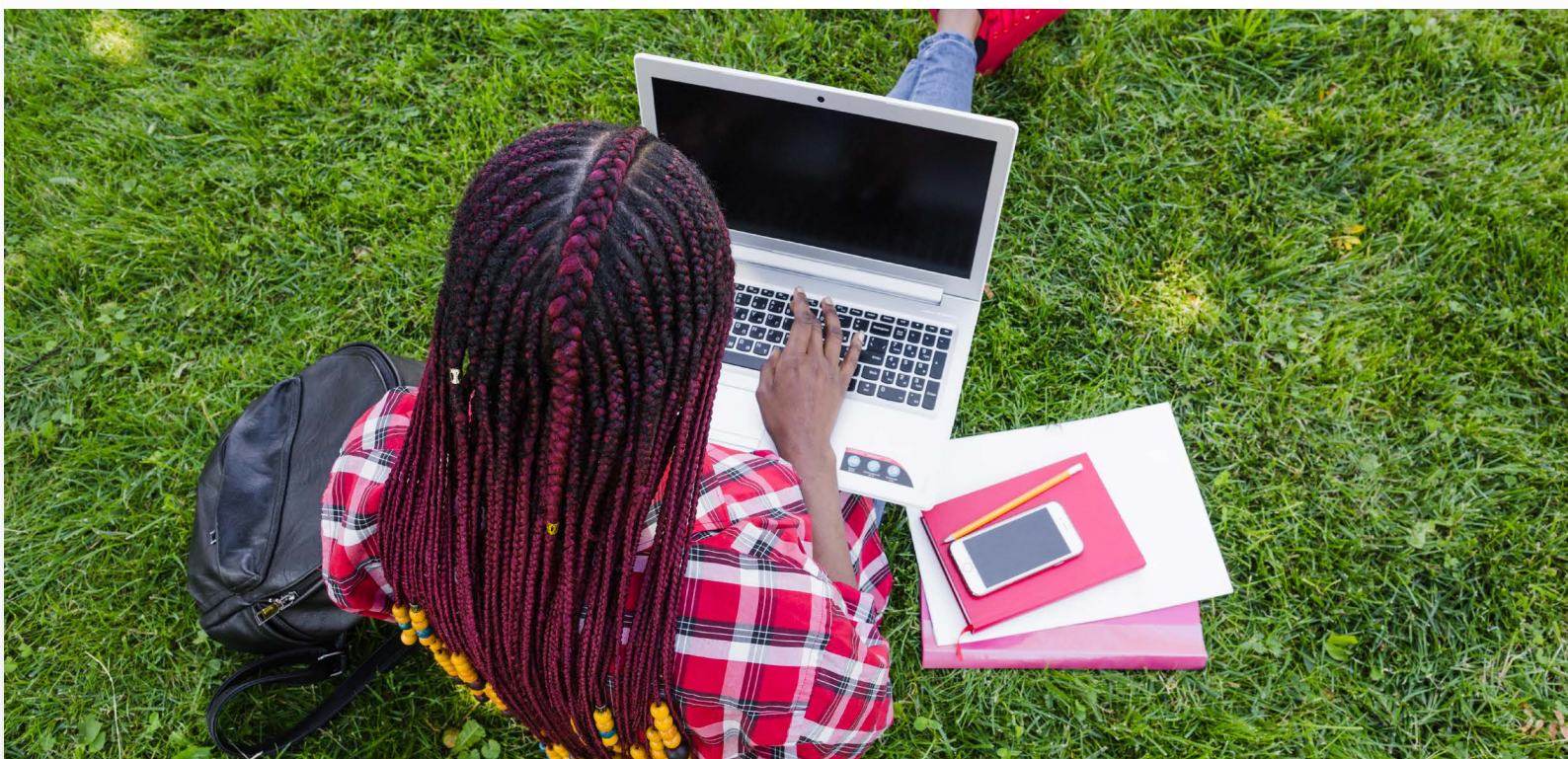
The study was conducted in the 10 provinces in Zimbabwe, Bulawayo, Harare, Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matabeleland North, Matabeleland South and Midlands. The rationale for selecting the 10 provinces is that they are representative of Zimbabwe.

Study Population

The study population includes secondary schools, teachers who are employed by MoPSE in the selected study sites, secondary school learners, and officials from government departments that oversee ICT education for both teachers and learners.

Sampling

The study utilised a mixed methods approach with a concurrent study.



Selection of Provinces

Stratified Sampling/Multi-Stage Purposive Sampling

The population was purposively selected from the 10 provinces. In each province 15 secondary schools were purposively selected to reflect areas that cut across private, public, boarding, day, night, urban, peri-urban, rural schools, boys only and girls only schools and mixed schools. In total, 150 schools were targeted to take part in the study. The DigComp survey instrument was sent to 3,000 secondary school teachers who taught various learning areas. Initially, the research team had planned to survey 300 ICTs teachers, but during the stakeholder engagements felt the need to include non-ICTs teachers and to increase the number of participants. A total of 2,263 questionnaires were received back.

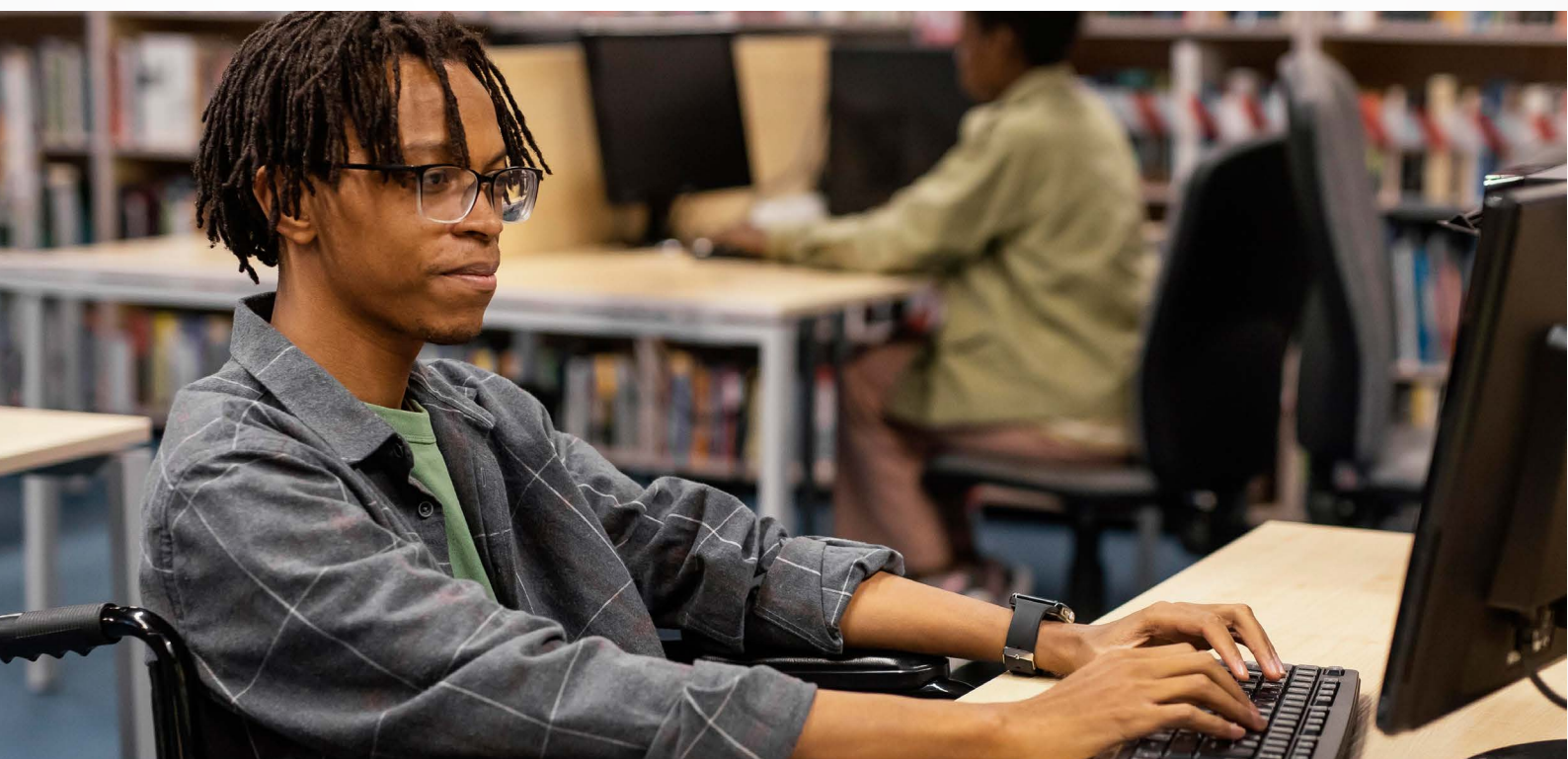
Selection of In-Depth Informants

Purposive sampling

30 in-depth interviews were conducted with teachers from secondary schools that included government public schools and private schools in each province.

Data Collection

Data was collected using a mixed-methods approach. Qualitative data was collected using interviews, FGDs and facility assessment. The quantitative data was collected using the DigComp tool.



Questionnaires

The survey participants were teachers working at secondary schools. The questionnaires captured socio-demographic data of the teachers as well as the 5 DigComp dimensions.

In-Depth Interviews

The interviews involved oral questioning of respondents either individually or as pairs. The interviews were recorded using a digital voice recorder and transcribed in the offices. The interviews captured information on the knowledge, attitudes and skills of digital literacy skills used at secondary schools as well as the factors which lead to their usage.

Focus Group Discussions

A total of 15 focus group discussions (FGDs) was planned with learners from different schools which are representative of each province. The FGDs comprised of at least 12 learners with an equal balance between boys and girls. The FGDs captured learners' experiences learning digital literacy skills at their secondary school as well as the factors which lead to their usage.

Facility assessment

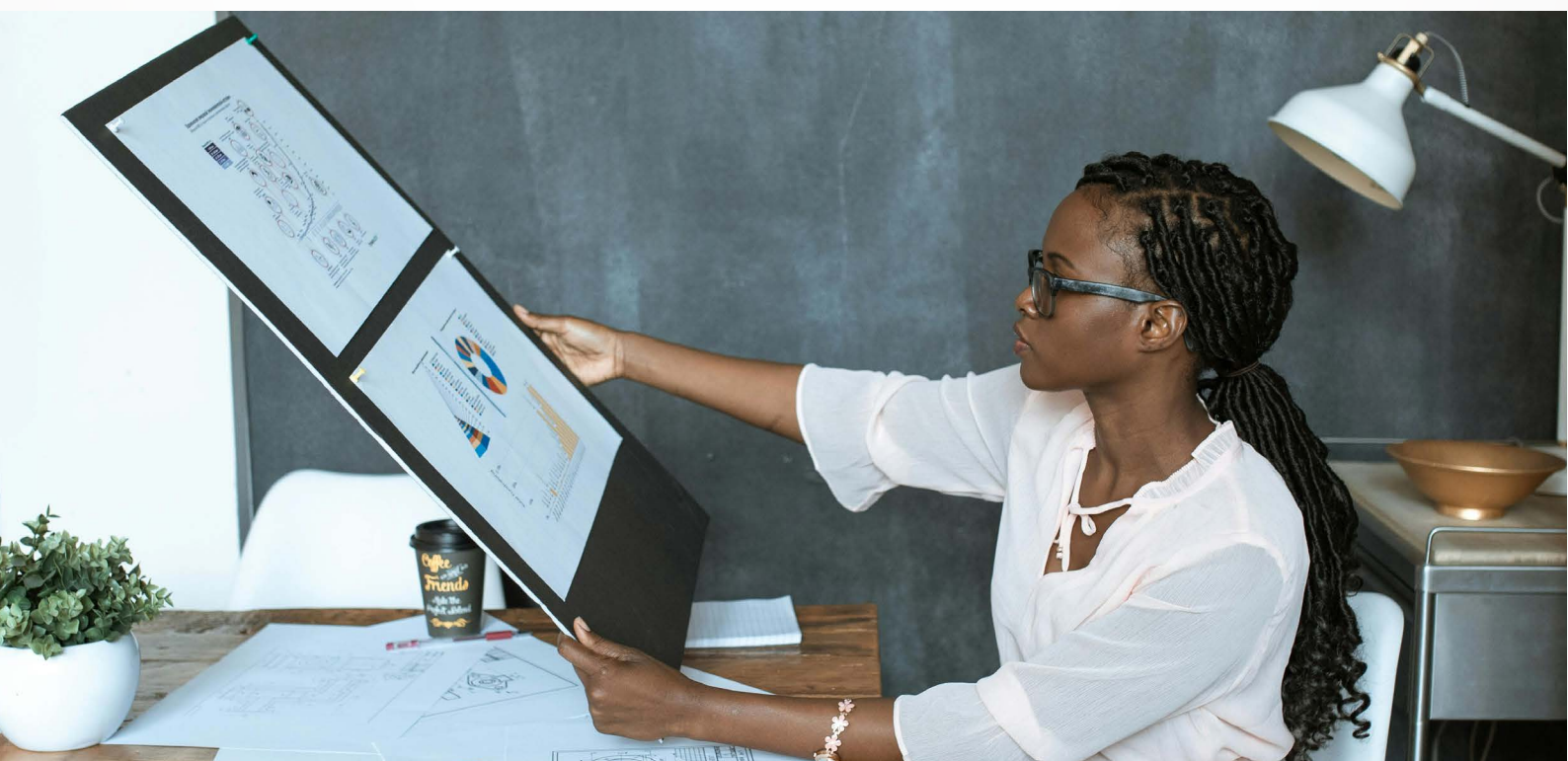
A facility assessment was conducted on each selected school to map out the available equipment and infrastructure for teachers and learners alike, for example, available ICT equipment and type of internet connectivity.



Data Management and Analysis

The qualitative report was developed using a qualitative research method called mixed methods phenomenography which aims to explore and understand the different ways in which individuals experience and understand a particular phenomenon or aspect of the world (Dabengwa et al., 2023). Phenomenography in itself has strengths in showing that there are differences in the manner in which digital literacy skills are applied among several groups depending on their socio-economic statuses. Phenomenography also has the strength to allow participants to relate to first-, second-, and third-person narratives instead of focusing solely on first-person perspectives (Dabengwa et al., 2023). This provided teachers and learners a platform to talk about their personal experience of digital literacy, the experiences of others, and how they navigated through these interfaces in both the real-world experience and conceptions of it. Mixed-methods phenomenography was key because it combined both quantitative and qualitative data on digital literacy to complement each other when integrated.

The phenomenographic analysis was conducted on MaxQDA 24. The transcripts were read and familiarised to get the codes. The DigComp 2.2 framework was used to cover key thematic areas, while open coding was used to develop new codes (labels or tags that describe key passages in the text) as they appeared while reading each transcript. Each transcript was treated as a single case at first to identify key codes, subcategories, and main categories. The names of codes are normative. During the analysis, the researchers 'translated' what the participants were saying into short words that describe the statements. The codes are not exactly what the participants said but close to the meaning. The codes and categories developed were then compared to identify commonalities and differences between participants. Selected passages have been used to present rich and thick descriptions from the transcripts.



The quantitative data was imported and cleaned using Statistical Package for Social Sciences (SPSS) 27. Analytical tables for quantitative data were computed using SPSS – descriptive statistical analysis and multivariate analysis to aid the identification of factors associated with the use of digital literacy skills as well as relationships between each dimension.

Ethical Considerations

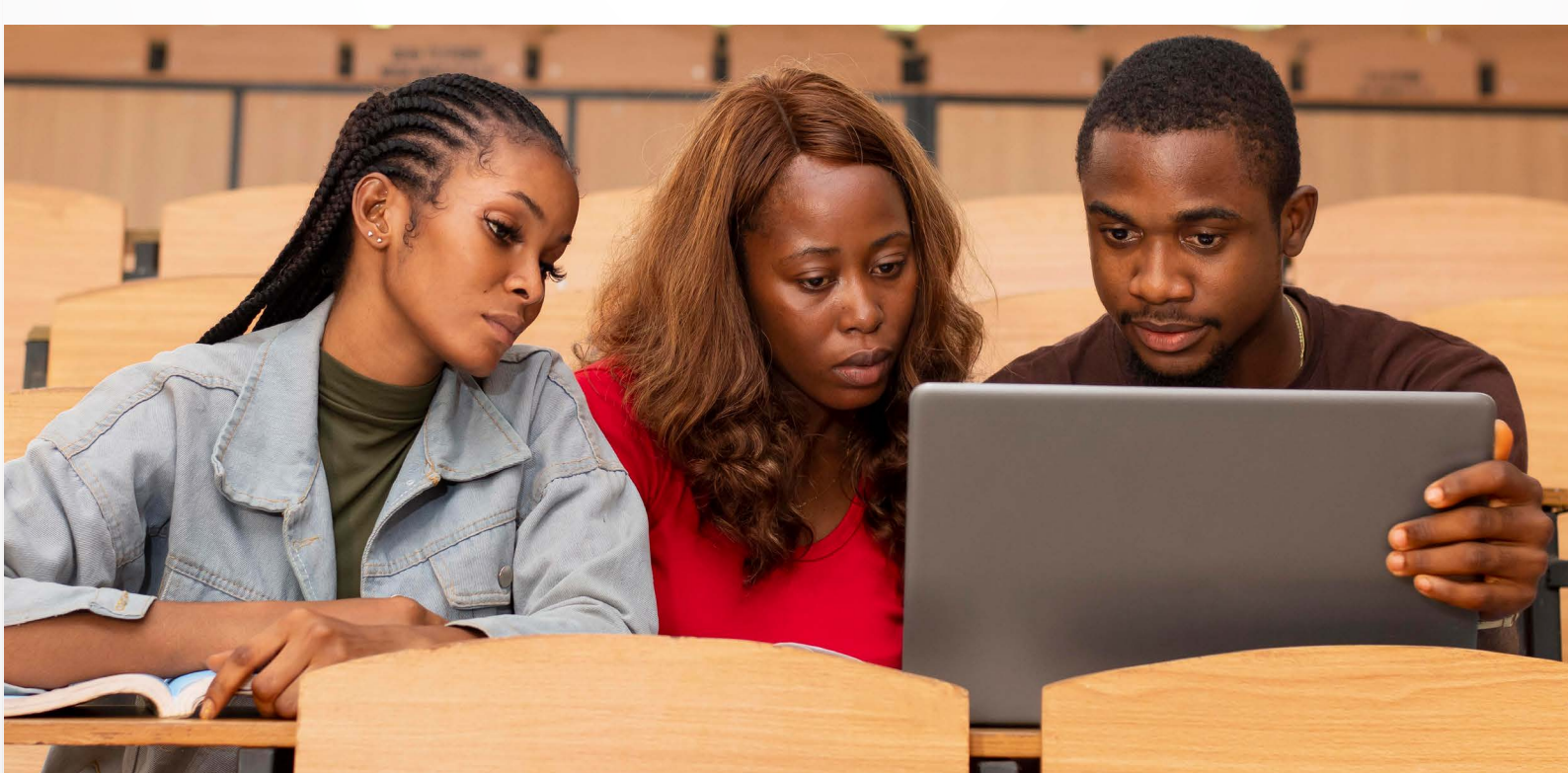
The researchers applied to National University of Science and Technology's Institutional Review Board to determine if there are any harms and risks that could be incurred to the participants because of the study. The approval number for the study is NUST/IRB/2022/128 which is used in correspondence, consent forms and other documents as appropriate. Permission was sought from MoPSE before collecting data at the school level. The ethical issues reviewed by the above bodies include, but were not limited to:

Informed Consent

The research team sought informed consent from all participants who took part in the study.

Risks

The researchers explained that the risks of participating in this study were very minimal. One of the anticipated risks was that the assessment may expose participants' ignorance of some digital literacy concepts thereby, reducing their confidence/self-esteem.



Benefits

Participants were told that there are no direct benefits from participating in this study and how their responses will benefit the study findings.

Confidentiality

The participants were assured that their questionnaire or transcription will be de-identified (No actual names of the respondents would be captured. Additionally, only the research staff, all of whom were trained and instructed about confidentiality requirements, had access to participants' data once it is electronically captured.

Voluntary Participation

Participants were briefed that their participation in the study is voluntary and that they can withdraw at any time without having to give a reason or being victimized.

Project Activities

In this section, we present activities that the project team has undertaken. These are guided by the milestones set in the project proposal, with adjustments set to address the prevailing situation on the ground. In general, the team has been able to undertake all the key activities that constitute project initiation. The activities carried out so far are elaborated in the following paragraphs



Activity 1: Formulation of Project Team

Following the approval of the proposal submitted to the RCZ, the first task was to set roles to be played by each team member in the project.

The team comprises of officers from NUST and MOPSE. Each team member was assigned a role based on their expertise (see Annex 1). Ethical clearance was sought from the NUST Institutional Review Board.

Activity 2: Engaging key persons from the Ministry of Primary and Secondary Education (MoPSE)

After the project team was formulated and roles assigned, we engaged MoPSE in identifying schools, teachers and other stakeholders who would attend the Stakeholder Engagement Workshop in Bulawayo.

Activity 3: Design of Data Collection Instruments

The research team read key literature such as UNESCO (2006), Zimbabwe National Statistics Agency [ZIMSTAT] (2017), the International Telecommunications Union [ITU] (2020) and Vuorikai et al. (2022) to design the DigComp questionnaire, interview guide, FGD guide, and infrastructure observational checklist.

The DigComp 2.2 framework was selected because it is the most recent digital competency framework. The research team felt that this strength was adequate to measure the target group in line with international expectations.

Out of the 250 DigComp 2.2 specific statements that cover the 5 dimensions: "Information and Data Literacy", "Communication and Collaboration", "Digital Content Creation", "Problem-Solving" and "Safety", 62 statements were selected to reflect knowledge, skills and attitudes (see Annex 3).

The following categories were agreed to reflect digital competences that could be found in the Zimbabwean context:

The terms you provided represent a progression of proficiency levels. Here's a breakdown of each level:

1

Non-proficient: This level indicates a lack of proficiency or in knowledge, and attitudes on a dimension.

2

Novice: Novice level suggests that individuals have just started learning and acquiring knowledge and skills, and attitudes on a dimension.

3

Intermediate: Intermediate level signifies a moderate level of proficiency in knowledge, skills and attitudes on a dimension.

4

Advanced: Advanced level represents a high degree of proficiency and expertise knowledge and skills, and attitudes on a dimension.

5

Expert: Expert level signifies the highest level of proficiency and mastery on knowledge and skills, and attitudes on a dimension.

Each statement on the question scaffolded the knowledge, skills and attitudes of each statement under the 5-point Likert scale above. In addition, 21 statements were added to act as a "Knowledge -Based Assessment" that comprised of True and False statements grouped under the

5 DigComp dimensions (see Annex 3).

A facility assessment tool was developed to capture information about the school environment, e.g., enrolments of learner's staff establishment, available ICTs devices and their functionality, etc (see Annex 4).

Activity 4: Engagement with Stakeholders

A stakeholder's workshop was held from the 17th to the 21st of March 2023 at Evelyn High School, Bulawayo. Representatives from the National University of Science and Technology, the Ministry of Primary and Secondary Education, and teachers from selected schools attended the workshop. The objectives of the workshop were to introduce the project and to obtain user feedback on the instrument.



Figure 1: Teachers at a Protocol Standardisation Workshop

Activity 5: Acquisition of Equipment

Guided by the requirements of the project and the procurement processes of the institution, the team acquired key project equipment.

Activity 6: Piloting the Instruments at Northlea High School

Following a successful stakeholder consultative meeting during the first month of the project, the team set out to conduct a pilot study on the instruments developed for the research. Permission was sought through the Ministry of Primary and Secondary Education (MoPSE) to conduct a pilot study at Northlea High School. Having satisfied all the necessary requirements to do such a study, the study was conducted in one day. This involved the whole team participating in the administering of the DigComp questionnaire, the infrastructure assessment tool, the Interviews with teachers and the focus group discussion with learners. The team divided itself into groups enabling the instruments to be administered simultaneously. This strategy ensured minimal disturbance on the normal school activities and led to effectiveness and efficiency in the team.

Activity 7: Evaluating the Results from Northlea High School

Data entry from the pilot study was analysed to identify any flaws in populating the instruments. Guided by the outcome from the results, the instruments were revised to address any shortcomings. One notable glitch was the choice of several options in the questionnaire whereas respondents were meant to choose 1 option. Review of the research literature on DigComp showed that this was possible in instances where the response requires the respondent to indicate their level of competence. The highest selected option is considered as the best choice in this case. The team sought means to address the issue (see Annex 7).

Activity 8: A Second Pilot of the Instruments at Kwekwe High School

The revised instruments were further piloted at Kwekwe High School with teachers from various schools located in Kwekwe. The workshop was also used as a venue to train research assistants and team members. Role play was used as the main method for training interviewers, at the same time soliciting ideas on how to improve on the interview guide. The participants were asked to review their completed questionnaires and the role-played interviews. Comments and suggestions were noted which led to more revisions of the tools. (see Annex 7)

Activity 9: Mapping the Schools and Data Collection

Guided by the proposal, the NUST research team, assisted by the Ministry of Primary and Secondary Education team mapped 150 secondary schools in 10 provinces (See Attach 1). The schools are representative of government-owned, privately-owned and missionary schools which are in urban, peri-urban, rural, mining centres and border towns. Data was collected from 1-31 July 2023 and encompassed site visits to the selected schools.

Activity 10: Mid Project Review

The team met with the Research Council of Zimbabwe (RCZ) team at the NUST Bursar's boardroom. Four members from RCZ visited NUST to check on project progress. Members of the project team were all present, apart from team members from MoPSE who had commitments on National duty.

The Principal Investigator presented the work covered so far, with the main highlights being the data collection stage that had just been concluded. After the presentation, the monitors sought clarification on some issues, and team members present took turns to answer the questions posed. The main comment from RCZ was that the work covered so far was of high quality, and the PI was commended for doing a sterling job. The team was encouraged to continue in the same spirit in the next stage. The Monitors proceeded to meet the NUST Vice Chancellor, Professor M.E. Dlodlo.

Activity 11: Planning for the Data Analysis Stage

The research team met to collate the questionnaires that were returned. The questionnaires were graded as "complete" or "incomplete". Audios were listened to gauge the quality of the recordings. Audios with poor quality were identified and set aside, while those with better quality were set aside for analysis. A data input form and codebook were developed to guide the data entry process into Microsoft Excel spreadsheets.

The interviews and the FGDs were transcribed verbatim. In the case of interviews in local languages, these were translated into English.



Project Outputs

Data Collection Instruments

- a. A validated questionnaire that can be used to measure digital literacy within the Zimbabwean context in any sector of the economy. The results of this instrument are comparable with other countries (see Annex 3).
- b. Interview guides - these can be used in any study where digital literacy of a certain population/ sector of a society is sought (see Annex 5 & 6)
- c. Infrastructure assessment tool - Same as (a) (see Annex 4)
- d. Baseline data of Zimbabwe secondary school teachers' digital literacy that covers their knowledge, skill and attitude levels.
- e. Data on distribution of ICT infrastructure in sampled schools.

Proposed Research Manuscripts

- a. Assessing the Digital Literacy Skills of Zimbabwean In-service Secondary School Teachers using the DigComp Tool
- b. Exploring Digital Competence in Zimbabwean Secondary Schools: A Mixed Methods Phenomenography

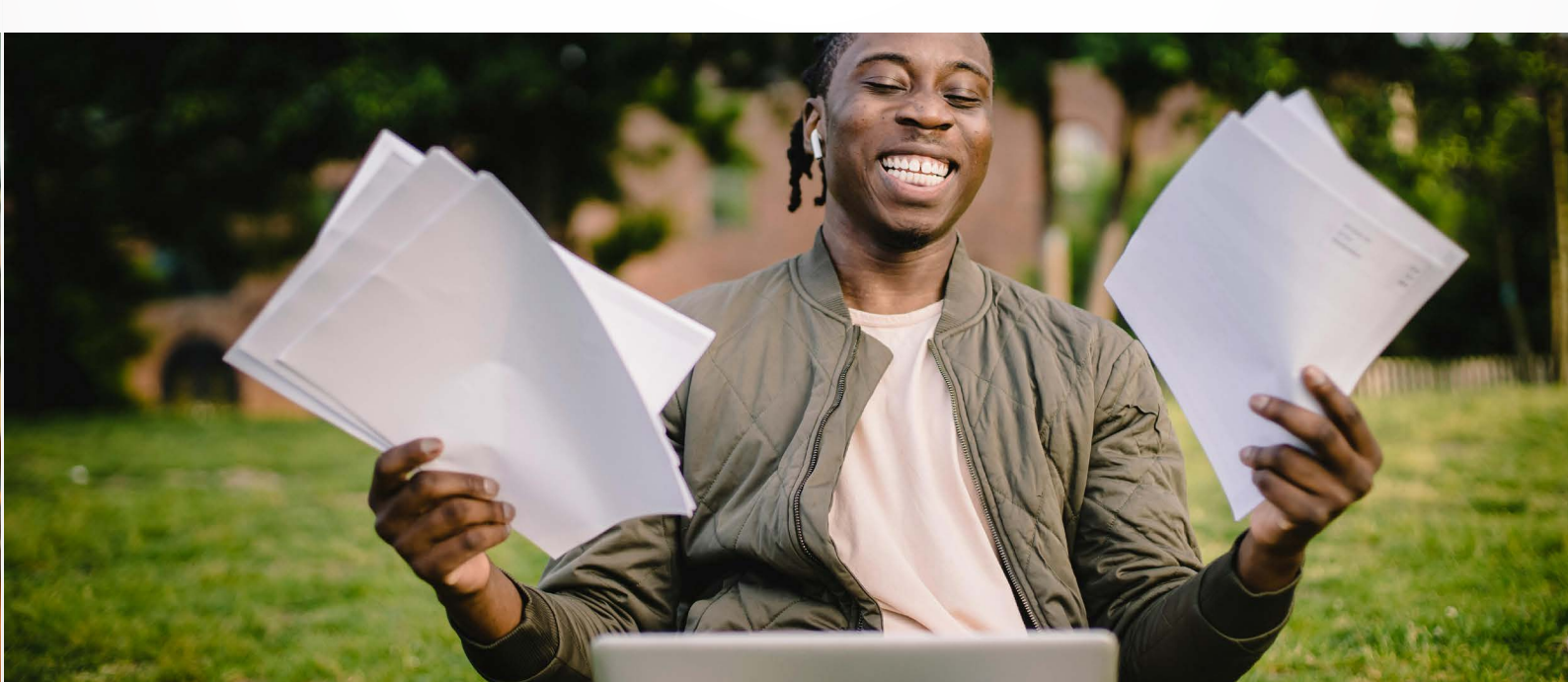


Capacity Building

- a. Teachers were trained on the importance of digital literacy skills in their profession.
- b. 11 core team members were trained on the DigComp 2.2 tools design, distribution, and analysis while 84 secondary school teachers were taught on digital literacy, the DigComp tool and how to conduct surveys.

Sustainability Strategies

- a. Multi-stakeholder Partnerships: The partnership with the Ministry of Primary and Secondary Education will go a long way in strengthening the Curriculum Review process.
- b. Community-Driven Initiatives: The research project was conducted using participatory and engaging methods that included the co-design of digital literacy tools. At the end, the team had an instrument that connects well with the socio-cultural context of the Zimbabwean education system.
- c. Capacity Building of Trainers: Training 11 local trainers from NUST and MoPSE who are now capable of conducting a national assessment of digital literacy skills in any sector of the economy. Apart from the research team, 84 teachers were trained on how to administer the tool.
- d. Monitoring and Evaluation: Establish robust monitoring and evaluation systems to track progress, identify gaps, and adapt programs for long-term impact.



Contributions to Capacity Building for Women and Marginalized Groups

- a. Most of the workshop participants were women and coincidentally the respondents were mainly women. In this way, it can be argued that the research project increased the digital inclusion of women.
- b. The data collected shows women's and girls' usage of technologies, especially their exclusion when resources are limited.
- c. Both the workshops and data collection included teachers who came from under resourced and rural settings. The team went on further to select them on categories such as communal lands, resettlement areas, mining settlements and commercial farms to better understand their socio-cultural context.
- d. The study identified cyberbullying as an issue that needs attention as it is quite rampant among learners. This is an issue that needs attention so that this age group is ensured to participate in digital spaces without any discrimination.
- e. The study has given recommendations to create an inclusive digital transformation in Zimbabwe.



Policy & Practice

- Policy analysis, recommendations, and documents
- Other milestones in terms of policy/practice stakeholders and processes, such as the involvement of research users or ultimate beneficiaries

MoPSE-Specific Recommendations

- a. Increase the number of ICT teachers or teachers with 21st century skills
- b. The school should have competent system administrators. There are instances where learners faced challenges with their fees payments and faced possible disruptions on learning.
- c. Motivate teachers to be able to impart and use digital literacy to classes that do not study computer science.



Learning Materials

- a. Marketing of learning passport and similar eLearning platforms that are relevant to the current syllabus.
- b. Downloading past exam questions and making these accessible to learners over digital tools.
- c. Increase the digital content in local languages.
- d. Reduce computer science examination fees as this deters underprivileged learners from studying and registering for examinations.

Device Policies

- a. Create research timeslots where digital tools can be used in the classroom or school setting
- b. Rewrite the school device policy to suite both those who oppose the ban on devices and those want it lifted. There somehow should be a compromise.
- c. All learners should use standard uniform devices to reduce peer pressure and or digital exclusion.

Supportive Infrastructure

- a. Donations of bandwidth or payments of data subscriptions, e.g., the POTRAZ scheme should be revived.
- b. Schools wholly fund ICT programmes.
- c. Increase Internet network coverage, WI-FI access, and speed.
- d. Build more computer labs in schools.
- e. Install Closed-Circuit Television (CCTV) cameras in schools to ensure the physical safety of learners, especially at boarding schools.
- f. Increase interactive boards in classrooms.



CALAs

- a. Conduct situation analysis over the country to understand the local context.
- b. Lesser components so that learners can have time for other activities.
- c. A common platform to access CALAs throughout the country.
- d. Computer science should be compulsory for all learners.
- e. Integration of ICTs across the curriculum, regardless of teaching areas.

Recommendations to the Ministry of Information, Communication and Technologies

Who Should Buy Devices for the School?

- a. The Government of Zimbabwe
- b. Schools
- c. The community
- d. Donations from well-wishers

Improving Digital Literacy

- a. Introduce ICT certifications for all teachers regardless of teaching areas, e.g., International Computer Driver's License (ICDL).
- b. Girls should have more access to technology.
- c. A whole-national approach to digital literacy skills that uses the DigComp framework and targets even the most rural places, leaving no one behind.
- d. Increase the number of community information centres (CICs) for ICT access outside the school environment.
- e. Reinforce digital literacy skills at the primary school level so that they are scaffolded well into secondary schools.
- f. Introduce community programmes that teach ICTs to parents so that they are more supportive to the school systems.
- g. Teacher training on evaluating the credibility of information.
- h. Teach communities (especially parents) digital literacy so that they are supportive to the learners and their schools.
- i. Integrate ICTs across the curriculum instead of confining it to computer science students.
- j. There should be more literacy on digital safety.
- k. Increasing safety nets for digital literacy
- l. More refresher trainings for teachers so that they keep abreast with digital technologies.

Findings

Sociodemographics of the Quantitative Data

“Data was collected from the 10 administrative provinces of Zimbabwe (Table 1).”

Two districts were randomly selected in each province. A total of 2, 263 teachers from 134 schools participated in the questionnaire survey. The highest number of teachers was recorded in Manicaland (320 teachers; 14.1%) and the least number was recorded in the Midlands Province (150 teachers; 6.6%).

Province	Number of Teachers	Percentage	District	Frequency	Percentage	Number of Schools
Midlands	150	6.6	Kwekwe	73	3.2	2
			Chirumanzu	77	3.4	7
Masvingo	213	9.4	Masvingo	122	5.4	6
			Zaka	91	4.0	6
Mat South	166	7.3	Mzingwane	83	3.7	6
			Mangwe	83	3.7	6
Mat North	187	8.3	Nkayi	108	4.8	6
			Bubi	79	3.5	5
Bulawayo	233	10.3	Khami	145	6.4	7
			Reigate	88	3.9	5
Harare	245	10.8	Chitungwiza	118	5.2	6
			Northern Central	117	5.2	5
Manicaland	320	14.1	Mutare	174	7.7	9
			Buhera	146	6.5	9
Mash East	203	9.0	Marondera	94	4.2	8
			Chikomba	119	5.3	10
Mash Central	282	12.5	Bindura	121	5.3	7
			Shamva	161	7.1	8
Mash West	264	11.7	Hurungwe	116	5.1	7
			Zvimba	148	6.5	9
Total	2263	100.0	Total	2263	100.0	134

Table 1: Geographic Distribution of Teachers

Gender of DigComp Respondents

A slightly higher percentage of the respondents were females (59%) and 41% were males (Figure 2).

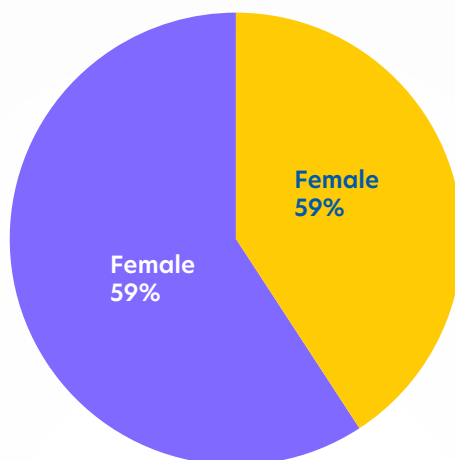


Figure 2: The gender composition of participants in the survey

Learning Areas Taught by Teachers

The participant's data was organised according to MoPSE's categories of learning areas. A higher percentage of the teachers (41.1%) taught STEM subjects (See Figure 3). Learning areas with the lowest respondents was Visual and Performing Arts (0.9%) and 0.8% of the teachers did indicate the subjects they taught. About 3.5% of the teachers indicated that they taught ICT or computers. Although, there are few ICT teachers, most of these are males.

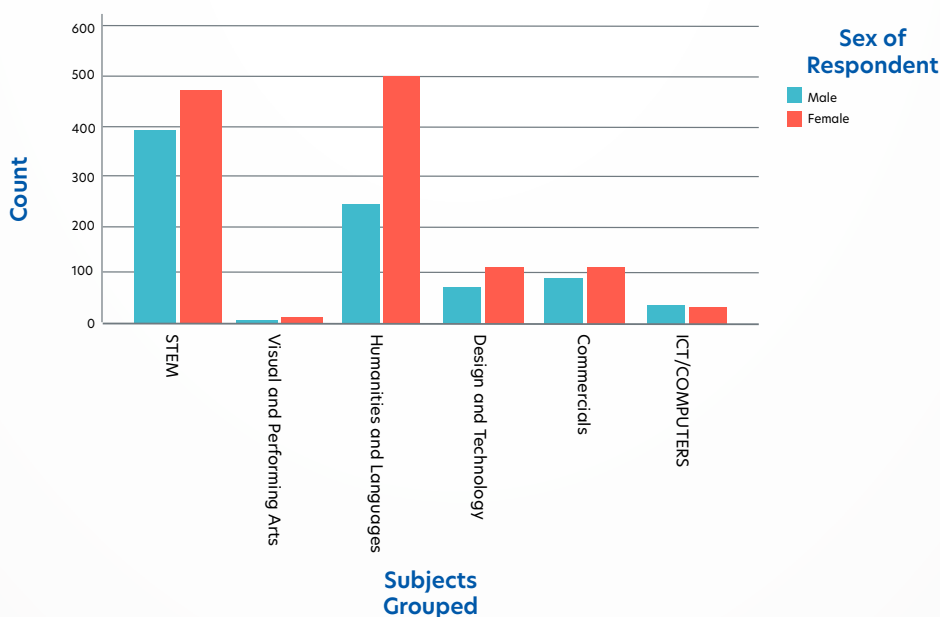


Figure 3: Learning areas Grouped by Gender

Age of Respondents

The majority of respondents (22.2%) were aged between 36 – 40 years, followed by 41 – 45 years (15.2%) and 31 – 35 years (15.1%) (see Table 1).

Age group	Frequency	Percentage
20-25 years	74	3.3
26-30 years	146	6.5
31-35 years	342	15.1
36-40 years	502	22.2
41-45 years	343	15.2
46-50 years	319	14.1
51-55 years	284	12.5
56-60 years	143	6.3
61-65 years	33	1.5
65 years and above	4	.2
Did not indicate	73	3.2
Total	2263	100.0

Table 1: Age Groups of Respondents



Number of Years of Experience in Teaching

About 20.4% of the teachers had been teaching for 11 – 15 years, 16.2% for 0 – 5 years and 15.1% for 6 – 10 years (Table 2).

Number of years of Experience Teaching	Frequency	Percentage
0-5 years	367	16.2
6-10 years	342	15.1
11-15 years	462	20.4
16-20 years	241	10.6
21-25 years	270	11.9
26-30 years	166	7.3
31-35 years	121	5.3
36-40 years	29	1.3
41-45 years	9	.4
46-50 years	8	.4
50 years and above	11	.5
Did not indicate	237	10.5
Total	2263	100.0

Table 2: Number of Years of Experience in Teaching

Academic Qualifications

The majority of the teachers (1,545) had attained a Diploma in Education, 967 teachers had a degree in education and 372 had other degree qualifications (Table 3).

Qualification	Number of Teachers	Graduating Years (Range)
Certificate in Education	239	1974 - 2022
Diploma in Education	1545	1980 - 2022
Degree in Education	967	1987 - 2022
Other Degrees	372	1977 - 2022
Other Professional Qualifications	162	1987- 2022

Table 3: Academic Qualifications of Respondents

Results of the DigComp 2.2 Survey

Test for Normality

Some groups violate the normality assumption hence we cannot perform parametric tests. Please find attached output from SPSS on the test for normality.

Some of the conditions are that:

- 1

Skewness and kurtosis values must be within the interval (-1.96, 1.96);
- 2

The histograms should show a close to normal distribution; and
- 3

Q-Q plots should be close to linear

Therefore, the data should be analysed using non-parametric tests like the Chi-squared test or the Mann-Whitney U Test.

Reliability

Construct reliability was assessed using Cronbach Alpha to measure internal consistency of the constructs in the study. A construct is reliable if the Cronbach's Alpha value is greater than 0.70 (Salkind & Frey, 2020).

The overall Cronbach's Alpha on DigComp tool is 0.975. The reliability analysis results suggest that the internal consistency of four primary components is good while that of Information and data literacy is acceptable (see Table 5).

Therefore, the measuring instrument is reliable.

DigComp 2.2 Component	Alpha	Lower Boundary	Upper Boundary	Remark
Information and Data Literacy	0.768	0.753	0.782	Accept
Communication and Collaboration	0.858	0.849	0.867	Good
Digital Content Creation	0.828	0.818	0.838	Good
Problem-Solving	0.863	0.855	0.872	Good
Safety	0.829	0.819	0.840	Good

Table 5: Cronbach's Alpha with Confidence Intervals for the Five Dimensions

Content Validity

Factor analysis was used to test for the content validity of measurement instruments (see Table 6). The Kaiser-Meyer-Olkin measure of sampling adequacy test (KMO) is greater than 0.5 for all categories. This is because the significance level for the Bartlett's test is not greater than 0.05 (Sig. <0.05). Consequently, the content validity of the instrument can be approved.

Item	KMO	Bartlett's Test
Information and Data literacy	0.871	Sig. 0.000
Communication and collaboration	0.937	Sig. 0.000
Digital content	0.893	Sig. 0.000
Safety	0.883	Sig. 0.000
Problem solving	0.915	Sig. 0.000

Table 6: Validity Test Using Factor Analysis

Principal Component Analysis

Principal Component Analysis (PCA) was conducted to simply participant's most significant components on the DigComp 2.2 scale. The assumption is that these components will significantly affect the other components and perhaps lead to their attainment (see Figure 4).

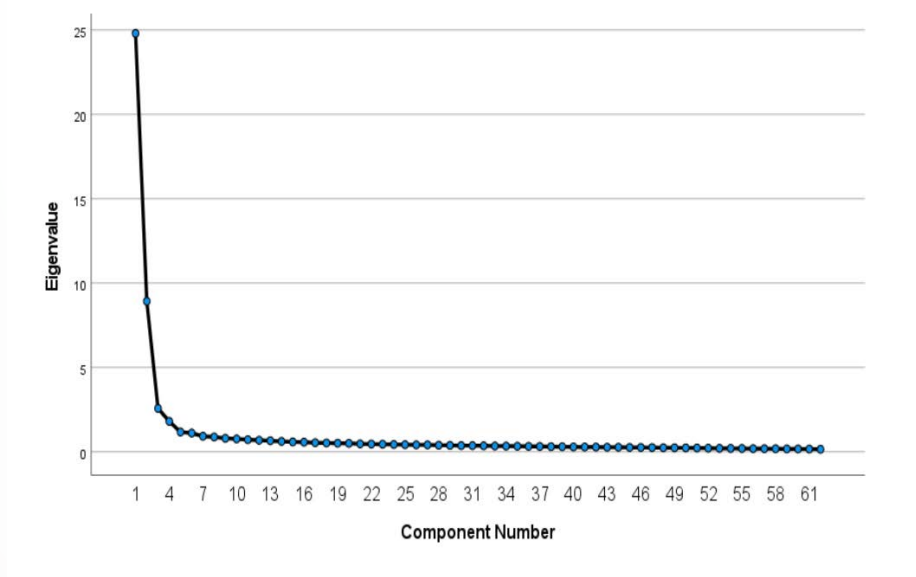


Figure 4: A scree plot showing the items that are significant before the elbow of the curve

CFA found there are 5 significant items on the tool, of which these are under the knowledge aspects of the scale. Only 2 items fall under Information and Data Literacy, while the 3 other fall into Communication and Collaboration. The items are as follows:

- 1 **Screening online information** (Information and Data Literacy)
- 2 **File management** (Information and Data Literacy)
- 3 **Digital communication** (Communication and Collaboration)
- 4 **Digital citizenship** (Communication and Collaboration)
- 5 **Online collaboration** (Communication and Collaboration)

An Overview of the Digital Literacy Levels of Secondary School Teachers

Overall, the responses that were obtained from the survey participants suggest that the teachers who took part in the study possess an intermediate digital literacy knowledge level (see Table 7).

DigComp 2.2 Component	Mean Score	Knowledge Level	Skill Level	Attitude Level
Information & Data Literacy	3.37	Intermediate	Intermediate	Highly Positive (i.e., Strongly Agree)
Communication & Collaboration	3.28	Expert	Novice	Positive (i.e., Agree)
Digital Content Creation	2.85	Novice	Novice	Positive (i.e., Agree)
Problem-Solving	2.73	Non-proficient	Non-proficient	Positive (i.e., Agree)
Safety	2.57	Novice	Novice	Positive (i.e., Agree)

Table 7: Summary of the Survey Results Based on the DigComp Framework

The Usage of the Median and Mode to Determine Levels of Digital Literacy

Because the data is not normally distributed, the Median and the Mode were then analysed to rank the survey participants into the levels of digital literacy. The results of the ranking still place the teacher's levels at the Intermediate category (see Table 8).

Table 8: Raking of the Digital Literacy Levels using the Median and the Mode

Item	Median	Mode	Digital literacy level
Information and data literacy			
Knowledge			
B1.1	3	5	Intermediate
B1.2	3	3	Intermediate
B1.3	3	3	Intermediate
Skill			
C1.1	3	3	Intermediate
C1.2	3	2	Intermediate
C1.3	3	3	Intermediate
Attitude			
D1.1	4	4	Advanced
D1.2	4	5	Advanced
D1.3	5	5	Expert
Communication and collaboration			
Knowledge			
B2.1	4	5	Advanced
B2.2	4	5	Advanced
B2.3	3	2	Intermediate
B2.4	3	3	Intermediate
B2.5	4	4	Advanced
Skill			
C2.1	3	3	Intermediate
C2.2	3	3	Intermediate
C2.3	2	2	Novice
C2.4	2	2	Novice
C2.5	3	2	Intermediate
C2.6	3	3	Intermediate
Attitude			
D2.1	4	5	Positive
D2.2	4	4	Positive
D2.3	4	4	Positive
D2.4	4	5	Positive
D2.5	5	5	Very Positive
D2.6	4	5	Positive

Item	Median	Mode	Digital literacy level
Digital content creation			
Knowledge			
B3.1	3	2	Intermediate
B3.2	3	2	Intermediate
B3.3	3	1	Intermediate
B3.4	3	1	Intermediate
Skill			
C3.1	2	2	Novice
C3.2	2	1	Novice
C3.3	2	1	Novice
C3.4	2	1	Novice
Attitude			
D3.1	4	4	Positive
D3.2	4	4	Positive
D3.3	4	5	Positive
D3.4	4	4	Positive
Safety			
Knowledge			
B4.1	2	2	Novice
B4.2	3	2	Intermediate
B4.3	3	4	Intermediate
B4.4	2	2	Novice
Skill			
C4.1	2	2	Novice
C4.2	2	2	Novice
C4.3	2	2	Novice
C4.4	2	1	Novice
Attitude			
D4.1	4	5	Neutral
D4.2	4	5	Neutral
D4.3	4	4	Neutral
D4.4	4	4	Neutral
Problem solving			
Knowledge			
B5.1	3	1	Intermediate
B5.2	2	1	Intermediate
B5.3	3	3	Intermediate
B5.4	3	1	Intermediate
Skill			
C5.1	2	1	Novice
C5.2	2	1	Novice

Item	Median	Mode	Digital literacy level
C5.3	2	1	Novice
C5.4	2	2	Novice
Attitude			
D5.1	3	3	Neutral
D5.2	4	4	Positive
D5.3	4	4	Positive
D5.4	4	4	Positive

Digital Competences by Learning Areas

The results of the DigComp 2.2 tool were evaluated according to the learning areas by clustering Computer Science teachers together and teachers from other learning areas on the other cluster based on the frequency of the statements they made per dimension (Table 9). It was found that Computer Science teachers are experts in all the DigComp dimensions. However, teachers from other learning areas were only Intermediate when it came to Information and Data Literacy, Novice in Communication and Collaboration, Digital Content Creation, and Safety and Non-proficient on Problem-solving.

DigComp Items	Comp Science teacher	Other teachers
Information and Data Literacy	Expert	Intermediate
Communication and Collaboration	Expert	Novice
Digital Content Creation	Expert	Novice
Problem-Solving	Expert	Non-proficient
Safety	Expert	Novice

Table 9: A Breakdown of the Digital Literacy Skills on Learning Areas



Mann-Whitney U Test

The Mann-Whitney U Test was conducted to see if there were differences between the way that males and females answered the DigComp questionnaire. Out of the 62 items, 27 items were dropped because they supported the null hypothesis, while the rest of the 35 items were retained.

Table 10 below shows the results of the Mann-Whitney U Test and the corresponding significance on each statement categorised under each dimension. It can be seen that both males and females do not exhibit similarities when it comes to the knowledge and skills on Communication and Collaboration.

	Information and Data Literacy	Communication and Collaboration	Digital Content Creation	Safety	Problem-Solving
Knowledge	S1 (0.004); S3 (0.001);	S5 (0.018); S6 (0.026); S7 (0.003); S8 (0.001); S9 (0.007); S10 (0.004);	S11 (0.001); S12 (0.015)	S13 (0.000); S14 (0.000); S16 (0.002)	S17(0.000); S18(0.000); S19(0.003); S20(0.005)
Skills	S21(0.009); S22(0.041); S23(0.000)	S24(0.000); S25(0.006); S26(0.027) S27(0.033) S28(0.008); S29(0.003)	S30(0.004); S31(0.013)	S35(0.013)	S38(0.000); S40(0.008) S41(0.020)
Attitudes	S42(0.035)	S47(0.011)			S62(0.010)

Table 10: The Mann-Whitney U Test Results with Corresponding Significance



Qualitative Data Analysis of Interviews and Focus Group Discussions

Sociodemographic details of the participants

Table 11 shows that a total of 36 interviews (15 FGDs with learners and 21 key informant interviews with teachers) were conducted in the 10 provinces. These 36 interviews included 212 participants in total.

Province	School Name	School characteristics	Focus Group Discussion (Number of Participants)	Key informant interviews (Number of Participants)	Sub-total of participants	Total participants
BULAWAYO	Northlea High School	Government day school/both sexes/boarding for both	12 teachers of varying subjects	2 teachers	25	212
	Inyanda High School	Government day high school/both sexes	N/A	2 teachers		
	High Luveve High	Government day school	8 (4 boys and 4 girls)	1 teacher		
HARARE	High Achievers	Private day school/both sexes	N/A	2 teachers	28	
	Heritage School	Private day school/both sexes	12 (6 boys, 6 girls)	N/A		
	Seke 2 High School	Government day school/both sexes	12 (6 boys, 6 girls)	2 teachers		
MIDLANDS	Chizhou High School	Government Rural Day School/both sexes	N/A	1 teacher	5	
	Manunure High	Government day school	N/A	2 teachers		
	Holy Cross	Church boarding school/both sexes	N/A	2 teachers		

Province	School Name	School characteristics	Focus Group Discussion (Number of Participants)	Key informant interviews (Number of Participants)	Sub-total of participants	Total participants
MATABELELAND NORTH	Alpha Alpha Secondary School	Rural government day school/both sexes	12 (6 boys, 6 girls)	1 teacher	29	
	Guwe Secondary School	Rural government day school/both sexes	12 (6 boys, 6 girls)	N/A		
	Mphumelelo Secondary School	Rural government day school/both sexes	N/A	2 teachers		
	Gloag High School	Church boarding school/both sexes	N/A	2 teachers		
MATABELELAND SOUTH	Mzinyathini Secondary School	Rural church boarding school/both sexes		1 teacher	3	
MASHONALAND CENTRAL	Tahangana high	Gvt day school	N/A	2 teachers		
	Chipindura High School	Boarding School with day scholars/both sexes	12 (6 boys, 6 girls)	2 teachers	26	
	Mtumba High School	Day scholars/both sexes	12 (6 boys, 6 girls)	N/A		
	Liebenberg High School	Boarding School with day scholars/both sexes	12 (6 boys, 6 girls)	2 teachers	28	
MASHONALAND EAST	Marondera High School	Boarding School with day scholars/both sexes	12 (6 boys, 6 girls)	2 teachers		
	Karoi Chiedza	Boarding School with day scholars/both sexes	12 (6 boys, 6 girls)	2 teachers	28	
MASHONALAND WEST	Kutama Boys High	Boarding School with day scholars/both sexes	12 (6 boys, 6 girls)	2 teachers		
MASVINGO	St. Antony's High School	Church boarding school	10 (5 boys and 5 girls)	2 teachers	12	

Table 11: Qualitative Data Completion Sheet

Results of the Phenomenographical Data Analysis

DigComp Framework in Interviews

Under the DigComp 2.2 framework, Communication and Collaboration received the highest number of codes (192), followed by Problem-solving (164), Safety and Security (164), Digital Content Creation (133), and Information and Data Literacy (129) issues (see Figure 5). The word cloud is created using the frequency of the codes that appear in the dataset. The bigger the word, the more frequencies it has.



Figure 5: A Word Cloud of the Codes Used in the Study of Digital Literacy Skills in Zimbabwean Secondary Schools

Communication and Collaboration

The theme Communication and Collaboration, had three categories: (1) School device policy, (2) Communication and (3) Collaboration. Out of these three categories, School device policy had more sub-categories and codes. The theme is explored in more detail below.

Problem Solving Using Technology

Under Problem Solving, the participant's use of Artificial Intelligence (AI), customising digital tools and technology in society (both positives and negatives). Technology in society had the highest codes, followed by customising digital tools and then AI. Under the technology in society theme, the most common positive trait was the use of technology in cases of emergency, among other issues like e-banking, do-it-yourself (DIY) tutorials, faster teaching pace, online shopping, career advancement, etc. The most significant negative impact was the lack of electronic waste (e-waste) management services in the country. Other negative issues of technology included exposure to pornography, plagiarism, lack of creativity, fake information, low social cohesion, cultural erosion, etc.

Safety and Security

Under safety and security, the key categories included Feeling unsafe, strategies for security and privacy, legal and ethical issues, monitoring the usage of ICTs in classroom and non-classroom environments and cyberbullying. Monitoring ICT usage and strategies for safety and privacy received significant attention in the interviews. For Monitoring ICT usage, supervision was seen as the best solution compared to limiting the features of devices, creating more group work as opposed to individual study, creating timeslots for device usage, and the usage of CCTV, etc.

Creation of Digital Content

The theme of Digital Content Creation was discussed under these categories: Copyright and Licensing, and Technology in Education. Of these categories, Technology in Education was found to be significant, as it gained a great deal of emphasis in the interviews. In this category, the 'School ICT curriculum' subcategory was found to be the most prominent. Continuous Assessments Learning Activities (CALAs) were the most relevant issue. This category is covered in more detail in the key findings reported below.

Information and Data Literacy

The Information and data literacy subtheme, 'Information credibility' received more codes than other categories that included 'Information sources', 'Information cost' and 'Information storage'. Under Information Credibility, the most used strategy was the usage of "multiple information sources" that included reference sources, other websites, textbooks and the syllabus to verify the truthfulness of the information gathered.



Key Findings Based on the Code Map

Figure 2 shows a code map of the intersection of the codes found in the data. The following passages explain these interconnections. The general rule in the code map is that the thicker the line, the greater the relationship. Also, the closer the distance between the codes, the greater the relationship. The phenomenographic analysis was created by closely analysing the intersection of the code map in Figure 6.

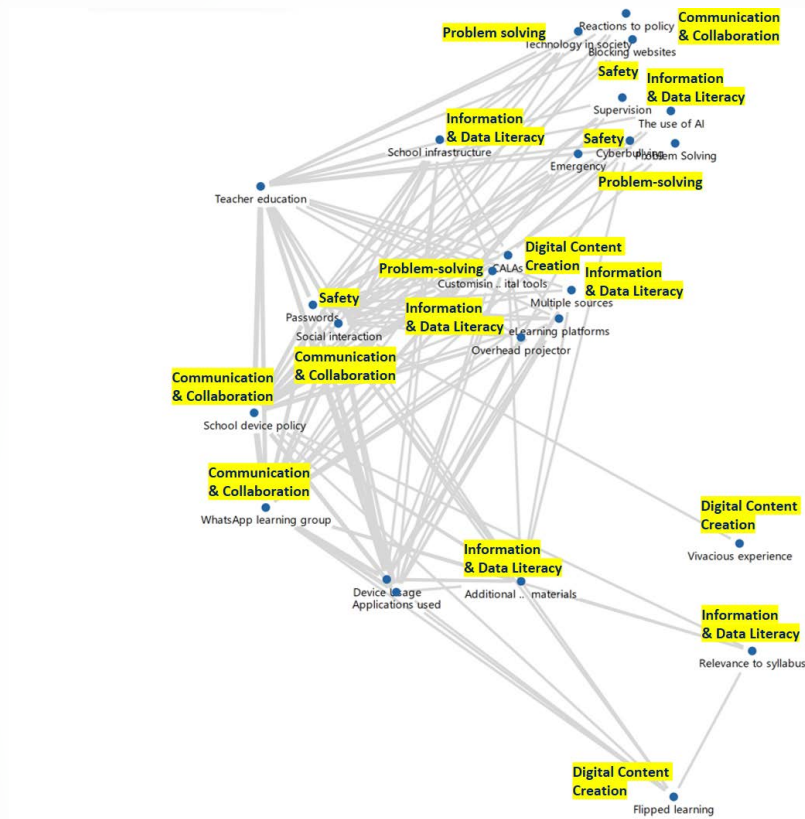


Figure 6: Intersection of Codes from the Qualitative Data Set

The diagram shows that the codes (a) School Device Policy, (b) WhatsApp Learning Group, (c) Additional Learning Materials in Digital Format, (d) Device Usage, (e) Teacher Education, (f) Flipped Learning and Technology in Society significantly interconnect the codes found in the phenomenographic mixed methods. In terms of DigComp 2.2, (a) & (b) belong to Communication and Collaborations, (c) corresponds to Digital Content Creation, (d) belongs to Information and Data Literacy, (f) is grouped with Digital Content Creation, and then (g) corresponds to Problem Solving. When it comes to e, it does not belong to the DigComp framework's categories, but it reinforces them. Although Teacher Education, Device Usage and Applications Used do not fall under any particular DigComp dimension, they strongly interact with various facets of the DigComp tool. Taken together, the results indicate that teachers are using a flipped classroom approach, where most of the usage of digital tools occurs outside of the classroom because the school device policy seems to be a hindrance.

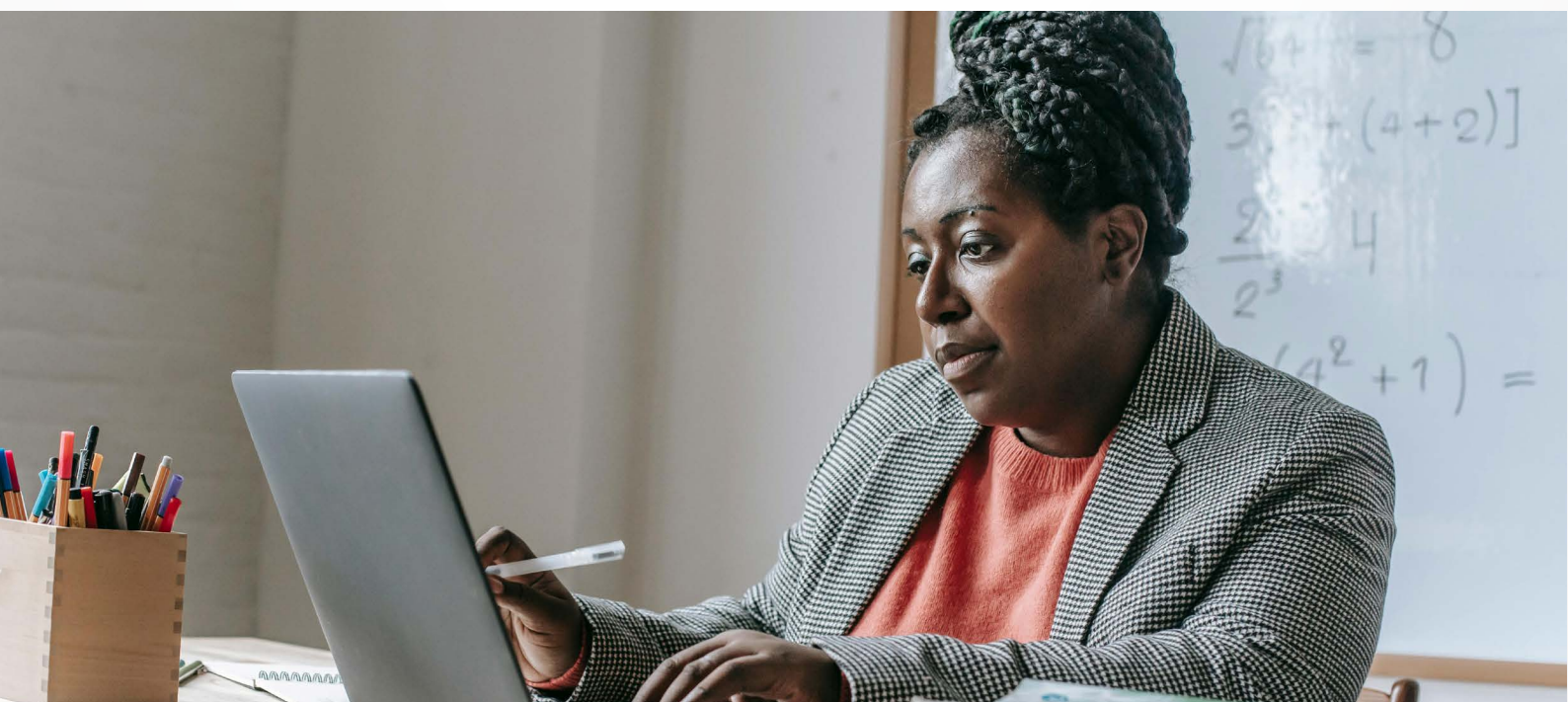
Teacher Education and Digital Literacy

Most teachers, including ICTs / Computer Science, felt that the training they received from teacher training colleges did not prepare them to use digital tools in the classroom.

"According to me, because I did part of a computer literate program. But it was not enough because it was more of pure internet research than practical. The practical thing you have to encounter in life then there wasn't much of practical. Yeah, it was more of a theory. When we started, there was only Facebook as a social media item. And email was still a thing that people had a phobia about you Google, like, whereby people would say 'how do I log into my email?', 'What am I supposed to type?', 'How do I do this?' In those days, just one lecturer who used this kind of a projector would take papers and then they would be BEAMED and would reflect. That was the only kind of projector that we had. So, when we went to school, I went to Jameson for my teaching practice (TP). And then I had to face as an overhead projector. And I was like, 'Whoa, how do I do this?', 'Am I supposed to use this?' So, we are not like, taught some of these things. We had to do them practically when we were teaching. And one thing is the lack of resources, because there were those periods back at Belvedere. There were enough computers; they were overhead projectors. They had everything, so maybe they didn't have the time to help us practically." Commented on one Computer Science teacher in Mashonaland Central.

The Teachers had developed their digital skills either out of self-interest or on-the-job training to fit into their teaching roles and keep abreast with technological advances.

"I'm not a 'fundi' (expert) in computers, I have just basic skills that I think with some applications, you need to get some know-how. But generally, general I have a challenge. unless there are specific areas that you're looking at." a teacher in Bulawayo said.



"We need to enforce a law on how the cell phone can be used in school. If we do so, people will not use cell phones. ' A student from Mashonaland West.

Self-Rated Rankings of Digital Literacy Skills

The teachers were asked to rate their level of digital literacy skills on a scale of 1-10, with 1 being the lowest and 10 being the highest. None of the teachers self-reported to be below 5. Most of the teachers reported that they believed that there were 7 out of 10 that indicated an advanced level of understanding. The teachers cited that they lack digital skills such as using overhead projector and interactive screen boards, antivirus, tools such as MS Excel, the Internet of things, programming languages, etc.

One teacher in the Midlands mentioned that she relied on students who studied computer science to help with ICT-related tasks such as online research.

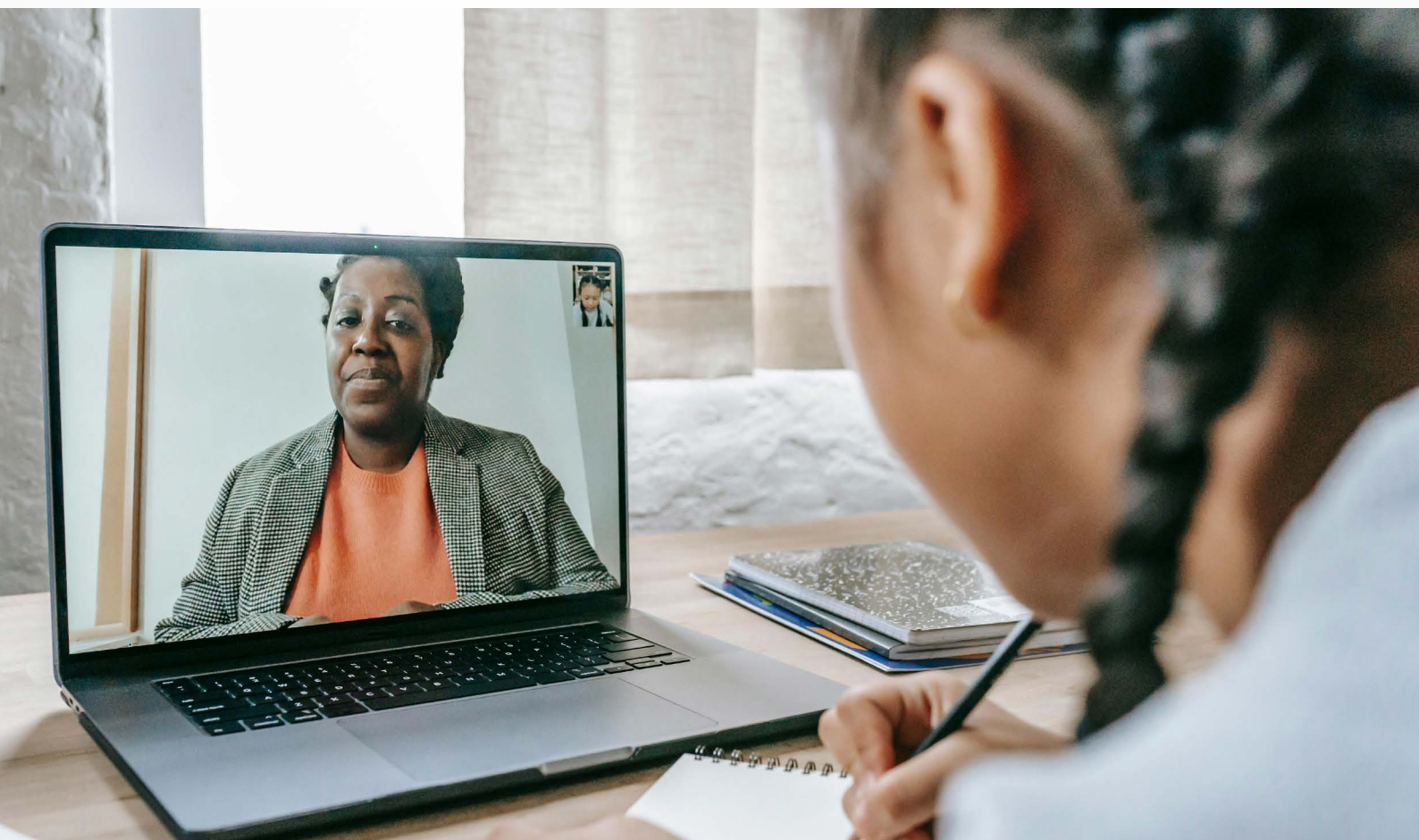
"Most of the time, I involve students. Mostly those who do computer science. Yes, I engage them and then they do the research, and then they give me the information that I want. Mostly from my phone, or I can give them that flash. They put the information there. Then from that flash, download the information." Said a teacher in the Midlands.



School Device Policy

Either schools do not have enough gadgets or their rules and regulations do not support the usage of digital tools within their premises. There are varying traits of these policies, wherein (1) in extreme cases, learners are not allowed to bring any digital, (2) only tablets and laptops are allowed, while cell phones are excluded, (3) learners can only bring their devices when they have been requested to do so, usually accompanied with a school pass to use the device in class, (4) learners bring their devices to the school and the teacher uploads content on their behalf and the device is returned after school and (5) the usage of digital devices is limited to upper secondary learners while lower levels are denied the privilege, and (6) the school borrows the learner a device with restricted or limited features for use during class or out of class.

For both the teachers and learners, most schools have not issued devices and the existing infrastructure (computer labs and projectors) is inadequate to support the learners (in the context of current enrolment). In this case, the teacher uses his devices to conduct teaching using digital tools.



Usage of Devices in Classrooms

In the schools where digital devices were allowed in the classroom, the teachers explained that learners needed more monitoring so that they were not easily distracted. The teachers would move around the classroom, observing each student in the case that they had adequate devices or the teacher would group the learners to conduct tasks together. Teachers felt that either the laptop or the tablet were the best devices that learners could use because learner activities could be easily monitored. Teachers expressed that cell phones were not easy to monitor due to their size. One teacher observed that learners who used the cell phone could be on another site or conducting other activities, while others were learning.

“Whenever you are teaching students when they are connected to the Internet, it is very difficult, especially when you look at our large classes, it is difficult to check that no one opens their site, especially when everyone is connected to the Internet. You think the students have opened the site they are told to open when someone is on Facebook.” The teacher in Matabeleland South Province said.

The devices that were preferred for usage in the classroom included laptops, phones (though in few instances), desktops at the computer lab and tablets. In most cases, the learners were expected to use tablets and laptops for easy monitoring (see Figures 7 & 8). Whereas most teachers used their phones because they did not have access to laptops. In most cases, teachers used their devices to conduct lessons and other administrative duties.



“As teachers, we don’t have laptops. I once was told that they were there. There are stories of them being there but we don’t access them. Also, as one such person would do children’s welfare and record things to do with BEAM, there is Higher Life, there is ZHI. At times I will be required to produce like 500 names, taking their attendance and grouping them. Sometimes I am asked this and this, but there is no provision for a laptop and at times I struggle to get that information done. They will be interested in the information, but I don’t have the gadget (from the school). I have the gadget (a personal one), yes, but I’ve got my children at home that are students. They also want that laptop we have a severe scarcity of resources (at home) and at times I sit up until 3:00 am when all my children are asleep, that’s when I wake up to use that laptop to feed onto my schoolwork. Even if I want to type notes or type things, there is no provision here. The home gadget is overwhelming, so I have to stretch so that I can use it during odd hours. And because of that, I may tend to go back to the olden days when I used my handwritten notes.” Explained a teacher in Bulawayo.

Hence, the shortage of digital devices was often seen as the greatest deterrent for integrating ICTs into the curriculum, causing traditional methods to be used throughout the lessons. Very few schools were able to ease this situation by providing departmental laptops or tablets to teachers. However, these were very few cases and at times the departmental laptops were either too few to cater to the number of teachers or they were now obsolete.

In the case of learners, those who could bring a digital device had to register the device and were expected to share it with less privileged peers. Teachers noted that there were instances where some children were uncomfortable sharing their devices with other learners. There were also reports that the learners stole devices from each other, raising suspicion among each other. In some instances, learners felt that the type of devices brought by their peers furthered

the digital divide, especially in cases when some learners brought high-end devices to the school. This would result in peer pressure or cases of theft as learners would attempt to match each other’s social status.

One of the learners noted that digital devices should be allowed in school settings, but there should be rules concerning their application instead of putting a caveat on all learners.

“We need to enforce a law on how the cell phone can be used in the school. If we do so, people will not use cell phones.” A learner in Mashonaland East said.

Another student said that the ban on phones disadvantaged students who used the devices appropriately or needed to keep in contact with their parents at home, in the case of boarding school.

“There is something that happened that caused the authorities (at the school) to ban the use of phones. Students are not using phones for education purposes. They are using phones to transfer music and watch movies and stuff, and that’s why we were stopped, but this disadvantaged other student who were using phones properly”. Said a learner in Mashonaland. Other students felt that the usage of digital devices should be allowed in school settings as it prepared learners for a life with technology, e.g., at college or university.

“I think at university you will be mature enough to know how to use your phone responsibly. I think at university it’s an open road, its survival of the fittest. If you go on a self-destructive path, it’s your fault. You see that I am destroying myself, let me better restrain myself. At least everyone knows that they are on their own.” A learner in Bulawayo said.

However, other learners feel that devices such as cell phones should not be allowed as they could cause distractions during the lessons.

“But in addition to that, there is a fact that in

class, when you have a laptop, the teacher can see that this student is using a laptop, but a cell phone when under the desk a student can be chatting while the teacher is teaching. As I spoke, if you're someone who reasons much, you actually understand that we want to do important stuff, we wanna research. If it was a matter of saying that we want only to research and that's the only thing a cell phone is capable of, we would allow them. But to a greater extent, we are using it for bad things not only for research. If you want to see the time, we use it for research maybe you let us out there and the rest it's not research at school." A learner in Harare said.

Another learner expressed that the ban should be maintained because learners were not mature enough to use digital devices without supervision.

"I think cell phones should be restricted, looking at the types of students we have. Although we

know they will still be smuggled in, that way there will be damage control when they are being used. Usage will be done cautiously, if allowed blanketly, the students will lack self-control. The rules of banning cell phones and confiscating them on-site are better than just allowing all. Yes, they are needed for school, but not everyone will use them for school." Said one learner.

Although teachers expected learners to use phones and tablets, some learners expressed that they could only afford cell phones. Some learners suggested that they should be allowed to use phones instead of laptops and tablets since these devices are quite affordable. In cases where students were not allowed to bring cell phones, they would sneak these devices into school or rely on teachers they were close to in order to use the devices.



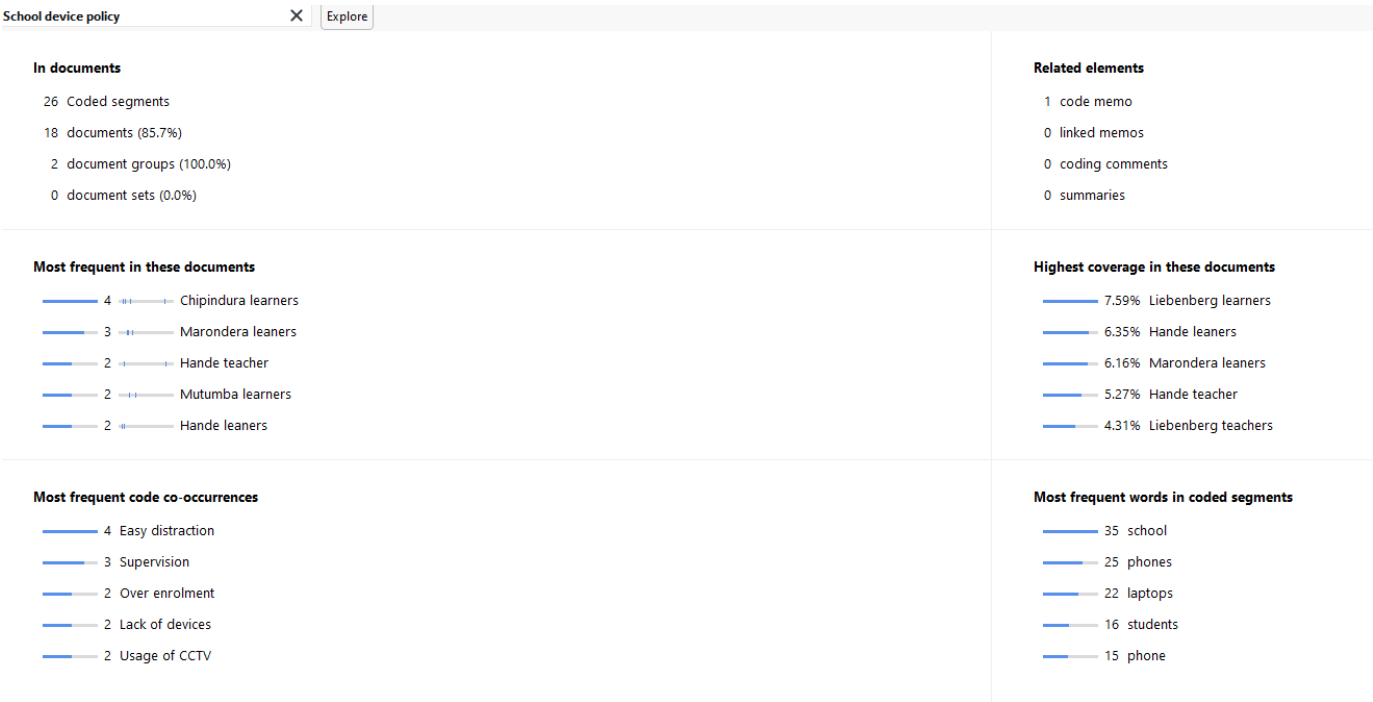


Figure 7: Code Explorer of Preferred Devices Used in the Classroom

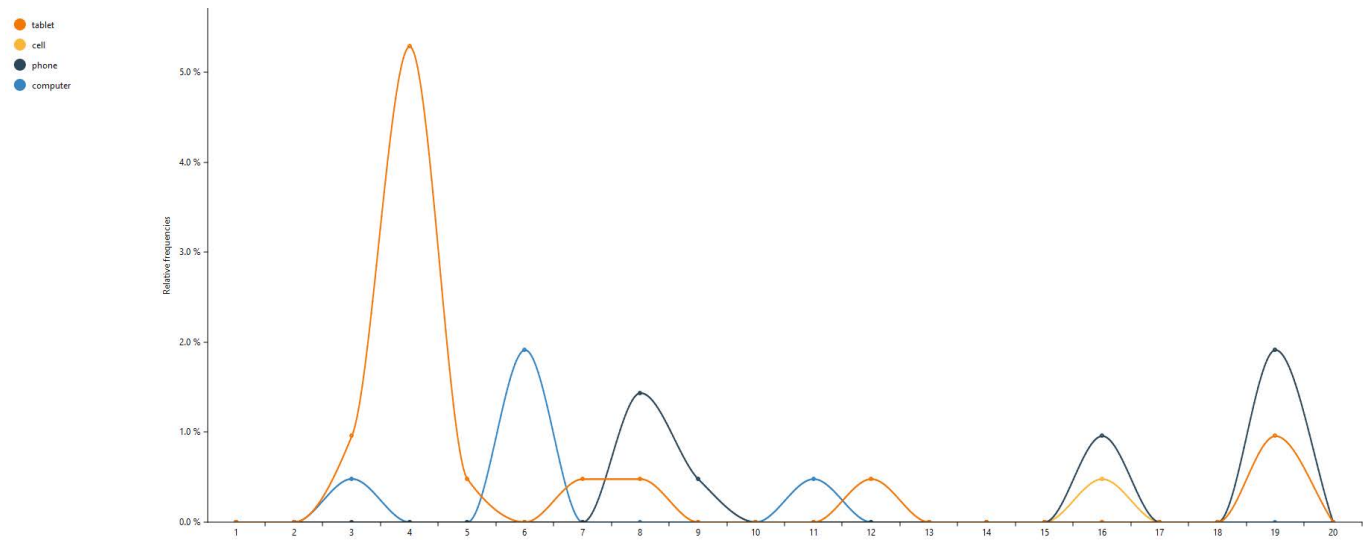


Figure 8: A Word Trend Graph on the Usage of Digital Devices in a Sample School

Electronic assignments and eLearning management systems

Mostly, the computer science students had the privilege of submitting their assignments in electronic format, e.g. assignments and the project. Although the non-computer science learners are given additional learning materials in electronic format, in most cases they were expected to submit their assignments as hard copies or save the assignment onto workstations. The teacher would then access the content of the assignments using the LAN or eLearning management system. Very few schools in the study had an eLearning management - these were usually done asynchronously, with the content being uploaded on a server and the learners accessing this content via the LAN or Internet. However, no schools in the study reported that they were using eLearning management systems that have online sessions between the teacher and the learner. A school mentioned that the students were able to suggest content, such as videos, that could be uploaded to the eLearning system. This shows some democratisation of knowledge as learners can share content with other learners and the system has some permanence as the content will be seen by other future learners.



The Teaching of ICTs in Secondary School Classroom Settings

The study found that ICTs are taught in four forms, these are: (1) computer science which has a practical/project and is examinable under the Zimbabwe School Examinations Council (ZIMSEC), (2) as ICTs under the Higher Education Examinations Council Centre (HEXCO) that does not require a project but continuous assessment, and (3) basic computer literacy that requires does require assessments or examinations. In the case of computer science, this subject was taken up mostly by Ordinary Level (especially the first classes) and Advanced Level students. Both the HEXCO curriculum and basic computer literacy were favoured in cases where resources were limited. However, both of these programmes were considered ineffective in imparting digital literacy skills to learners.

One teacher in Manicaland highlighted that her school had favoured the HEXCO curriculum due to the lack of resources. She noted that the HEXCO curriculum did not include skills like programming.

“Now, at the moment, they’re not using anything (programming languages) because we are not doing computer studies as a subject.” She highlighted. “We are doing HEXCO because of limited resources, so we can’t do the ZIMSEC syllabus.”

Some teachers noted that it was not possible to integrate digital tools into the curriculum because they felt that their learners lacked basic computing skills, the digital tools, and the data to download the materials.



The Influence of a Flipped Classroom

The usage of digital devices led the teachers to conduct flipped classrooms, wherein the teacher would send audio, videos, pictures, and textual materials (e.g., notes and further reading) to the learners so that they could read at their own pace. The flipped classroom differs from the traditional classroom environment in that the activities conducted by the students are carried out outside the classroom at the learners own pace and then presented within the classroom as individual or group assignments. This strategy helped to complete the syllabus much faster, suited the learner's needs and led to a vivacious learning experience. One teacher mentioned that the learners had more visual abilities and learnt faster using this strategy because it creates interest.

"When I'm talking about the French Revolution, there are videos that I show them. That for them is interesting. It creates a lasting impression; they can visualize what I'm talking about". said a history teacher, in Bulawayo Province.

"But when you project and show them a map of Europe, it creates a picture." She went on. "Our students are now more visual learners than reading from a textbook. So, for me, I have since discovered that when I project and show videos and everything, it is easier for them to remember." Another teacher who taught literature shared her experience of how learners used technology to create an interesting and vivacious experience.

"If we want to record some clips, we record. If you want to dramatise, then use our phones to take pictures so that learners on their own they can visualise what was acted on the stage these days, we are doing Shakespeare, it is quite a challenge to so many people. So, as they are learning literature. I make those that are versatile, the group that I taught earlier on gave the group that is talented in acting. I made them act out some scenes. As they're acting out, I am sending out vivid information to the rest of the

students that I teach in class. So, when they see, they remember, unlike when they hear because of the complexity of Shakespeare's language." Said a teacher in Bulawayo.

Apart from the fact that schools did not have enough interactive screen boards and projectors, not all teachers were confident in using these devices during their lessons as seen in the excerpts below.

"I cannot use the overhead projector so I can't give myself a higher score on digital literacy skills." said one teacher in Manicaland.

Another teacher from Manicaland observed that she could not use the interactive board.

"There are some gadgets I cannot use like an interactive board, now, okay." Said a teacher in Manicaland.

Another teacher reacted that she had learnt how to use the overhead projector when she was now a teacher at a school.

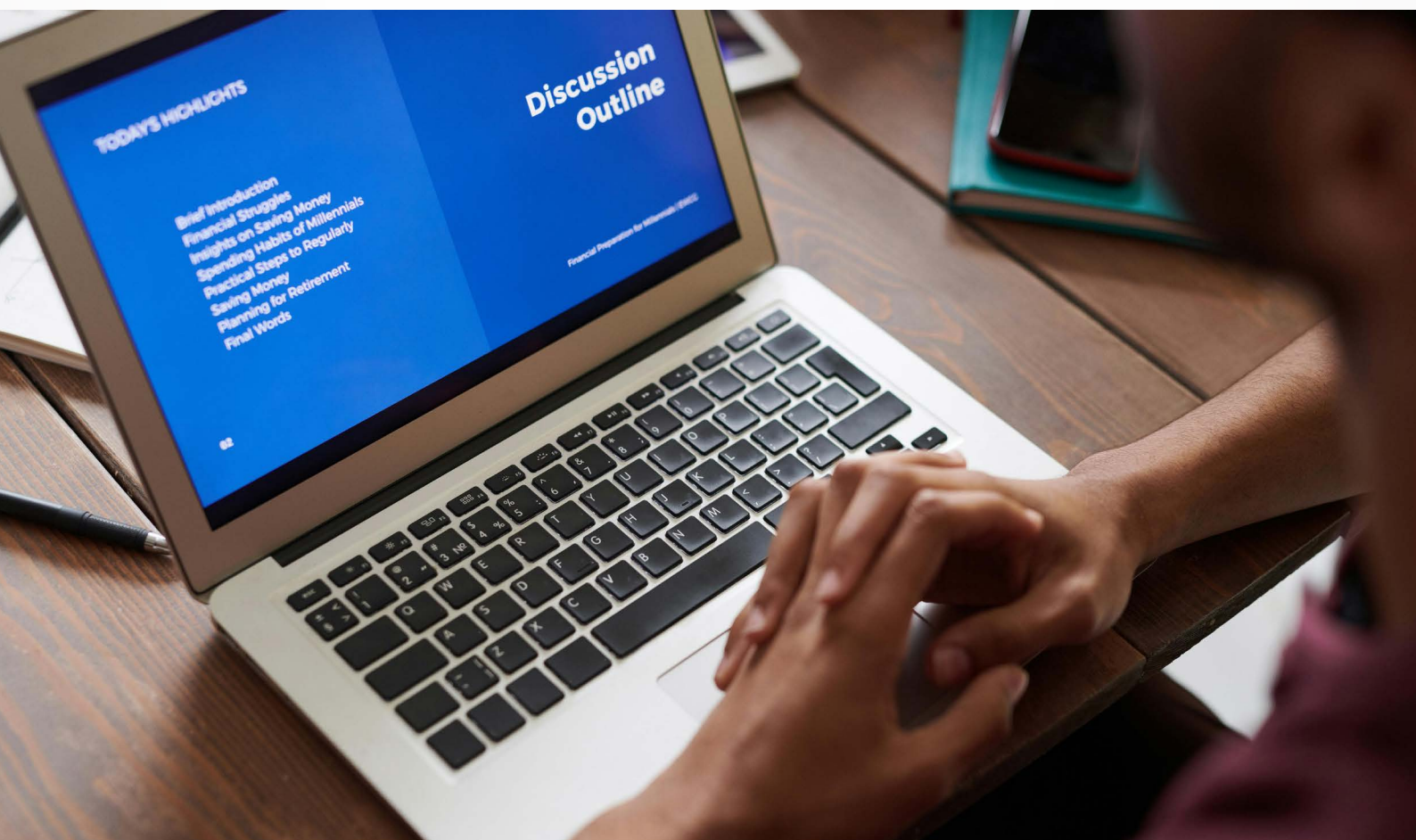
"When we started, there was only Facebook as a social media item. And email was still a thing that people had a phobia about you Google, like, whereby people would say 'how do I log into my email?' 'What am I supposed to type?' 'How do I do this?'" In those days, just one lecturer who used this kind of projector would take papers and then they would be BEAMed and would reflect. That was the only kind of projector that we had. So, when we went to schools, as I went to [name of school withheld] for my TP okay. And then I had to face an overhead projector. And I was like, 'Whoa, how do I do this?' 'Am I supposed to use this?' So, we are not like, taught some of these things. We had to do them practically. When this happens, we are now teaching". Said a Mashonaland West teacher.

The flipped classroom model had positive effects on the learning areas, especially the Continuous Assessment Learning Activities (CALAs), which required the learners to conduct activities outside

the classroom. Flipped learning was found to be useful not only for CALAs, but especially during the school holiday and the COVID-19 pandemic, when students were unable to have face-to-face interactions with teachers. In schools where Wi-Fi was accessible to learners, they would use the facilities to conduct their CALAs before knocking off to save data costs while learners in schools with no access to Wi-Fi conducted their CALAs while at home. Both teachers and students expressed that the CALAs were harder to conduct when there was no access to Wi-Fi. In this case, learners, especially boarders in schools that did not allow mobile devices to be used, were more digitally marginalised when expected to conduct their CALAs.

Usage of Visual Learning Tools

At times, the flipped classroom would require the teacher to make some demonstrations to the learners with the use of a projector a television or an interactive screen. However, these devices were not enough to meet the needs of the teacher. Most schools had one projector that would be used among the teacher population. However, the interactive screen board was out of the reach of most schools. There was a notable case in Bulawayo where the interactive screen board had become a “white elephant” as it did not have some necessary components. In most cases, teachers did not receive laptops, school computer labs were less equipped or teachers were not sufficiently qualified to use devices such as projectors. Therefore, teachers would use innovative techniques such as sending content to learner phones or using the computer lab to conduct their lessons. In some cases, the learners provided technical assistance during the lesson or suggested content that could be shared with other learners.



Collaborating using WhatsApp learning platforms

The WhatsApp learning groups have been created as an alternative strategy to share additional learning materials with the learners, either to support the CALAs or reinforce what has been taught in class. Most teachers preferred to leave WhatsApp groups as announcement groups so that learners could not post unwanted content that would detract from the learning process. Very few teachers allowed the learners to post content on the group and would reprimand learners who did not comply with the group's rules.

There are four types of WhatsApp learning groups: (a) groups for learners in a particular form who are studying a subject in which learners can participate with the teacher as a facilitator, (b) announcement groups in which the teacher posts information but does not expect feedback from the learners, (c) learning groups that are run by learners in a school or nationally and allow interactivity, (d) learning groups comprised of subject teachers who share information or peer teaching about their learning areas, e.g., ZIMSEC markers or teachers writing a book, and (e) parent-admin groups in which teacher/parent could get information from the school authorities. In the case of groups where teachers and students interact, teachers were cautious that parents or guardians could be on the other side of the phone since the activities were conducted at home.

A teacher gave insight into how interactive groups with learners are formed.

“When you create a WhatsApp group you need numbers, so for each class, the class monitor will be the class administrator, and they add the class to the group, and WhatsApp is used at home. Maybe they will use the parents’ phone.” said one teacher from Matabeleland South.

However, some teachers felt that the groups should have less interactivity because there was a chance that they would be interacting with the parent or guardian instead of the learner.

“At one time I sent notes to my learners on WhatsApp. One of the parents threatened me by answering on WhatsApp saying: ‘How do you send my child’s notes at 9 pm?’ Said one teacher in Masvingo.

In some cases, teachers preferred to have fewer interactive groups with the learners. In this case announcement groups were created in which the teacher was the administrator and the learner could not send any feedback. Parents would then communicate with the school through the groups that the administration runs while the learner would respond through face-to-face in-class discussions.

“I have activated my groups to allow me and I am the only admin in that group to share whatever it is that I want to share. It is an announcement group. If there is anything, I tell them to come see me personally tomorrow. I just announce what I want to announce to them. They come to see me. They bring whatever they are going to bring me so that I control this (information). Before that eish, they could

just send anything.” Said one teacher in Mashonaland Central.

A teacher mentioned how she used WhatsApp to collaborate with other teachers in writing a book for the student.

“I wrote a grade three English book and it was a collaboration. I wrote some chapters in the revision book. So, we used to have a WhatsApp group where everyone at the end of the week would send their work, believe me, we solved it together and helped each other correct the information so that people could emerge perfect teachers”. Said a teacher in Manicaland.

Learners’ Digital Literacy Skills

The learners were asked about their digital literacy skills. In general, learners were confident in customising devices to suit personal needs and the usage of applications such as WhatsApp, MS Word, Excel, and PowerPoint. Specialised skills were found mainly among computer science learners, and these included the use of programming languages. Teachers said that some learners were interested in digital tools, even if they did not have gadgets. The digital literacy of the students was impeded by their lack of exposure to digital tools.

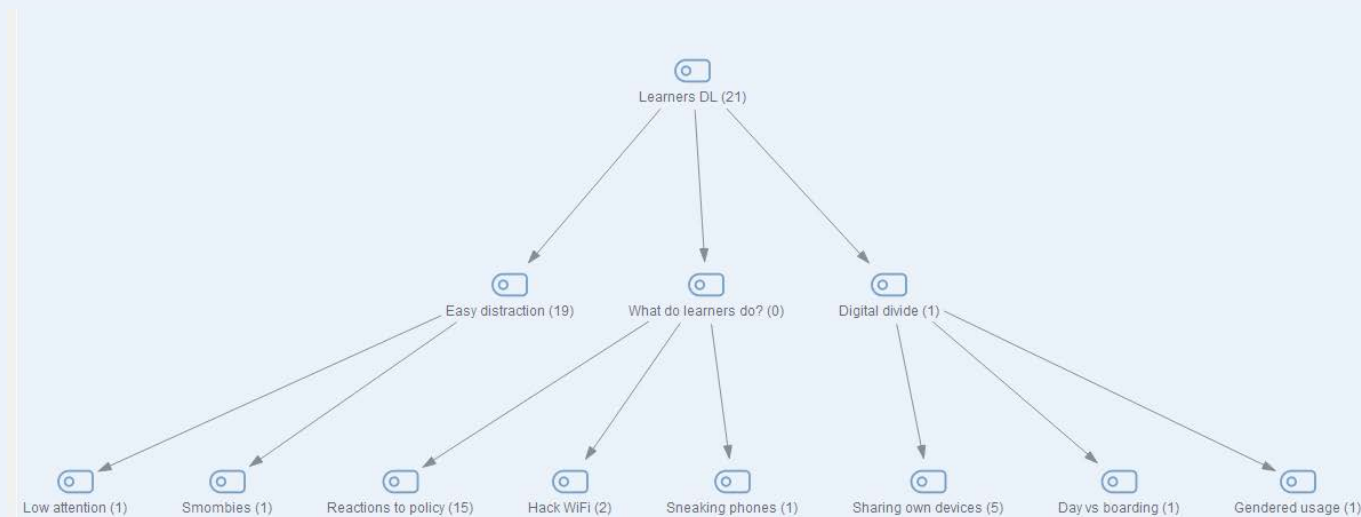


Figure 9: Use of Digital Devices by Students in School Settings

However, the students had low digital literacy skills when it came to ethical use of devices and filtering information on the Internet. In terms of ethical usage, the study found that learners could hack the school Wi-Fi, sneak their phones into school despite the device policies, and have a high likelihood of being exposed to pornography, digital peer pressure and cyberbullying (see Figure 9). When it comes to information filtering, for example, students would cite materials that were beyond their level or outside of the syllabus. Other challenges cited were the gendered usage of digital devices, wherein parents were more likely to buy their boy child a digital device, rather than buying one for the girl child. As discussed previously, boarders were more likely to be deprived of the usage of digital devices as compared to day scholars. This worsens when the school Wi-Fi infrastructure does not reach hostels and is concentrated around administration blocks.

Analysis of the Infrastructure/Observation Checklist

Schools Distribution

A total of 124 schools filled in the Infrastructure Assessment questionnaire (Table 12). The highest number of respondents were received from Manicaland (17) and Mashonaland East (17).

Province	Number of Schools	Percentage
Harare	7	5.6
Bulawayo	11	8.9
Manicaland	17	13.7
Midlands	8	6.5
Mashonaland Central	14	11.3
Mashonaland West	15	12.1
Mashonaland East	17	13.7
Matabeleland South	11	8.9
Matabeleland North	12	9.7
Masvingo	12	9.7
Total	124	100.0

Table 12: Distribution of Schools by Province

The schools were clustered into their localities to reflect the socio-economic environment in which they operate as well as the gross enrolments. It can be seen from Figure 10 that schools in high density areas and medium density suburbs have a high enrolment, especially in Harare and Mashonaland East.

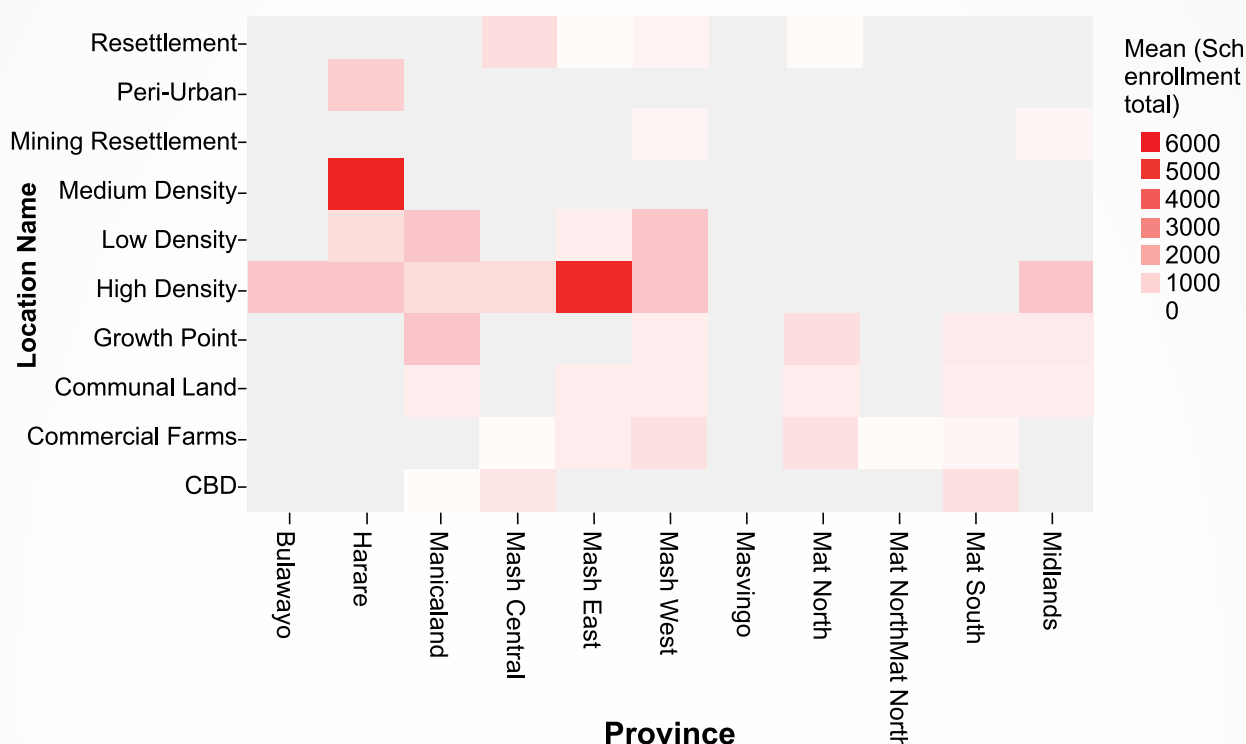


Figure 10: Distribution of Schools Per Province Clustered By Locality

Responsible Authority

The majority of the schools were run by rural local authorities (43.5%) followed by the government (30.6%) (Table 13).

	Frequency	Percent
Government	38	30.6
Church	18	14.5
Rural Local Authority	54	43.5
Urban Local Authority	5	4.0
Private Owner	5	4.0
NGO	2	1.6
Government Department	2	1.6
Total	124	100.0

Table 13: Responsible Authority of the schools

Electricity Supply

At most of the schools the National Electricity Grid was available (91.9%) and 88.7% were connected to the National grid (Table 14).

	Mains Electricity/National Grid Available		Connected To Grid	
	Frequency	Percent	Frequency	Percent
No	7	5.6	9	7.3
Yes	114	91.9	110	88.7
Did not indicate	3	2.4	5	4.0
Total	124	100.0	124	100.0

Table 14: National Electricity Grid

Mobile Network Operators

Econet and Netone (39.5%) were the most mobile operators among the sampled schools (see Table 15).

Mobile Operator	Frequency	Percentage (%)
Econet	18	14.5
Netone	4	3.2
Econet, Telecel, Netone, Africom	4	3.2
Econet, Telecel, Netone	37	29.8
Econet, Netone	49	39.5
Econet, Telecel, Africom	1	0.8
Telecel, Netone	1	0.8
Did not indicate	10	8.1
Total	124	100.0

Table 15: Mobile Phone Operators

Available Internet Service Providers

The most available ISP to the schools was Telone (29.8%) (see Table 16).

Internet Service Provider	Frequency	Percent
TELONE	37	29.8
UTANDE	7	5.6
ZARNET	6	4.8
Econet	5	4.0
Netone	5	4.0
ZOL & TELONE	3	2.4
Liquid Telcom	4	3.2
ZOL	3	2.4
Econet & Netone	3	2.4
TELONE & UTANDE	3	2.4
Econet, Netone & Telecel	3	2.4
Telone & Zarnet	3	2.4
POTRAZ	2	1.6
Dark Fibre Africa, Zimbabwe	1	0.8
Higherlife	1	0.8
Liquid & POTRAZ	1	0.8
Netone & ZOL	1	0.8
Radio Link NBRE Network	1	0.8
Telone & Liquid Telcom	2	1.6
Telone & Telecontract	1	0.8
Telone, Africom, UTANDE, Liquid Telcom	1	0.8
TELONE, UTANDE & POTRAZ	1	0.8
ZARNET, TELONE & ECONET	1	0.8
Zim Community Network (Vision Internet)	1	0.8
ZOL/LIQUID	1	0.8
Did not indicate	27	21.8
Total	124	100.0

Schools Main Power Source

The majority of the schools were connected to the national grid (71%) and were using generators as alternative power sources (40.3%) (see Table 17)

School Main Power Source			Alternative Power Sources		
Main Power Source	Frequency	Percent	Alternative Power Source	Frequency	Percent
ZESA	88	71.0	ZESA	2	1.6
Solar	4	3.2	Solar	26	21.0
Generator	1	0.8	Generator	50	40.3
School not connected to any power source	5	4.0	None	21	16.9
ZESA, Solar, Generator	5	4.0	ZESA, Solar, Generator	2	1.6
ZESA, Solar	9	7.3	ZESA, Solar	4	3.2
ZESA, Generator	11	8.9	ZESA, Generator	3	2.4
Solar, Generator	1	0.8	Solar, Generator	8	6.5
Total	124	100.0	Did not indicate	8	6.5
			Total	124	100.0

Table 17: Schools Main Power Source



Where are School Computers Located

In most schools (62.1%), computers were located in the computer laboratory and storeroom (12.1%) (see Table 18).

School Computers location	Frequency	Percent
Computer Lab	77	62.1
Library	3	2.4
Storeroom	15	12.1
Classroom	3	2.4
Computer lab, Classroom	2	1.6
Computer Lab, Library, Storeroom	1	0.8
Computer Lab, Library	7	5.6
Computer Lab, Classroom	1	0.8
Computer Lab, Library, Science Lab	1	0.8
Computer Lab, Library, Classroom	1	0.8
None	2	1.6
Did not indicate	11	8.9
Total	124	100.0

Table 18: School Computers Location

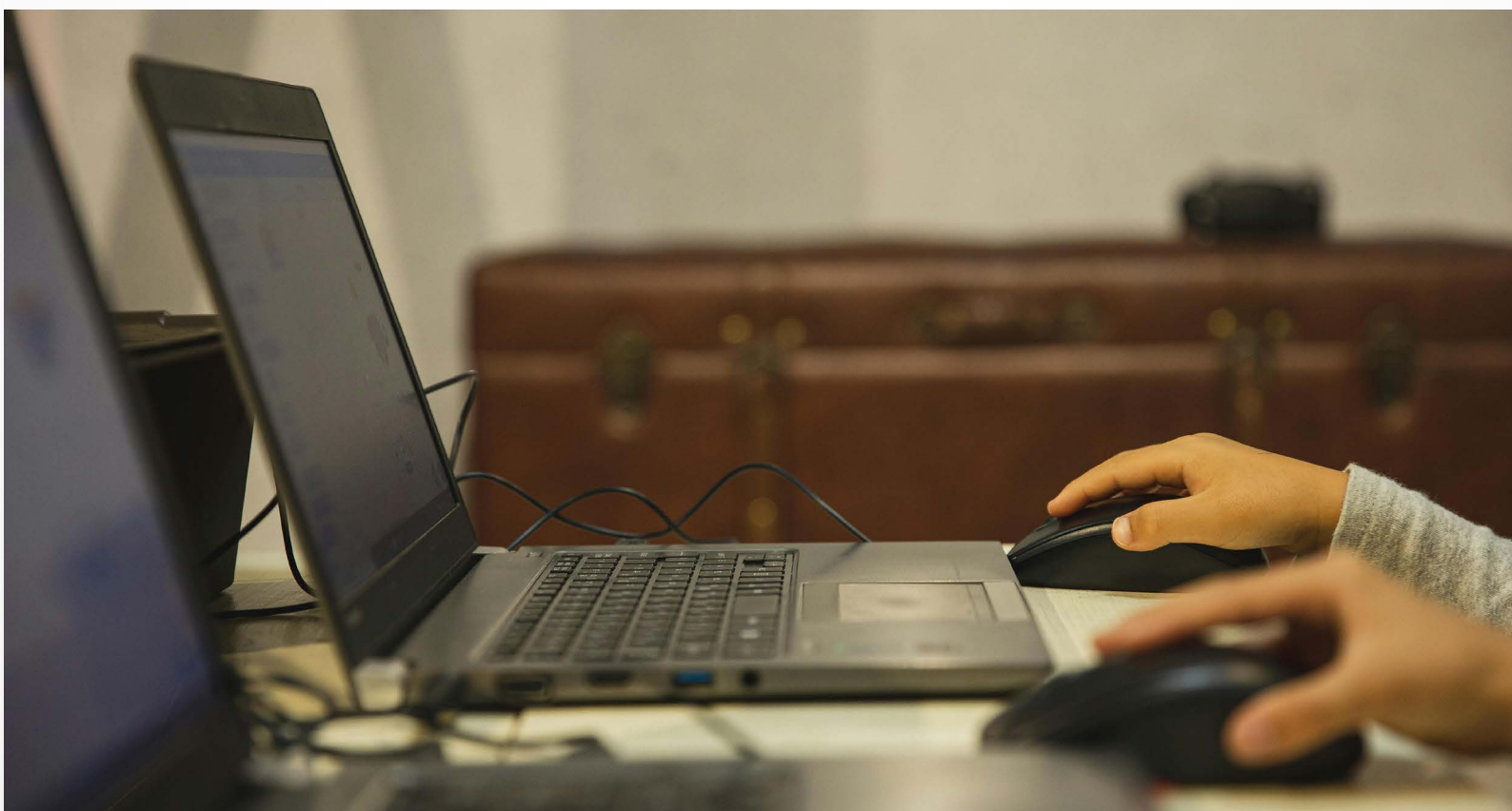


State of Computer Laboratory/Room

Air-conditioners, UPS/Inverter, Fire extinguishers and Intranet were said to be non-existent at most schools (see Table 19).

	Non-Existent	Non-Functional	Functional Obsolete (Outdated)	Functional up to date	Did not answer
Comfortable Chairs	34 (27.4%)	2 (1.6%)	20 (16.1%)	52 (41.6%)	16 (12.9%)
Sockets	9 (7.3%)	4 (3.2%)	9 (7.3%)	92 (74.2%)	10 (8.1%)
Air-Condition-ers	93 (75%)	3 (2.4%)	2 (1.6%)	13 (10.5%)	10 (8.1%)
Lighting	12 (9.7%)	10 (8.1%)	9 (7.3%)	83 (66.9%)	10 (8.1%)
Tables	18 (14.5%)	1 (0.8%)	27 (21.8%)	68 (54.8%)	10 (8.1%)
Cable Trunking	39 (31.5%)	5 (4.0%)	11 (8.9%)	51 (41.1%)	18 (14.5%)
UPS/Inverter	72 (58.1%)	2 (1.6%)	4 (3.2%)	21 (16.9%)	25 (20.2%)
Fire Extinguish-ers	54 (43.5%)	8 (6.5%)	11 (8.9%)	38 (30.6%)	13 (10.5%)
Ventilation	11 (8.9%)	3 (2.4%)	11 (8.9%)	82 (66.1%)	17 (13.7%)
Ramp	68 (54.8%)	3 (2.4%)	2 (1.6%)	30 (24.2%)	21 (16.9%)
Ceiling	45 (36.3%)	2 (1.6%)	7 (5.6%)	62 (50.0%)	8 (6.5%)
Intranet	61 (49.2%)	8 (6.5%)	6 (4.8%)	27 (21.8%)	22 (17.7%)
Internet	21 (16.9%)	16 (12.9%)	8 (6.5%)	69 (55.6%)	10 (8.1%)

Table 19: State of Computer Laboratory/Room



Available Computing Equipment Quantity

At most schools, most of the equipment was said to be less than 15 per item (see Table 20).

Equipment	5 or less	6 to 15	16 to 25	26 to 35	36 to 45	46 to 55	56 and above	Did not answer
Desktops	18 (14.5%)	33 (26.6%)	26 (21.0%)	4 (3.2%)	8 (6.5%)	6 (4.8%)	6 (4.8%)	23 (18.5%)
Laptops	66 (53.2%)	18 (14.5%)	4 (3.2%)	15 (12.1%)	4 (3.2%)	0 (0%)	4 (3.2%)	13 (10.5%)
Tablets	62 (50.0%)	10 (8.1%)	3 (2.4%)	1 (0.8%)	5 (4.0%)	0 (0%)	2 (1.6%)	41 (33.1%)
Smartphones	60 (48.4%)	2 (1.6%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	3 (2.4%)	53 (42.7%)
Smartboards	71 (57.3%)	3 (2.4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	50 (40.3%)
Projectors	94 (75.8%)	10 (8.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	20 (16.1%)
Scanners	82 (66.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	42 (33.9%)
Printers	89 (71.8%)	17 (13.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18 (14.5%)
Photocopiers	94 (75.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	30 (24.2%)
Landline phone/VoIP	83 (66.9%)	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	40 (32.3%)
Router Modems	93 (75.0%)	2 (1.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	29 (23.4%)
E-learning Platform	66 (53.2%)	2 (1.6%)	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	54 (43.5%)
Technology for the Disabled	45 (36.3%)	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	78 (62.9%)
Televisions	82 (66.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	42 (33.9%)
Website	59 (47.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	65 (52.4%)
Other	9 (7.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	115 (92.7%)

Table 20: Available Computing equipment quantity

Operating System Installed Name

Windows was the most installed OS at most schools (see Table 21 a &b).

	OS name		
	Windows	MS Office	Android
Desktops	53 (42.7%)		
Laptops	41 (33.1%)	1 (0.8%)	
Tablets	2 (1.6%)		8 (6.5%)
Smartphones	1 (0.8%)		6 (4.8%)

Table 21 (a): Available Computing equipment quantity

Operating System Installed Version

A variety of versions had been installed in devices across the different schools.

Table 10 (b). Available Computing equipment quantity
Table 21 (b): Available Computing equipment quantity

Operating system	7	8	7 & 10	7, 8 & 10	7, 10 & 11	10	10 & 11	11
Desktops	9 (7.3%)	3 (2.4%)	3 (2.4%)	1 (0.8%)	1 (0.8%)	20 (16.1%)	1 (0.8%)	1 (0.8%)
Laptops	3 (2.4%)	2 (1.6%)		1 (0.8%)		28 (22.6%)	1 (0.8%)	1 (0.8%)

Available Computing Equipment Ownership



Most of the computing equipment was owned by schools (see Table 22).

	Own School		Own Personal		Own Other	
	Not Selected	Selected	Not Selected	Selected	Not Selected	Selected
Desktops	3.30%	96.70%	100%	0%	100%	0%
Laptops	97.90%	2.10%	97.90%	2.10%	75.80%	24.20%
Tablets	31%	69%	100%	0%	100.00%	0%
Smartphones	63.90%	36.10%	51.40%	48.60%	97%	3%
Smartboards	0.00%	100%	0%	0%	0%	0%
Projectors	15.60%	84.40%	1.60%	98.40%	100%	0%
Scanners	27.50%	72.50%	100%	0%	100%	0%
Printers	6.70%	93.30%	100%	0%	100%	0%
Photocopiers	12.50%	87.50%	100%	0%	100%	0%
Landline/VoIP	27.80%	72.20%	97.30%	2.70%	100%	0%
Router modems	0%	100%	100%	0%	100%	0%
E-Learning platform	48.40%	51.60%	6.50%	93.50%	90.00%	10%
Technology for the Blind	92.90%	7.10%	92.90%	7.10%	92.90%	7.10%
Televisions	34.20%	65.80%	94.70%	5.30%	97.4%	2.60%
Website	0%	100%	100%	0%	90%	10%

Table 22: Available Computing Equipment Ownership

Available Computing Equipment State



	Non existent	Non functional	Functional Obsolete (Outdated)	Functional Up to Date	Non Functional, Functional Up to Date	Functional, Functional Obsolete	Functional Obsolete, Functional Up to date	Non Functional, Functional Obsolete, Functional Up to Date	Did not Indicate
Desktops	6 (4.8%)	8 (6.5%)	23 (18.5%)	36 (29%)	15 (12.1%)	2 (1.6%)	4 (3.2%)	4 (3.2%)	26 (21%)
Laptops	2 (1.6%)	1 (0.8%)	4 (3.2%)	75 (60.5%)	6 (4.8%)	1 (0.8%)	4 (3.2%)	3 (2.4%)	28 (22.6%)
Tablets	19 (15.3%)	1 (0.8%)	1 (0.8%)	16 (12.9%)	2 (1.6%)	2 (1.6%)		1 (0.8%)	82 (66.1%)
Smartphones	17 (13.7%)	4 (3.2%)	21 (16.9%)					82 (66.1%)	
Smartboards	24 (29.4%)	1 (0.8%)	2 (1.5%)	13 (10.5%)					84 (67.7%)
Projectors	12 (9.6%)	5 (4.9%)	5 (4.9%)	56 (45.2%)	2 (1.6%)				44 (35.5%)
Scanners	12 (9.65%)	2 (1.6%)	2 (1.6%)	35 (28.2%)	1 (0.8%)				72 (58.1%)
Printers	6 (4.8%)	4 (3.2%)	10 (8.1%)	58 (46.8%)		2 (1.6%)	2 (1.6%)	32 (25.8%)	
Photocopiers	9 (7.2%)	3 (2.4%)	7 (5.6%)	51 (41.1%)	2 (1.6%)	1 (0.8%)		2 (1.6%)	49 (39.5%)
Landline/VoIP	14 (11.2%)	10 (8.1%)	3 (2.4%)	24 (19.4%)	1 (0.8%)				72 (58.1%)
Router modems	10 (8.0%)	5 (4.0%)	7 (5.6%)	57 (46.0%)	2 (1.6%)				43 (34.7%)
E-Learning platform	15 (12.1%)	1 (0.8%)	1 (0.8%)	22 (17.7%)	1 (0.8%)				84 (67.7%)
Technology for the Blind	21 (16.9%)		3 (2.4%)					100 (80.6%)	
Televisions	19 (15.3%)	3 (2.4%)	5 (4.0%)	26 (21.0%)	2 (1.6%)				69 (55.6%)
Website	18 (14.7%)	3 (2.4%)	2 (1.6%)	14 (11.3%)				87 (70.2%)	
Other	11 (8.8%)			2 (1.6%)					111 (89.5%)

Table 23: Available Computing equipment state

Perception of Adequacy of ICT Devices at Schools

Devices at most schools were said to be inadequate (see Table 24).

Are ICT Devices at School Adequate?	Frequency	Percentage
No	117	94.4
Yes	7	5.6
Total	124	100.0

Table 24: Adequacy of ICT Devices in Schools

Are you connected to the Internet?

The majority of the schools were connected to the internet (see Table 25).

Connected to the Internet	Frequency	Percentage
No	23	18.5
Yes	100	80.6
Did not answer	1	0.8
Total	124	100.0

Table 25: School Internet Connections

Reasons why Schools are not Connected to the Internet

Not having enough equipment and lack of funds were cited as the major reasons most schools were not connected to the internet (see Table 26).

Reasons why not connected to the Internet	Frequency	Percent
Non-functional, Outdated Equipment	5	4.0
Lack of Funds	30	24.2
Computer learning still being introduced	1	0.8
Destroyed by fire	1	0.8
Devices attacked by termites	1	0.8
Not enough equipment	36	29.0
No electricity	5	4.0
Lack of space	1	0.8
No ICT Devices	1	0.8
No Internet Service Providers	1	0.8
Did not answer	42	33.9
Total	124	100.0

Table 26: Reasons why Schools are not Connected

Internet Service Provider

Telone was indicated to be the major ISP at most schools (see Table 27)

Internet Service Provider	Frequency	Percentage
Econet	6	4.8
Econet, Netone	1	0.8
Higherlife	1	0.8
Liquid Telcom	3	2.4
Mirko Tech	1	0.8
Netone	4	3.2
POTRAZ	3	2.4
Telone	50	40.3
Telone, Liquid Telcom	2	1.6
Telone, Telecontract	2	1.6
Telone, Utande	1	0.8
Telone, Zarnet	2	1.6
Telone, Econet, Zarnet	1	0.8
Utande	8	6.5
Vision Internet	2	1.6
Zarnet	8	6.5
ZOL	3	2.4
ZOL, Liquid Telcom	2	1.6
ZOL, Telone	1	0.8
Did not answer	23	18.5
Total	124	100.0

Table 27: Internet Service Providers at Schools

Challenges in the Use of Digital Literacy Skills

- Interruption of learning, for example, sharing classrooms or unpredictable school schedules
- Lack of social cohesion because learners are absorbed by the phone.
- Learners can easily get distracted when using digital devices in class.
- Limited time to learn ICTs
- Overwhelmed ICT Teachers
- Monitoring learners is hard
- Electricity not available
- No ICT integration
- Competing for space
- Weak Parent Teacher Associations (PTA)
- Lack of funds
- Primary scuffling
- Teachers with low digital literacy skills
- Technology Advancement
- Decline in Library Services
- Learners' ICT literacy
- Over-enrolment
- Lack of devices
- Cost of data
- Inconsistency in school device policies
- Theft of digital devices
- Vandalism of electrical sockets when learners charge their devices

Overall Assessment and Conclusions

To come with an overall assessment and conclusions of the study, the researchers developed an index to benchmark regional and international research with the results of the study.

A systematic literature search was conducted to ensure that the researchers compared studies with similar characteristics. Dimensions, Scopus and Web of Science databases were searched. Another search was conducted on Google Scholar to find literature that is not indexed within the databases. The following question guided the search: “What is the impact of integrating DigComp into the curriculum on the teaching of digital skills in secondary schools?”. The sample search below summarises how the process was conducted.

Sample search on Google Scholar

The sample search was applied in other databases with some modifications based on the syntax capabilities. See the table below for the keywords applied.

TABLE 28: SAMPLE SEARCH ON GOOGLE SCHOLAR

Searcher: Israel Mbekezeli Dabengwa

Date of Search: 13 December 2023

Search phrase	Results
“digcomp” NEAR “Information and Data Literacy” NEAR “Communication and Collaboration” NEAR “Digital Content Creation” NEAR “Safety” NEAR “Problem-solving” AND “teach*” OR “educat*” AND “secondary school” OR “high school”	131

Inclusion Criteria and Exclusion of the Studies for Benchmarking

To ensure heterogeneity in the studies inclusion and exclusion criteria below were applied.

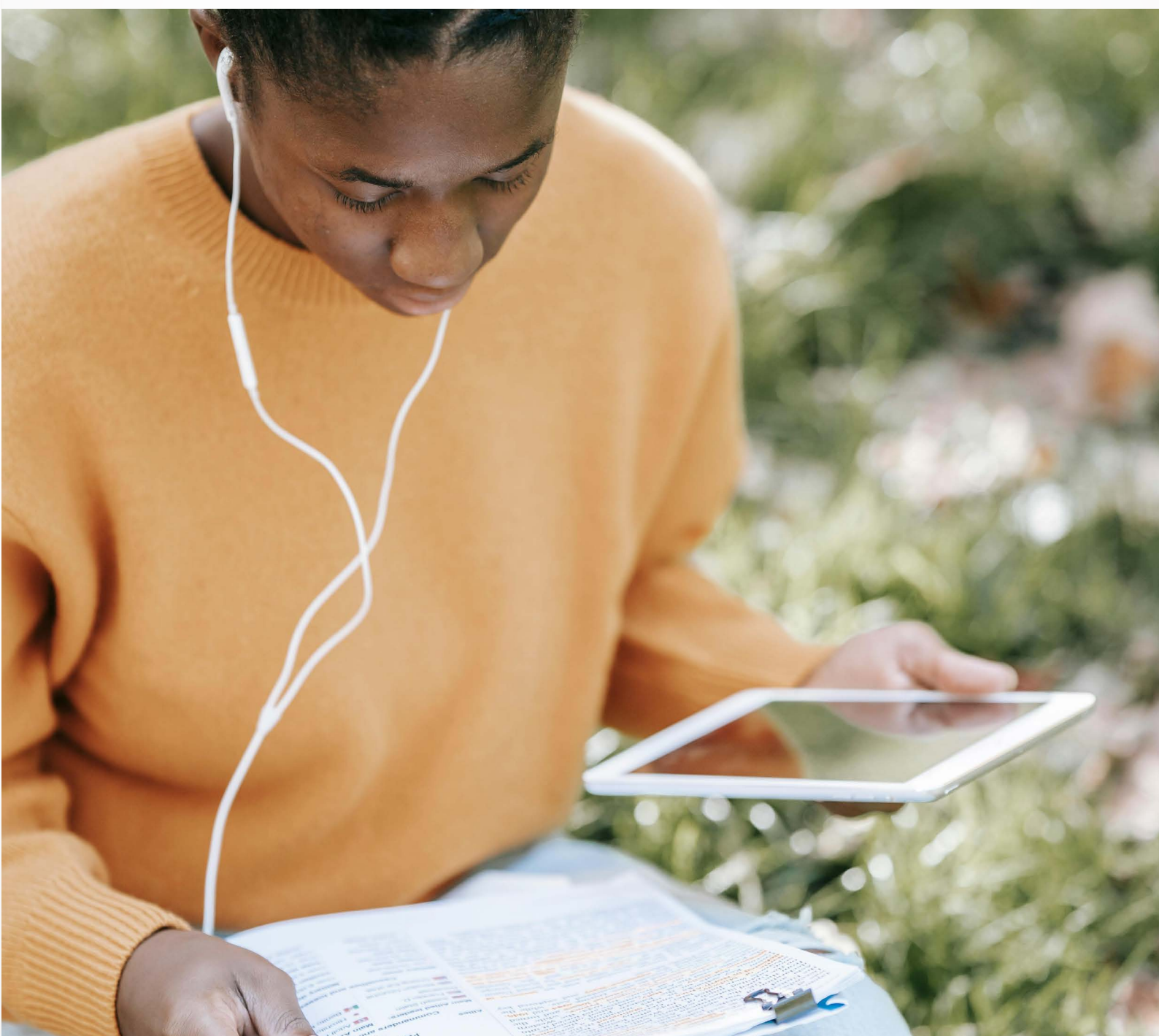
Inclusion Criteria

1. Studies that apply any version of the European Framework for Digital Competence known as DigComp.
2. Studies conducted on in-training and in-service secondary education teachers.

3. Quantitative surveys that apply the DigComp framework over the target population.
4. Research designs such as cohort studies and cross-sectional surveys.
5. All geographic regions.
6. English language only.

Exclusion Criteria

1. Studies that use other digital competence frameworks such as Teacher Training for Compulsory Secondary Education, Digital Competence Framework for Educators (DCF)
2. Studies that do not use all the 5 dimensions of the DigComp framework such as Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Problem-Solving and Safety.
3. Studies that do not report the overall digital literacy levels of secondary teachers.



Selected Studies for Benchmarking

Only 5 studies were selected because they fit into the inclusion criteria. Therefore, the results of this study are comparable to countries like Macedonia and Slovenia, Malaysia, and Spain. The authors include García-Vandewalle García et al. (2023), Lim et al. (2021), Nančovska Šerbec et al. (2016) , Tsankov & Damyanov (2019) and Zhang et al. (2023).

Data Extraction to Build an Index

The methods and the results sections of the studies were extracted for data such as "Author", "Country of the Study", "Study Group", "Scale used", "Number of items", "Statistical Tests Used", and "Key findings". This data is tabulated in Annex 7 (Index for Comparing Digital Literacy Skills among Secondary School Teachers in Different Parts of the World).

Discussion Section

Teacher Demographics

The literature retrieved studies cover only Asia and Europe. For Asia, Lim et al. (2021) explored the upsurge of digital competence and social media usage in Malaysia among teachers, but did not specify the demographics of the pre-service secondary school teachers and Zhang et al. (2023) examined 910 pre-service teachers from 12 Chinese universities. In Europe, García-Vandewalle García et al. (2023) total of 266 pre-service secondary school teachers Spain, Nančovska Šerbec et al. (2016) examined 138 secondary school teachers from Slovenia and Macedonia, and Tsankov & Damyanov (2019) surveyed 338 Bulgarian pre-service secondary school teachers. Compared to the literature, the study's sample size of 2,263 teachers seems to be the largest. Also, the literature seems to concentrate more on pre-service teachers as compared to in-service teacher that are addressed by this study. As such, the present study includes the teachers with practical experience in the classroom whereas, the in-service teachers have more theoretical knowledge because of lack of experience.

Digcomp Instruments Used

The literature points that there is no consistence in the DigComp tools that have been administered to teachers. There are instances when the DigComp tool is adapted to fit in measures from other instruments, e.g., Alnasib (2023). In other instances, the number of items per dimension differ with each study. The number of items range from 21-91, while other authors do not specify the number of items used. For example, Tsankov & Damyanov (2019) used 21 items, Zhang et al. (2023) relied on 21 items, and García-Vandewalle García et al. (2023) had 91. The DigComp questionnaire in the had 62 items that spread across Knowledge,

Skills and Attitude levels. Although the number of items differs, all of the studies, including the present are conforming to the DigComp framework as the number of statement is suggestive according to the need rather than prescriptive and whole (Vuorikai et al., 2022),

Likert Scales Used

There is a difference in the Likert scales used by researchers within this area. The 5-point Likert scale and the 3-point Likert scale (Nančovska Šerbec et al. 2016; Tsankov and Damyanov 2019).The 4-point Likert scale (García-Vandewalle García et al., 2023), and the 8-point Likert scale (Lim et al., 2021) are not quite used. Although not included in the studies for analysis, the 5-point scale was found in the studies from Alnasib (2023) and Jiménez-Hernández et al. (2020).

There are also differences in the grading even on the same scale. For example, some 5 Likert scales use (1 = Rarely, 2 = Sometimes, 3 = Half The Time, 4 = Almost Always, and 5 = Always), e.g., (Pérez-Navío et al., 2021). Whereas, Jiménez-Hernández et al. (2020) stated that 1 was then minimum and 5 as the maximum and Alnasib (2023) used Agree (4), Partially Agree (3), Disagree (2), and Strongly Disagree (1).

Outcomes of the DigComp Assessment

Although the study's findings may not be comparable with others without standardisation or transformation, the outcomes such as levels of digital literacy and ranking of items can be applied (see Table below).

Zimbabwe's findings are comparable with international evidence as the Cronbach Alphas per dimension of the DigComp tool are within acceptable margins and do not deviate from those found in published studies. What differs is the manner in which the DigComp dimensions are ranked in each country, wherein the order may change. However, what is common is that Information and Digital Literacy are always on the top of the ranking in most cases, followed by Communication and Collaboration. Although, there is an interchange between Problem-solving and Safety, the latter seems to be ranked lower in most cases. This may be consistent with recent results from Hidayat et al. (2023) that established that Problem-Solving items are usually the hardest in the DigComp tool. Zhang et al. (2023) explained that the order in which the top 3 dimensions appear shows a significant positive relationship with use of specific applications that teachers use on a daily basis, either for work or for personal purposes.

At the intermediate level, the DigComp handbook states that this level of proficiency means that a person can explain, perform well-defined routines, illustrate what they can do, organising and describing tasks conducted using digital tools. Zimbabwean secondary school teachers seem to be at par with secondary school teachers from Spain and Macedonia and above the level of Bulgaria.

Authors	Country	Likert Scale
Dabengwa et. al (2023)	Zimbabwe	5-Point Likert scale
(García-Vandewalle García et al., 2023)	Spain	4-Point Likert Scale
(Lim et al., 2021)	Malaysia	8-point Likert scale
Nančovska Šerbec et al., 2016)	Macedonia and Slovenia	3-Point Likert scale
(Tsankov & Damyanov, 2019)	Bulgaria	3-point Likert scale

Table 29: An Index to Compare the Results of Digcomp Tools that have used a 5-Point Likert Scale Among Secondary Teachers

	Reliability of Scale (Alpha upper boundary: lower boundary)	Level of Digital literacy	Ranking of DigComp Dimensions
	Information and Data Literacy ($\alpha = 0.768 0.753:0.782$); Communication and Collaboration ($\alpha = 0.849 0.849:0.867$); Digital Content Creation ($\alpha = 0.828 0.818:0.838$); Problem Solving ($\alpha = 0.863 0.855:0.872$); Safety ($\alpha = 0.829 0.819:0.840$)	Slightly Above Intermediate	1. Information & Data Literacy; 2. Communication & Collaboration; 3. Digital Content Creation; 4. Problem-Solving; 5. Safety
	Information and Data Literacy ($\alpha = 0.870$); Communication and Collaboration ($\alpha = 0.900$); Digital content creation ($\alpha = 0.854$); Security ($\alpha = 0.723$); Problem-solving ($\alpha = 0.830$).	Slightly Above Intermediate	1. Information and Data Literacy, 2. Safety; 3. Digital content creation; 4. Problem-solving; 5. Communication and collaboration
	1. Information and Data Literacy ($\alpha = 0.939$); Communication and Collaboration ($\alpha = 0.964$); Digital Content Creation ($\alpha = 0.920$); Safety ($\alpha = 0.915$); Problem Solving ($\alpha = 0.956$)	Advanced	1. Information and Data Literacy; 2. Communication and Collaboration; 3. Digital Content Creation; 4. Safety; 5. Problem Solving
	Not stated	- Slovenia (Slightly Below Intermediate) - Macedonia (Slightly Above Intermediate)	1. Information and Data Literacy; 2. Digital Content Creation; 3. Communication and Collaboration; 4. Problem-Solving and 5. Safety. Both countries scored low on Problem Solving and Safety.
	Not stated	Basic	1. Information & Data Literacy (Independent/Intermediate); 2. Communication and
			Collaboration (Basic); 3. Digital Content Creation (Basic); 4. Problem-Solving (Basic); 5. Safety (Basic)

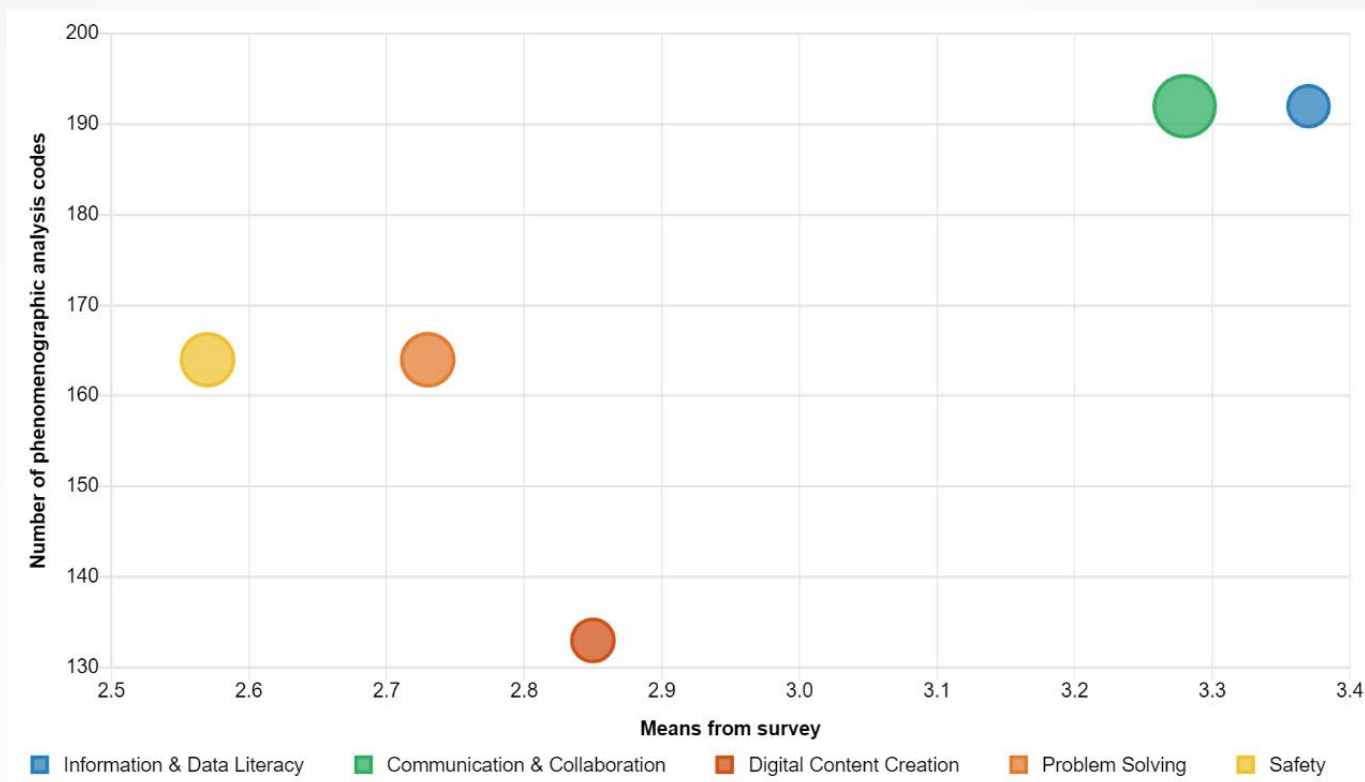


Figure 11: A Bubble Chart Analysis of the Quantitative and Qualitative Data

Integrating Qualitative and Quantitative Data

None of the retrieved studies have used qualitative data. From Figure 11, it can be seen that only Information and data Literacy and Communication and Collaboration are above Intermediate Level Skills when both qualitative and quantitative data are integrated. On the other hand, digital skills, such as Digital Content Creation, Safety and Problem Solving are found to be below the Intermediate Level.

When the data is integrated, Communication and Collaboration has the biggest bubble as compared to other dimensions. This is followed by Safety and Problem Solving, though they are below the Intermediate Level. However, the bubble for Information & Data Literacy is smaller, though it is above the Intermediate Level.

A study by Lim, Halim, and Ramayah (2021) among Malaysian pre-service teachers explains the reasons why Communication and Collaboration seem to take a central role. Lim, Halim, and Ramayah (2021) found that digital competences were influenced by the usage of social media, and in turn the relationship had a positive effect to the endogenous construct (workforce agility). This study has proved the central role that social media plays in and out of the classroom. In the Zimbabwean context, social media platforms like WhatsApp are used for eLearning. However, this is a contextual issue that may be relative to Zimbabwe. Lim, Halim, and Ramayah (2021) comment that Malaysian teachers do not communicate with their learners through social media and prefer to use formal channels like the school learning management system. The Zimbabwean case could probably be influenced by the lack of school learning management systems in most of the secondary schools visited.

Overall, the study findings on the DigComp questionnaire cannot explain the reasons behind the gendered differences in the statements and dimensions of the scale. However, Jiménez-Hernández et al. (2020) is a typical study that explored the gendered differences on the DigComp tool among secondary teachers. Jiménez-Hernández et al. (2020) found that women scored lower than men in some categories of the scale. Jiménez-Hernández et al. (2020) found that this trend was higher in the Information and Data Literacy and Communication and Collaboration dimensions. The current study found similar results after performing the CFA and Mann-Whitney U Test. However, comparisons on specific statements from DigComp cannot be made with this study as the number of items differs and the inaccessibility of the scale from Jiménez-Hernández et al. (2020).

Learner's Digital Literacy Skills

For the learners, the school device policy seems to be an impediment to their usage of the digital devices in the classroom, within the midst of shortages due to school's lack of financial resources. Technology-enhanced education is a panacea for learners to participate in "digital citizenship+" (e.g., the skills needed for youth to fully participate academically, socially, ethically, politically, and economically in our rapidly evolving digital world) (Cortesi et al., 2020). However, learner's usage of digital tools in the classroom is a global contentious issue that needs much more debate and planning. This

is not really an issue with a straight answer as there are debates between the protectionist and empowering views (United Nations Children's Fund [UNICEF], 2019) . While there is a need to protect children from the dangers of the Internet such as low concentration spans, self-absorption with technology (e.g., smoombies), cyberbullying, cybercrime and pornography, a total ban does foster the growth of digital competences, nor does it promote netiquette and preparation for a whole where the learner is constantly exposed to technology (Montag & Elhai, 2023). This is further supported by studies on teenager's digital competence when it comes to communicating online where it was found that learners need more training on communicating online, e.g., collaborating through digital technologies, knowledge of tools and netiquette, etc. (Iglesias-Rodríguez et al., 2021). In the Zimbabwean context, resources such as Child Online Protection Guidelines for Children (https://www.potraz.gov.zw/wp-content/uploads/2015/05/POTRAZ_COP.pdf) should be publicised at the school level so that learners are familiarised with these. Instead of banning digital tools altogether, schools and communities should work together to develop more controls on children's online safety and digital citizenship. Furthermore, soft skills such as coding should be taught to learners regardless of whether they are Computer Science learners or if they will take the ZIMSEC examination as these skills can lead to job opportunities or self-employment for school leavers.

Conclusions

This was the first assessment of secondary teachers using the DigComp tool in Africa. Previous studies conducted in Asia (China and Malaysia) and Europe (Macedonia, Slovenia, and Spain) have included mostly pre-service teachers instead of in-service teachers. When compared to other studies, this is the largest study considering our sample size. Therefore, the findings could be more accurate. However, comparisons with previous studies should be taken with caution as there are differences in the and socio-economic contexts of other countries and the DigComp tools used (e.g., differences in Likert scales, number of statements, whether other studies consider the combination of

knowledge, skill, attitude or if they focus their attention only on one of these, etc.). In the context of Zimbabwe, the findings are only generalizable to the secondary school teachers and may not apply to other sectors of the economy or at least the general population. However, the study is proof of the richness of DigComp in assessing digital competences in Zimbabwe. The study's methods can be adapted and adopted in other facets of socio-economic life.

There is insufficient data from the findings to support the reasons behind the differences in the gendered usage of digital competences. This may be an area that needs further explorations.



Recommendations

Areas of Future Research

- b. Conduct an assessment of learners' digital literacy skills to determine if they have a surplus or a deficit as compared to their teachers. It is assumed that learners are more advanced than their teachers because they were born in the 21st-century. However, this is a general assumption that has not been empirically proven and does not show the areas in which learners will excel over teachers, especially considering that digital literacy is more than the usage of digital tools. Perhaps, it may be too far-fetched to use this DigComp 2.2 as it is. There may be a need to put at the understanding the learner or even better, if it could be translated to the learner's language of choice.
- c. There is a need to explore further the gendered usage digital competences among the teachers. This is an area that the current study did not get much evidence on. Perhaps, it is because gender was on a key variable that the study sought after.
- d. There is a need to investigate how secondary school-teacher education training centres are unpacking the curriculum as a way to ensure that teacher education institutions integrate digital literacy skills that ensure graduates have the requisite skills in preparation for the future of work. In conjunction with the usage of the DigComp tool, the Technological Pedagogical Content Knowledge (TPACK) model can be used to study the intertwined interplay between technology, pedagogy, and content knowledge. This type of assessment can show the differences between the intended, the implemented, and the attained curriculum. A comparison of pre-service and in-service teachers can help to understand the future of work in this sector.
- e. There should be a population-wide assessment of digital literacy to determine if the results of the study are comparable to other sectors or different populations altogether.

References

- Alnasib, B. N. M. (2023).** Digital Competencies: Are Pre-Service Teachers Qualified for Digital Education? *International Journal of Education in Mathematics, Science and Technology*, 11(1), 96-114. <https://doi.org/10.46328/ijemst.2842>
- Baller, S., Dutta, S., & Lanvin, B. (2016).** The Global Information Technology Report 2016. <https://doi.org/10.1016/b978-0-12-804704-0.00010-4>
- Chigama, T., & Goronga, P. (2022).** Exploring teachers' perceptions towards ICT integration in teaching and learning: the case of selected primary schools in Harare, Zimbabwe. *Journal of African Education*, 3(1). <https://doi.org/10.31920/2633-2930/2022/v3n1a6>
- Cortesi, S. C., Hasse, A., Lombana, A., Kim, S., & Gasser, U. (2020).** Youth and Digital Citizenship+ (Plus): Understanding Skills for a Digital World. *SSRN Electronic Journal*, 7641. <https://doi.org/10.2139/ssrn.3557518>
- Dabengwa, I. M., Young, S., & Ngulube, P. (2023).** Rigour in phenomenological and phenomenography studies: A scoping review of library and information science research. *Library & Information Science Research*, 45(1), 101219. <https://doi.org/10.1016/j.lisr.2022.101219>
- Dhliwayo, A., & Muchemwa, S. (2017).** An Assessment of Zimbabwe Secondary School Teachers' Attitudes towards the Use of Smartphones in the Classroom: A Case of Midlands Province Zimbabwe. , Vol.4, No.1. *International Journal of Social Sciences & Educational Studies*, 4(1).
- García-Vandewalle García, J. M., García-Carmona, M., Trujillo Torres, J. M., & Moya Fernández, P. (2023).** Analysis of digital competence of educators (DigCompEdu) in teacher trainees: the context of Melilla, Spain. *Technology, Knowledge and Learning*, 28(2), 585-612. <https://doi.org/10.1007/s10758-021-09546-x>
- Global Alliance to Monitor Learning. (2018).** Global Alliance to Monitor Learning. https://gaml.cite.hku.hk/exec_summary/
- Hidayat, M. L., Prayitno, H. J., Anif, S., Meccawy, M., & Khanzada, T. J. S. (2023).** Science Learning in Answering Digital Competency Needs of Pre-Service Math and Science Teachers in the Stem Context. *Jurnal Pendidikan IPA Indonesia*, 12(3), 410-422. <https://doi.org/10.15294/jpii.v12i3.43960>
- Hove, B., & Dube, B. (2021).** Covid-19 and the entrenchment of a virtual Elite private school: Rethinking education policies in Zimbabwe. *Journal of Culture and Values in Education*. <https://doi.org/10.46303/jcve.2021.5>
- Iglesias-Rodríguez, A., Hernández-Martín, A., Martín-González, Y., & Herráez-Corredera, P. (2021).** Design, validation and implementation of a questionnaire to assess teenagers' digital competence in the area of communication in digital environments. *Sustainability (Switzerland)*, 13(12). <https://doi.org/10.3390/su13126733>

- International Telecommunications Union [ITU]. (2020).** Digital Skills Assessment Guidebook. International Telecommunication Union. https://academy.itu.int/sites/default/files/media2/file/D-PHCB-CAP_BLD.04-2020-PDF-E_02 June 2020.pdf
- Jiménez-Hernández, D., González-Calatayud, V., Torres-Soto, A., Martínez Mayoral, A., & Morales, J. (2020).** Digital Competence of Future Secondary School Teachers: Differences According to Gender, Age, and Branch of Knowledge. *Sustainability*, 12(22), 9473. <https://doi.org/10.3390/su12229473>
- Lim, Y. S., Halim, H. A., & Ramayah, T. (2021).** Agile or not? The upsurge of digcomp and social media usage among teachers. *Journal of Applied Structural Equation Modeling*, 5(2), 1-21. [https://doi.org/10.47263/JASEM.5\(2\)04](https://doi.org/10.47263/JASEM.5(2)04)
- Mathende, A., & Beach, J. (2022).** The Integration of Information Communication Technology in Education: A Review of Policies and Practices in Angola, South Africa, and Zimbabwe. *Journal of Special Education Preparation*, 2(1), 80-89. <https://doi.org/10.33043/josep.2.1.80-89>
- Montag, C., & Elhai, J. D. (2023).** Do we need a digital school uniform? Arguments for and against a smartphone ban in schools. *Societal Impacts*, 1(1-2), 100002. <https://doi.org/10.1016/j.socimp.2023.100002>
- Nančovska Šerbec, I., Žerovnik, A., Natalija, J., Rechkoska S., U., & Davcev, D. (2016).** Digital competences of selected university students from Macedonia and Slovenia. *ICT Innovations 2016 Conference*, September.
- Pérez-Navío, E., Ocaña-Moral, M. T., & Martínez-Serrano, M. D. C. (2021).** University graduate students and digital competence: are future secondary school teachers digitally competent? *Sustainability (Switzerland)*, 13(15), 1-14. <https://doi.org/10.3390/su13158519>
- Salkind, N. J., & Frey, B. B. (2020).** Study guide to accompany Salkind and Frey's Statistics for people who (think they) hate statistics (7th ed.). SAGE Publications Inc.
- The Sunday Mail. (2019, July 16).** Zim records drop in mobile phone users in Q1, 2019 – Potraz. The Sunday Mail. <https://www.ebusinessweekly.co.zw/zim-records-drop-in-mobile-phone-users-in-q1-2019-potraz/>
- Tsankov, N., & Damyanov, I. (2019).** The digital competence of future teachers: Self-assessment in the context of their development. *International Journal of Interactive Mobile Technologies*, 12, 4-18. <https://doi.org/10.3991/ijim.v13i12.11068>
- UNESCO. (2006).** ICTs and education indicators: (Suggested core indicators based on meta-analysis of selected International School Surveys). Unesco, 1-44.
- United Nations. (2017).** Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development. https://unstats.un.org/sdgs/indicators/GlobalIndicatorFrameworkafterrefinement_Eng.pdf

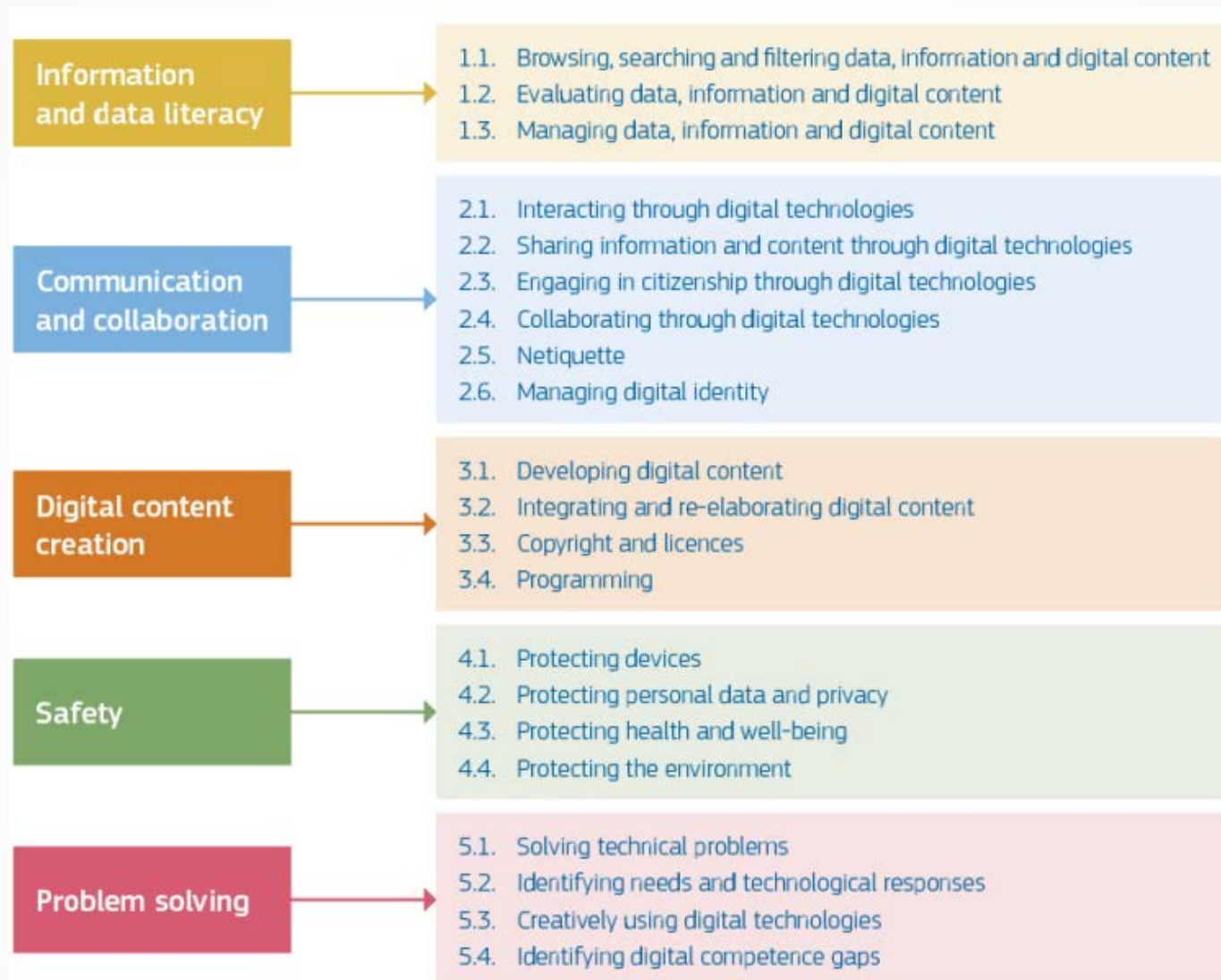
- United Nations Children's Fund (UNICEF). (2019).** Digital Literacy for Children: Exploring Definitions and Frameworks. <https://www.unicef.org/globalinsight/media/1271/file/UNICEF-Global-Insight-digital-literacy-scoping-paper-2020.pdf>
- Vuorikai, R., Kluzer, S., & Punie, Y. (2022).** DigComp 2.2 - The Digital Competence Framework for Citizens. <https://doi.org/10.2760/115376>
- Zhang, S., Mingyue Gu, M., Sun, W., & Jin, T. (2023).** Digital literacy competence, digital literacy practices and teacher identity among pre-service teachers. *Journal of Education for Teaching*, 00(00), 1-15. <https://doi.org/10.1080/02607476.2023.2283426>
- Zimbabwe National Statistics Agency (ZIMSTAT). (2017).** Information and Communication Technology (ICT) Census 2017. Zimbabwe National Statistics Agency (ZIMSTAT).

Annexes



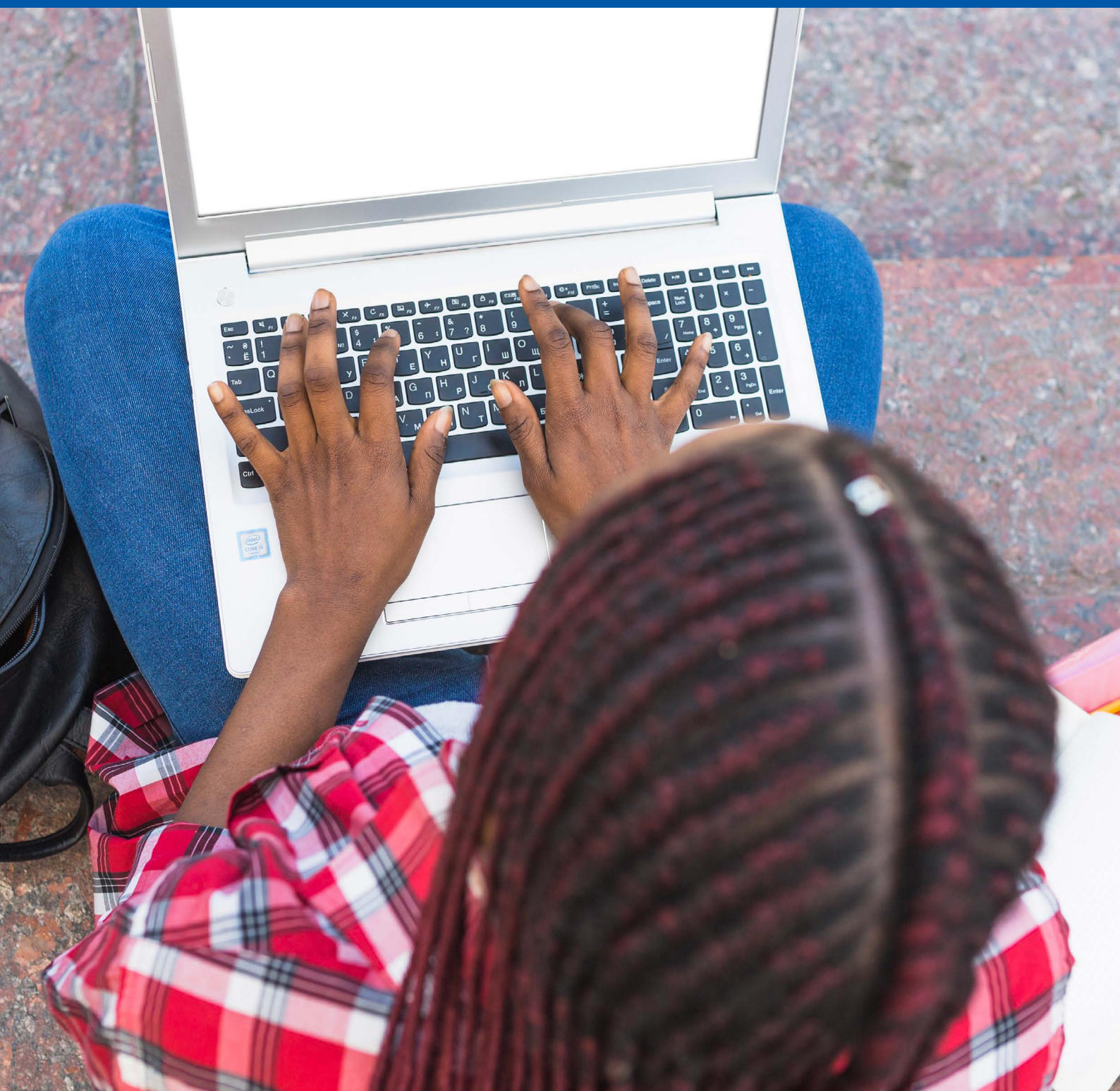
Annex 1

Unpacking Each Dimension of DIGCOMP 2.2



Annex 2

An Example Competency Classification Within
DIGCOMP 2.2





DIMENSION 1 • COMPETENCE AREA

1. INFORMATION AND DATA LITERACY

DIMENSION 2 • COMPETENCE

1.1 BROWSING, SEARCHING AND FILTERING DATA, INFORMATION AND DIGITAL CONTENT

To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies.

FOUNDATION	1	At basic level and with guidance, I can:	• identify my information needs, find data, information and content through a simple search in digital environments, • find how to access these data, information and content and navigate between them, • identify simple personal search strategies.
	2	At basic level and with autonomy and appropriate guidance where needed, I can:	• identify my information needs, • find data, information and content through a simple search in digital environments, • find how to access these data, information and content and navigate between them. • identify simple personal search strategies.
INTERMEDIATE	3	On my own and solving straightforward problems, I can:	• explain my information needs, • perform well-defined and routine searches to find data, information and content in digital environments, • explain how to access them and navigate between them, • explain well-defined and routine personal search strategies.
	4	Independently, according to my own needs, and solving well-defined and non-routine problems, I can:	• illustrate information needs, • organise the searches of data, information and content in digital environments, • describe how to access these data, information and content, and navigate between them, • organise personal search strategies.
ADVANCED	5	As well as guiding others, I can:	• respond to information needs, • apply searches to obtain data, information and content in digital environments, • show how to access these data, information and content and navigate between them. • propose personal search strategies.
	6	At advanced level, according to my own needs and those of others, and in complex contexts, I can:	• assess information needs, • adapt my searching strategy to find the most appropriate data, information and content in digital environments, • explain how to access these most appropriate data, information and content and navigate among them, • vary personal search strategies.
HIGHLY SPECIALISED	7	At highly specialised level, I can:	• create solutions to complex problems with limited definition that are related to browsing, searching and filtering of data, information and digital content, • integrate my knowledge to contribute to professional practice and knowledge and guide others in browsing, searching and filtering data, information and digital content.
	8	At the most advanced and specialised level, I can:	• create solutions to solve complex problems with many interacting factors that are related to browsing, searching and filtering data, information and digital content. • propose new ideas and processes to the field.

Annex 3:

Digital Literacy Questionnaire Based on the DIGCOMP Framework

Introduction

This questionnaire is divided into four (4) sections. Each section collects different types information on the digital skills levels of teachers. Try as much as possible to answer all sections of the questionnaire.

A/ Demographic Data

Province: District:

School: Subject (s) Taught:

Tick the appropriate box that best describes you

Gender: Male: ☐ Female: ☐

Age: ☐

20 - 30: ☐

31 - 40: ☐

41 - 50: ☐

51 - 60: ☐

Over 60: ☐

Highest Qualification:

Diploma in Education:

Degree in Education:

Other Degree:

Other, please specify:

B/ Digital Literacy (Knowledge) Self-Assessment

Indicate with a tick (✓) the option that best describes your knowledge from questions 1 to 5. You are supposed to pick only one item per question.

B1. Information And Data Literacy

B1.1 How do you rate your knowledge with regard to identifying and retrieving relevant information from the Internet to solve your daily problems and duties?

- i. I am not aware of methods/tools of locating information on the Internet.

ii. I am aware that search engines are used to find information from the Internet.

iii. I know of the various procedures of locating online digital content

iv. I know the several methods and use them as per need.

v. I know that search results, and content recommendations on the internet are influenced by a range of factors.
- ☐

☐

☐

☐

☐

B1.2 Are you aware of the need to screen information from the Internet?

- i. I do not know that information from the Internet needs to be screened.

ii. My colleagues normally remind me of the need to screen information.

iii. I am aware of the need to screen information from the Internet.

iv. I am aware that I need to screen information and always remind others of the fact.

v. I know of various tools and skills to verify information from various sources.
- ☐

☐

☐

☐

☐

B1.3 What do you know about the creation, storage, retrieval, and management of digital information (files)?

- i. I do not know what a file is.

ii. I am aware of the need to digitize data for storage

iii. I am aware of the various forms in which data can be created and stored

iv. I know the different types of files used to store data and can share these with others.

v. I know various forms of files and some open data repositories for free use.
- ☐

☐

☐

☐

☐

B2. COMMUNICATION AND COLLABORATION

B2.1 Are you aware of the means of communicating digitally?

- i. I am not aware of the means of communicating digitally

ii. I know of a number of free communication services
- ☐

☐

- iii. I know that there are tools used for specific circumstances
- iv. I understand that messages need to be formulated to suit various audiences
- v. I am aware that at times tools need to be adjusted to suit the need and audiences

B2.3 Do you know any tools that can be used for the benefit of citizens?

- i. I do not know what tools to use to benefit myself and other people.
- ii. I am aware of digital communication tools that benefit society.
- iii. I know some digital communication tools that can be used to benefit the citizenry.
- iv. I know that ICT tools can generate information that benefit the citizens.
- v. I am aware of ICT tools that can be used for citizens empowerment and uplifting.

B2.4 Are you aware of the opportunities to use digital tools for online collaboration?

- i. I am not aware of collaboration opportunities.
- ii. I know that digital tools facilitate online collaboration on simple tasks.
- iii. I understand that digital tools can be set to facilitate online collaboration
- iv. I am aware of the power of online collaboration and share my knowledge with others
- v. I know that you can combine digital tools to create a complex communication platform

B2.5 Do you know the importance of interacting and engaging online in a socially acceptable manner?

- i. I simply know of the use of the internet without any social consideration.
- ii. I am aware of the need to ensure safe internet use.
- iii. I know that I should use the internet within the confines of the law to ensure safety.
- iv. I know safe measures to use on the internet and those to be used by others.
- v. I know measures to set up safety nets on ethical and legal issues to accommodate diverse cultural audiences.

B2.6 Are you aware of the importance of protecting your digital identities?

- i. I do not know about protecting my online identity.
- ii. I am aware of means to create digital identity.
- iii. I learn from others of the means to create digital identity.
- iv. I know means of creating an authentic digital environment.
- v. I am aware of ways of limiting the tracking of my activities on the Internet.

B 3. DIGITAL CONTENT CREATION

B3.1 What is your idea about creating and editing digital content of various forms?

- i. I have no idea about creating digital content.
- ii. I know of basic tools used to create digital content.
- iii. I know there are various tools that can be combined to create digital content.

- iv. It is possible to use various tools to create complex digital content
- v. I know that digital tools can be used to create various formats of digital content as well as enable innovation.

B3.2 Can new content be created from existing digital content?

- i. I have no idea about using existing content to create new content.
- ii. I know that existing content can be modified to create new content.
- iii. I know that existing content can be modified and improved to suit a given need.
- iv. It is possible to integrate hardware and software to produce complex content
- v. I know that existing devices (both hardware and software) can be integrated with living and non-living things to produce complex systems.

B3.3 Are you aware of the copyright laws and licenses governing the use of digital content?

- i. I have no idea about copyright laws and licenses.
- ii. I know of copyright laws and licenses.
- iii. I am aware of the copyright laws and the need for compliance
- iv. I know of the different licenses (e.g. proprietary, free, and open-source software)
- v. I am aware of mechanisms to limit access to digital content (e.g. passwords)

B3.4 What does it take to produce a computer program?

- i. I don't know what is behind computer programs.
- ii. I know that computer programs are sets of instructions
- iii. I know that computer programs are written using programming languages.
- iv. I am aware that computer programs have to follow certain logic (algorithms).
- v. I know that any program follows certain logic and requires time and space to compute its output.

B4. SAFETY

B4.1 What can be used to protect digital content and devices from unwanted access?

- i. I have no idea about protecting digital content.
- ii. I know that passwords and antivirus software can be used to protect digital content.
- iii. I understand that in addition to passwords and antivirus software, there is need to protect my devices at all layers of protection.
- iv. I know that encryption, firewalls, and biometrics can be combined to secure content.
- v. Information protection protocols and systems can be designed and set up to protect digital content.

B4.2 How much do you know about protecting personal data as well as maintaining privacy?

- i. I have no idea about protecting my privacy and personal data.

--

- ii. Pseudonyms, passwords, and antivirus software can be used to maintain privacy.
- iii. I understand the need to protect my data at all layers of protection.
- iv. I am aware that several devices, software, and protocols can protect my privacy.
- v. I know that the processing of personal data is subject to local regulations.

B4.3 Are you aware of the health risks associated with the use of digital technology?

- i. I have no idea about any health risks or threats.
- ii. I know of the health risks and when not to use digital technology
- iii. I know some signs of digital addictions (e.g. loss of control, withdrawal symptoms).
- iv. I am aware that vulnerable groups (e.g. children) are at a higher risk of victimization.
- v. I know of solutions to solve complex problems of health risks and threats.

B4.4 Are you aware of the impact of technology on the environment?

- i. I have no idea about the impact of technology on the environment.
- ii. I am aware of the impact of technology on the environment.
- iii. I understand the impact of technology on the environment, and measures to protect the environment.
- iv. I am aware of the impact, engage in practices that seek to minimize the impact, and teach others to do so.
- v. I understand the concepts of green ICT and know some best practices in the field.

B5. PROBLEM-SOLVING

B5.1 Do you know what it takes to troubleshoot a computing device when it encounters a problem?

- i. I have no idea about the concept of troubleshooting technical problems on my device.
- ii. On my own I do not know the process of troubleshooting
- iii. I know that most online problems are due to issues of connectivity.
- iv. I understand the process of diagnosing technical problems.
- iv. I am aware that device manuals can be used to diagnose technical problems

B5.2 Are you aware of the processes used to develop computer systems to address user needs?

- i. I have never heard of processes used to develop computer systems.
- ii. I know the set of steps used to develop computer systems
- iii. I am aware of best practices in systems development.
- iv. I am aware of the need to develop systems for accessibility.
- v. I know that artificial intelligence can be used to develop complex systems

B5.3 Do you know that existing technologies can be used to create new knowledge, processes, and products?

- i. I am not aware of technology reuse.

--

- ii. I know that existing technologies can be studied to identify useful features for reuse.
- iii. I know that most technologies are derived from existing technologies .
- iv. I know that it is possible to automate the creation of technology.
- v. I know that computer algorithms have the potential to be used in many different sectors.

B5.4 Are you aware of your digital skills competence gaps?

- i. I do not understand the whole spectrum of digital skills
- ii. I know that digital competence entails the confident, critical and responsible use of digital technologies.
- iii. I know that digital tools can be used to help identify one's digital gaps .
- iv. I know that one can use digital tools to address one's competence gaps
- v. I know where to find opportunities for self-development and to keep up-to-date with the digital evolution.

C/ PERFORMANCE/ SKILLS SELF-ASSESSMENT

Choose the option that best describes your ability from questions 1 to 5. You are supposed to pick only one item per question. Each question has a number of subsections.

C1. INFORMATION AND DATA LITERACY

C1.1 Are you able to identify and retrieve relevant information from the Internet to on your daily problems and duties?

- i. I cannot find information on the Internet.
- ii. I usually seek help on finding information for simple personal use & teaching.
- iii. I can use the Internet to find any information with no problems.
- iv. I can use the Internet to find information on any problem and can also help others.
- v. I can use search tools and databases to find specific solutions for complex problems.

C1.2 Are you able to verify sources of information that you read or access online?

- i. I do not know how to verify information from the Internet.
- ii. With colleagues' assistance I can find and verify the information from the Internet.
- iii. I can easily verify information from the Internet.
- iv. I can easily verify information from the Internet and can also help others do so.
- v. I can use various tools and skills to verify information from various sources.

C1.3 Can you create, store, retrieve and manage digital information (files)?

- i. I cannot create digital files.

--

- ii. I can open files but I don't know how to create them.
- iii. I can create and work with files with no problems.
- iv. I can create files, work with them and also help others do so.
- v. I can create and format digital content to suit the intended recipients.

C2. COMMUNICATION AND COLLABORATION

C2.1 Rate your capability to communicate using various forms of digital technologies:

- i. I do not know how to communicate digitally.
- ii. I usually ask for assistance with the use of communication devices.
- iii. I can communicate digitally with no problems.
- iv. I can communicate digitally and can also help others do so.
- v. I can set up various communication technologies to deal with complex communication requirements.

C2.2 Are you able to share data, information, and digital content with others?

- i. I do not know how to share digital content.
- ii. I usually seek assistance in sharing information around.
- iii. I can easily share information and acknowledge authorship.
- iv. I can share information and acknowledge authorship using appropriate referencing styles.
- v. I can share information using various document management tools and referencing styles.

C2.3 Are you able to use various digital technologies to the benefit of the citizenry?

- i. I do not know how to use digital skills in citizenship activities.
- ii. I can search public institutions' websites for current information on societal issues.
- iii. I can monitor the school, local authorities, and national government activities through open data.
- iv. I can engage with others through digital technologies for the sustainable development of society.
- v. I can actively participate in various digital platforms looking for and disseminating information that help society in empowerment activities.

C2.4 Rate your capability for online collaboration.

- i. I do not know how to collaborate online.

--

- ii. I can use digital tools to collaborate online on simple tasks.
- iii. I can set up a collaboration environment using digital tools.
- iv. I can teach others to use and set up digital collaboration platforms.
- v. I can use different types of digital tools to create complex collaboration environments and recommend new ways of collaboration.

C2.5 Rate your ability to interact and engage online in a socially acceptable manner.

- i. I simply use the internet without any consideration.
- ii. I am cautious while using the Internet.
- iii. I use the internet within the confines of the law while considering my safety.
- iv. I can safely use the internet and advise others of safe and ethical manners.
- v. I can safely use the internet and set up safety nets on ethical and legal issues and accommodate diverse cultural audiences.

C2.6 Are you able to create and protect your digital identities?

- i. I have no online identity
- ii. I can create a digital identity through the help of others.
- iii. I can create my digital identity and manage it.
- iv. I can create, and manage my identity and also help others create theirs.
- v. I can manage various types of digital identities and assist others in protecting their online identities.

C3. DIGITAL CONTENT CREATION

C3.1 Are you able to create and edit digital content of various forms?

- i. I do not know how to create digital content.
- ii. I use basic tools to create digital content
- iii. I can create various forms of digital content using a mixture of digital tools.
- iv. I use various tools to create digital content and I can help others to do so.
- v. I use various digital tools to create various formats of digital content and create innovative and advanced means of doing so.

C3.2 What is your ability to create new content from existing digital content?

- i. I can only use existing content.

--

- ii. I can modify existing content.
- iii. I can modify and improve existing content to suit a given need or environment.
- iv. I can modify, improve and help others create new content from existing content.
- v. I can create guidelines to modify, refine, improve and integrate information and content into an existing body of knowledge.

C3.3 Can you identify the various licenses governing the use of digital content?

- i. I cannot tell which type of license governs the use of some given digital content.
- ii. I can identify some types of licenses through symbols.
- iii. I can identify licenses and use and share digital content legally.
- iv. I adhere to copyright laws and licenses and encourage others to comply.
- v. I can choose the most appropriate strategy to create and share my work.

C3.4 What is your ability to write a working computer program?

- i. I don't know how to program.
- ii. I can write a program that performs simple tasks
- iii. I can write a computer program using one language.
- iv. I can write running programs and help debug programs.
- v. I can write working programs, dry run them, and correct any wrong logic in them.

C4. SAFETY

C4.1 Can you protect your digital content and devices from unwanted access?

- i. I can't protect my digital content.
- ii. I can use passwords and antivirus software to protect my content.
- iii. I can protect my devices at all layers of protection.
- iv. I can use several devices, software, and protocols to protect digital content as well as help others to do so.
- v. I can design and set up information protection protocols and systems.

C4.2 Do you know how to protect our personal data and your privacy?

- i. I do not know how to protect my privacy and personal data.
- ii. I can use pseudonyms, passwords, and antivirus software.
- iii. I understand the need to protect my data at all layers of protection.
- iv. I can use several devices, software, and protocols to protect my privacy and personal data as well as help others to do so.
- v. I can design and set up information protection protocols and systems to maintain privacy.

C4.3 Can you protect yourself and others from health risks associated with the use of digital technology?

- i. I cannot deal with health risks or threats associated with the use of technology.
- ii. I can protect myself from obvious risks.
- iii. I cautiously shield myself from health risks associated with the use of digital technology.
- iv. I adhere to recommended best practices and also teach others to do so.
- v. I develop standardized best practice guidelines as well as carry out research on the emergence of new health risks and ways of curbing them.

C4.4 Are you able to protect the environment from the impact of technology?

- i. I cannot protect the environment from the impact of technology.
- ii. I can apply low-tech strategies for protecting the environment (switch-of-switches).
- iii. I can reduce the energy consumption of devices and services used, e.g. change the quality settings of video streaming services.
- iv. I can use digital tools to improve the environmental and social impact of technology.
- v. I actively engage in green ICT practices and design means of doing so.

C5. PROBLEM-SOLVING

C5.1 Are you able to troubleshoot a computing device when it encounters a problem?

- i. I cannot solve any technical problem on my device.
- ii. With assistance I can troubleshoot a malfunctioning device.
- iii. I can solve simple technical problems.
- iv. I can diagnose and assist others solve technical problems.
- v. I can diagnose various faults using several means and can come up with a manual guide for fault diagnosis.

C5.2 Are you able to apply the systems approach to addressing user needs?

- i. I cannot apply the systems approach.
- ii. I can identify needs and suggest software to address them.
- iii. I can go through the systems development life cycle to solve simple needs.
- iv. I can assess complex needs and recommend the best solution to address the needs.
- v. I can design complex solutions to complex problems that need a systems approach as well as teach others.

C5.3 Rate your ability to creatively harness existing technologies to create knowledge, processes, and products?

- i. I don't know how to use technology to create knowledge.
- ii. I can explore hidden features of existing technologies for the creation of knowledge.
- iii. I can exploit existing technology for new knowledge and products.
- iv. I can creatively use technology to develop content, and innovative processes as well as help others to do so.
- v. I can design and set up innovative tools and processes to solve relevant problems.

C5.4 Can you identify your digital skills competence gaps?

- i. I am unable to tell my digital skills competence gaps
- ii. I can use online platforms to identify my skills gap.
- iii. I can identify my skills gaps and make plans to upskill
- iv. I can identify my skills gaps and help others do so, as well as help them make plans to upskill.
- v. I can design tools to help others identify their skills gaps and design programmes for upskilling.

D/ ATTITUDES SELF-ASSESSMENT

Choose the option that best describes your ability from questions 1 to 5. You are supposed to pick only one item per question.

D 1. INFORMATION AND DATA LITERACY

D 1.1 There should be tools designed to protect search privacy and other rights of users.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 1.2 It is important to evaluate the credibility and reliability of sources of data, information and digital content.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 1.3 Knowing how to create, store, retrieve and manage digital information is vital.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 2. COMMUNICATION AND COLLABORATION

D 2.1 It is vital to communicate using various forms of digital technologies:

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 2.2 I evaluate the impact of the information before sharing it

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree gfr
- v. Strongly agree

D 2.3 The citizenry benefit from the use of various digital technologies

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 2.4 Online collaboration skills should be emphasised at all levels.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 2.5 I believe it is necessary to act in a socially acceptable manner when interacting online.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 2.6 I am careful about mine and other people's identity private.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D 3. DIGITAL CONTENT CREATION

D 3.1 The ability to create and edit digital content of various forms is a necessary skill in this digital age.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D .2 I am open to creating new content from existing digital content.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D3.3 Copyright laws and licenses governing the use of digital content are still relevant in regards to the use of digital content.

- i. Strongly disagree.
- ii. Disagree.
- iii. Neutral.
- iv. Agree
- v. Strongly agree

D3.4 I value the skill of computer programming as key in solving computer based problems.

i. Strongly disagree.	☐
ii. Disagree.	☐
iii. Neutral.	☐
iv. Agree	☐
v. Strongly agree	☐

D 4. SAFETY

D 4.1 I take vigilant stance towards protecting my computers and mobile devices from unwanted access.

i. Strongly disagree.	☐
ii. Disagree.	☐
iii. Neutral.	☐
iv. Agree	☐
v. Strongly agree	☐

D4.2 Everyone should know about protecting personal data as well as maintaining privacy.

i. Strongly disagree.	☐
ii. Disagree.	☐
iii. Neutral.	☐
iv. Agree	☐
v. Strongly agree	☐

D4.3 The use of digital technology poses health risks

i. Strongly disagree.	☐
ii. Disagree.	☐
iii. Neutral.	☐
iv. Agree	☐
v. Strongly agree	☐

D4.4 The use of technology may have a negative impact on the environment

i. Strongly disagree.	☐
ii. Disagree.	☐
iii. Neutral.	☐
iv. Agree	☐
v. Strongly agree	☐

D5. PROBLEM-SOLVING

D 5.1 I actively troubleshoot computing devices when they encounter a problem

i. Strongly disagree.	
ii. Disagree.	
iii. Neutral.	
iv. Agree	
v. Strongly agree	

D5.2 The systems approach to problem solving is key to addressing user needs

i. Strongly disagree.	
ii. Disagree.	
iii. Neutral.	
iv. Agree	
v. Strongly agree	

D5.3 I enjoy participating in challenges and at solving social, economic, and other related humanity problems through creatively harnessing existing technologies

i. Strongly disagree.	
ii. Disagree.	
iii. Neutral.	
iv. Agree	
v. Strongly agree	

D5.4 I keep abreast with emerging technologies

i. Strongly disagree.	
ii. Disagree.	
iii. Neutral.	
iv. Agree	
v. Strongly agree	

E/ KNOWLEDGE-BASED ASSESSMENT

1. Tick the correct statements in the table below:

	Resp.
1.1 Search engines, social media, and content platforms often use AI algorithms to generate responses that are adapted to the individual user on searching the Internet	
1.2 Information on the Internet is free from bias	
1.3 There is no need to convert sound into a digital form before storage	

2. COMMUNICATION AND COLLABORATION

Indicate the correct statements with regards to communication and online collaboration

- 2.1 All videoconferencing tools support voice and image
- 2.2 Content uploaded online can be used to train facial recognition systems resulting in the breach of privacy
- 2.3 Using computerized systems to recruit people eliminates bias in job selection
- 2.4 Online collaboration tools reduce costs of performing tasks
- 2.5 Non-verbal messages (smiley faces & emojis) differ in meaning according to culture
- 2.6 Accepting cookies online compromises one's privacy

Resp.

3. DIGITAL CONTENT CREATION

Indicate statements that apply in digital content creation

- 3.1 It is impossible for the disabled (blind, deaf, etc.) to use digital technology
- 3.2 Sensors, programs and other devices can be integrated to create an Internet of Things (IoT) environment
- 3.3 Free and open-source software can be modified to suit one's needs as long as one has permission to do so
- 3.4 As long as a computer program is correct, the output will always be correct

Resp.

SAFETY

Choose the correct statements among the following:

- 4.1 Using fingerprints to log into your computer protects your data more than using passwords
- 4.2 Apps can collect user data at will, and are not mandated to inform users of this.
- 4.3 Children are at high risk of cyberbullying as opposed to adults
- 4.4 Some examples of green ICT include less energy consumption and recycling

Resp.

4. PROBLEM-SOLVING

Which statements pertain to problem solving among the following?

- 5.1 Artificial Intelligence algorithms always give correct results
- 5.2 X-rays use algorithms to detect health problems in scans
- 5.3 High-quality digital systems are mainly designed by individuals as opposed to teams
- 5.4 Most online courses have no credibility

Resp.

ANNEX 4:

Infrastructure Assessment Tool

Province:

District:

Name of School:

School Type:

Nearest Town.....

Distance from Nearest Town (KM).....

Section A: National Infrastructure Tick where applicable

1. Mains Electricity / National Grid Available: Yes: ☐ No: ☐ Are you connected to the national grid? Yes: ☐ No: ☐
1. Telecommunications network coverage Econet: ☐ Telecel: ☐ NetOne: ☐ TelOne Landline: ☐ Optic Fibre: ☐ Other.....
1. Access to National Educational ICT Program Yes: ☐ No: ☐
2. If answer to (4) above is yes, name them,,,,

Section B: School Infrastructure

1. What is the school's available power source(s)? ZESA: ☐ Solar: ☐ Petrol/Diesel Generator: ☐ Other Specify.....
1. Does the school have a Computer room/lab Yes: ☐ No: ☐
2. Available computing equipment owned by the school or staff but used by the school.

Computing Device (s)	Quantity	OS Installed		Owner School	Staff	General State of the devices		
		OS Name	Version			Non Functional	Functional Obsolete	Functional Up to date
Desktops								
Laptops								
Tablets								
Smartphones								
Smartboards								
Projectors								
Scanner								
Printers								
Photocopiers								
Landline phone								

Do you have a Computers/ ICT teacher? Yes: ☐ No: ☐

How many teachers do you have to (9) above?.....

Their/His/Her Qualifications:

.....

.....

3. Do you have intranet connectivity? Yes: ☐ No: ☐

4. Do you have internet connectivity? Yes: ☐ No: ☐

5. Who is your Internet Service Provider (ISP)?

6. Data sponsor: School funds: ☐ SDA/SDC: ☐ Individuals: ☐ Govt: ☐ church: ☐ other.....

7. Bandwidth if known..... Monthly cost.....

8. Connection type. ADSL/Cable: ☐ VSat/Satellite Dish: ☐ Microwave: ☐ Mobile networks: ☐
Optic Fibre: ☐ Other.....

9. Computing equipment was bought by School funds: ☐ SDA/SDC: ☐ Individuals: ☐ Govt: ☐
church: ☐ other specify.....

Section C: Software and communication

10. Do you have a dedicated School Management system? Yes: ☐ No: ☐

11. If answer to (19) above is yes, name it

12. How did you acquire it? Purchased: ☐ Downloaded for free: ☐ Donated: ☐ Inhouse: ☐
13. Does the school have own website which is accessible externally Yes: ☐ No: ☐
14. Where is it hosted? Locally: ☐ Externally: ☐
15. Which software packages do use regularly for documents processing?
MS Office: ☐ Libre Office: ☐ Open Offices: ☐ Other: ☐.....
16. Browsers you use regularly Edge: ☐ Opera: ☐ NetScape: ☐ Chrome: ☐ Mozilla Firefox: ☐
Brave: ☐ Internet Explorer: ☐ Flock: ☐ Chromium: ☐ Other.....
17. Does the school have an email address? Yes: ☐ No: ☐
18. Does the school have own email domain? Yes: ☐ No: ☐
19. School communication is sent or received via email: ☐ whatsapp: ☐ postmail: ☐ phone: ☐
20. Fill in the next table about any other software that you regularly use in the school:

Name of software	Its use in brief

Thank You for your time

ANNEX 5:

Interview Guide For Teachers

1. Information and data literacy

1. Can you give me an example of a time when you used digital tools to find, evaluate, and use information effectively?
2. How do you help your students develop the skills they need to be critical consumers of information?
3. What are some of the challenges that students face in evaluating the credibility of information online?

2. Communication and collaboration

1. How do you use digital tools to collaborate with other teachers and professionals?
2. How do you help your students develop the skills they need to collaborate effectively online?
3. What are some of the challenges that students face in collaborating online?

3. Digital content creation

1. Can you give me an example of a time when you used digital tools to create and share content?
2. How do you help your students develop the skills they need to create and share digital content?
3. What are some of the challenges that students face in creating and sharing digital content?

4. Safety

1. How do you help your students stay safe online?
2. What are some of the risks that students face online?
3. How can schools and communities work together to create a safer online environment for students?

5. Problem solving

1. Can you give me an example of a time when you or one of your students used digital tools to succeed in school or in their personal life? do you think this changed the learning experience?
2. What are some real-world examples of how digital literacy skills are being used in the workplace and in other areas of life?
3. How can schools and communities support teachers in teaching digital literacy skills?
4. What are some of the challenges that students face in solving problems using digital tools?

6. Closing research questions

1. What are the most important digital literacy skills that students?
2. What are some challenges that teachers face in teaching digital literacy skills? What are some of the challenges that students face in developing digital literacy skills?
3. How can digital literacy skills help students prepare for the future?

ANNEX 6:

FGD Interview Guide

General Digital Competence

1. What is technology? What is ICT?
 2. How do you use technology in your everyday life? Give examples.
 3. Are you able to create, store and retrieve files when the need arises? Which applications do you normally use?
 4. Which tools do you normally use for communicating: (i) Personally? (ii) Professionally? Do you normally consider the legal and ethical implications of the messages you receive or send? How do you ensure that you are safe and secure when communicating?
 5. What do you think about the use of ICT in teaching and learning at High school? (Elaborate on the importance, opportunities, challenges, etc.)
 6. Do you think the use of technology is a blessing or a curse to society?
 7. In your opinion, does technology have any negative impact on the environment? What do you think can be done to mitigate the impacts you have mentioned?
 8. Did the teacher training give you enough skills to use technology in teaching now and in the future?
1. How do you use technology in your teaching? Describe and give examples.
 2. Have you ever used technology to solve any problem in life that you faced? Elaborate on what you did.
 3. Are you just an end user of the technology that you use, or you customize it to meet your needs or you at times produce your own technology?
 4. Have you participated in any collaboration to create innovative solutions to use ICT in the classroom? Describe and provide examples
 5. Do you perceive your digital competence/ literacy to be sufficient for leading digital development work (can you assist students to develop their own digital content) in teaching and learning practices? Why/why not?
 6. Are there any ICT infrastructures, technical, or pedagogical support at your institution? If yes, describe and elaborate.
 7. What digital skills do you think you need to add value to your profession?
 8. Do you think this exercise/research is important to your profession?

ANNEX 7:

Feedback from the Participants on Areas to Correct on the Digcomp Tools

Northlea High School Pilot

Following the workshop at Eveline High School with stakeholders from various schools, Northlea was used as a pilot site to test the improved instruments. The team agreed to have a full study including, Questionnaire completion, Infrastructure assessment, Interviews with the teachers and Focus group discussion with the learners. The following were observed from the Pilot study at Northlea High School:

1. The questionnaire distribution went well, the first person completed the questionnaire within 30 minutes, and 22 questionnaires were 100% complete.
2. Some respondents were still choosing more than one option for the Questionnaire.
3. There was need to trim the Interview guide and Focus group discussion guide.
4. There was still some need to reword some questions in the Interview guide.

Kwekwe High School Workshop Questionnaire

Participants raised concerns on the length of the Questionnaire and the technical language used in some of the questions. The length of the questionnaire seemed to also surface with the Kwekwe group. Further, participants also felt that the instruction to choose the responses to the questions was vague and could lead to respondents picking several options instead of choosing one option. Participants were also concerned with the presentation of the whole questionnaire. This was the first time the aesthetic aspect of the tool was raised. Recommendations for improvement included:

1. Starting with simple questions that introduce respondents to the major parts

1. of the Questionnaire.
2. Shortening the stems of the questions and making them clearer.
3. Ensuring that boxes for responses were of equal sizes to avoid confusing the respondents.
4. Creating tables to enclose both the questions and responses, so that respondents do not struggle on matching responses with questions.
5. There was a need to vary questioning techniques to avoid monotony.

These comments helped to guide the team in improving both the technical content and the aesthetics of the Questionnaire. However, the team agreed to revise the tool without losing the essence of the project as guided by the DigComp 2.2 framework.

Interview Guide

From the role plays conducted, participants felt that the interview was collecting the right information. However, it was felt that probing was necessary to get the required data.

Conclusion

The work done at the three sites have helped to focus the study at the same time assisting the team to revisit the literature, particularly in finding means of ensuring that participants give responses that show their level of digital competency clearly. After the piloting and validation process, it was agreed that the sample on the proposal was inadequate to generalise the findings, especially if there are missing values. There is a need to increase the size of participants of the sample for the survey to roughly 1,500 from 300. The results of the validation process and piloting indicated

ANNEX 8:

A Guide To Interpreting the Cronbach Alpha

Cronbach's Alpha value range	Interpretation
Alpha ≥ 0.90	Excellent
Alpha 0.80-0.89	Good
Alpha 0.70-0.79	Acceptable
Alpha 0.60-0.69	Debatable
Alpha 0.50-0.59	Poor
Alpha < 0.50	Not acceptable

