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Assessment to Measure Ethiopian Digital Literacy Maturity Level

Inception Report

This Inception Report defines the objectives, scope, and methodology of the project, in compliance with the contractual agreement signed between Ministry of Innovation and Technology and the School of Information Science of Addis Ababa University. The document also specifies review of best practices, conceptual framework as well as data collection instruments to be used in the assessment. In addition, project management issues that include risk and its mitigation including project team organization are incorporated. The document also presents the deliverables and the schedule of activities of the entire project.

Prepared by:

School of Information Science

Addis Ababa University

March 2021

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DEFINITIONS AND ACRONYMS

AAU: Addis Ababa University

DL: Digital Literacy

EA: Enumeration area

CSA: Central Statistics Authority of Ethiopia

IRD: Inception Report Document

MinT: Ministry of Innovation and Technology

PM: Project Manager

SIS: School of Information Science

APPROVAL

We, representatives from MInT, have carefully assessed this Inception Report Document (IRD) Submitted on **March ##** version **01** for the ***Assessment to Measure Ethiopian Digital Literacy Maturity Level*** Project which has been prepared by School of Information Science (SIS) of Addis Ababa University after signing a consultancy agreement with MinT**.**

CERTIFICATION –

Please check the appropriate statement.

_____ . The document is accepted.

_____ . The document is accepted pending the changes noted [Noted changes attached].

_____ . The document is not accepted.

We fully accept and authorize the project to progress to the next stage of work.

_____ Ato Elias Hailu MinT, Project Manager Date: _____
_____ Dereje Teferi (PhD) SIS, Project Manager Date: _____

1 ABOUT THE PROJECT

The School of information science and the top management of MInT discussed about digital literacy in general the type of intervention required by Ethiopia to improve its level in particular and later this project "Assessment to Measure Ethiopian Digital Literacy Maturity Level" is born.

A proposal for the project was submitted and after a series of discussions and negotiations, an agreement has been reached and a contract agreement was signed between MInT and the School of Information Science of Addis Ababa University.

The general objective of the project is to conduct an assessment to measure Ethiopian Digital Literacy Maturity Level using internationally accepted models and constructs like level of digital knowledge, attitude towards digital technology, behavior and skills related to ICT in all the ten regions as well as Dire-Dawa and Addis Ababa.

2 INTRODUCTION

In a world that's now powered by big data and advanced technologies, digital technology is disrupting everything from business models to entire industries, and impacting organizations in particular and countries in general, from top to bottom.

Nations are now operating in a complex and dynamic environment. This global challenge forces citizens and organizations to adopt new technological solutions to improve their efficiency and provide quality services to their customers. One of the basic requirements in this electronic world is being digitally literate. Digital literacy is essentially an indispensable skill as technology is rapidly evolving and so is advancement in information resources, especially digital resources. As the use of digital resources continue to rise within organizations, citizens are expected to develop the required digital literacy skills.[1]

The American Library Association (ALA) defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." A digitally literate individual becomes a socially responsible member of their community by spreading awareness and helping others find digital solutions at home, work, or on a national platform.

On top of UNESCO's Digital Literacy Global Framework, another way of conceptualizing digital literacy is articulated in four dimensions (operation, semiotic, cultural and civic) proposed by Pérez[2]:

- Operational: The ability to use computers and communication technologies.
- Semiotic: The ability to use all the languages that converge in the new multimedia universe.
- Cultural: A new intellectual environment for the Information Society.

[1] *Odede, Israel R. and Jiyane, Glenrose, "EXPLORING DIMENSIONAL CONSTRUCTS OF DIGITAL LITERACY SKILLS FOR HIGHER EDUCATION" (2019). Library Philosophy and Practice (e-journal). 2806.*

[2] *Pérez, J.M. (2008). Media Literacy. New Conceptualisation, New Approach. In Carlsson, U.; Tayie, S.; Jacquinot-Delaunay, G. and Pérez Tornero, J.M. (Eds.). (2008). Empowerment through media education. An intercultural dialogue. Sweden: Nordicom, University of Gothenburg.*

- Civic: A new repertoire of rights and duties relating to the new technological context.

Digital literacy is like any other core curricular subject. It is no longer an option, just as reading and math are not. Citizens must be digitally competent if they are to be successful in day-to-day tasks as well as in their professional and personal lives. Indeed, many of the best jobs for years to come will involve digital expertise. If nations neglect measuring and addressing gaps regarding digital literacy, it will be difficult for them to close the gap of digital divide.

The world is now increasingly digitalized and more so due to COVID 19 pandemic. The way businesses are conducted in industries, education, as well as economic and social sectors is changing much faster than thought because of the lock down. Ethiopia is no different from the rest of the world in this regard. Universities and primary and secondary schools were closed, several organizations reduced their workforce, people to people contact are reduced and several meetings and education was conducted via online means. However, the level of digital maturity in terms of readiness to conduct business using online means in particular and the countries' preparedness in terms of infrastructure and human capital in general were not high enough to accommodate the sudden change in requirement.

Digital transformation requires a country to have a clear vision of where it stands in regard to digital maturity of its citizens. This knowledge will give it an essential context to make decisions about digital initiatives, to identify priorities and develop a common digital vision of a country.

Ethiopia is strategically moving towards technological transformation by adopting technology in its education, industry, telecommunication, agriculture, and other sectors. To this end, the Digital Ethiopia 2025 outlined the countries direction for digital transformation in the next 5 years. Digital Ethiopia 2025 states that the country should transform digitally to:

- unleash value from its agriculture,
- ensure global value chain in manufacturing,
- build IT enabled services, and
- digital drive its tourism competitiveness

In line with this, the Ministry of Innovation and Technology (MInT) initiated this project to assess the level of digital literacy of the country based on internationally accepted standards so that appropriate interventions can be made to prepare its citizens for the digital age by 2025. With this in mind, MInT extended an invitation (with a letter dated 08/05/2012 EC) to the School of Information Science (SIS) of Addis Ababa University, requesting a consultancy service in order to conduct an assessment to measure Ethiopian Digital Literacy maturity level. In response to the

invitation, SIS has established team of relevant experts, who have rich experience in conducting similar survey research, to conduct the consultancy service.

This Inception Report is written to clearly show the objectives, scope, methodology, deliverables, project management and action plan to be used as a blueprint for MInT and SIS in conducting the assessment.

3 OPERATIONAL DEFINITION

This project adopted the digital literacy definition from UNESCO by incorporating attitude to use digital technologies.

> *Digital literacy is the ability to define, access, manage, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies and networked devices as well as the attitude to use digital technologies for participation in economic and social life. It includes competencies that are variously referred to as computer literacy, ICT literacy, Information Literacy, data literacy, and media literacy.*

4 PROJECT OBJECTIVES

The objective of this project is to conduct an assessment to measure Ethiopian Digital Literacy Maturity Level by using internationally accepted standards and constructs. Specifically, knowledge, attitude, and skills related to digital literacy in Ethiopia will be measured.

In pursuit of achieving the stated objective, the following activities will be undertaken.

- Conceptualize and document digital literacy through desk research
- Make a review of relevant guiding frameworks with the objective of comprehensive understanding and logical selection of one
- Develop and validate data collection instruments
- Measure digital literacy maturity level of the country through empirical data collection and analysis
- Indicate strategies and policy recommendations to fill the gap at a national level

5 DELIVERABLES

The following are the major deliverables from the consultancy service:

- **Inception report:** This report enumerates the scope of the work after detail review of the TOR and contract document, and face to face discussion with the client as required.

- **Monthly Status Reports:** These reports contain the status of the project including challenges and mitigation strategies. Schedule changes, if any, are also reported here.
- **Raw Collected Data:** As per the standard set by the Central Statistics Authority of Ethiopia regarding survey data collection at national level, we will submit the data collected to MInT.
- **Draft Final Report:** This report presents the draft assessment report of the digital literacy maturity level of Ethiopia and recommendations for intervention towards improvement of the status.
- **Final Report:** This report will be submitted after a validation workshop is conducted on the draft report and comments and suggestions from stakeholders is incorporated. This report will terminate the contractual agreement between MInT and SIS of AAU.

6 METHODOLOGY

Generally, both empirical and desk research approaches will be employed in the assessment of digital maturity level of the country. Accordingly, the following major tasks, data collection and analysis approaches will be employed for the purpose.

- **Desk research/study:** to understand theoretical underpinning, adopt a conceptual framework defining the constructs and variables than need to be measured in relation to digital maturity and develop data collection instruments.
- **Benchmarking:** to learn from other countries which are forerunners to assess their level of digital maturity. The benchmarking helps in selecting appropriate tools and instruments as well as methodology for use in the assessment.
- **Pilot testing:** the data collection instruments developed will be distributed to a selected few participant to collect feedback and check if there are any issues that need to be corrected or modified before the questionnaire is distributed to the selected large study sample.
- **Survey data collection:** A questionnaire is designed (both for online and paper-based data collection). It will be distributed to the selected samples using different approaches.
- Semi-structured and unstructured interviews with relevant experts in selected stakeholder institutions to understand the level of digital literacy at selected ministry level.

- Data analysis: the data collected using the survey will be encoded into a statistical data analysis tool to understand and measure the digital maturity level of the country.
- Periodic meeting and workshops (as required): for collecting feedbacks and inputs as well as validating the reports.

6.1 SURVEY METHODOLOGY

6.1.1 Sample Design

Literature review and benchmarking indicated that there are different approaches to conduct national digital literacy survey. In this project, we have presented two alternatives sampling frames. The first one is to study the national digital literacy maturity level using secondary school students from grade 9 to 12 in all the twelve administrative regions as the sampling frame. Moreover, semi-structured interview will be conducted in selected stakeholder institutions to see the trend in digital literacy within organizations. The second approach is to conduct the survey at house-hold level taking inclusion and exclusion criteria of people between 15 and 55 years of age respectively. Both the sampling strategies including the approach and the sample size determination are presented below as alternative 1 and alternative 2.

6.1.1.1 ALTERNATIVE 1: SAMPLING USING SECONDARY SCHOOL STUDENTS

In order to achieve the objectives of the 2021 Ethiopian digital literacy maturity level survey, a national stratified representative sample of about 6,630 students will be selected in 450 schools.

The sampling frame used for this project is a comprehensive list of secondary schools from the Ministry of Education and includes enrolment data by sex and grade level for all schools, indigenous enrolment data, school classification information and contact information.

The framework includes more than two million students with in 4,000 schools across the country. The frame file contains information about the school, the approximate number of students in each school.

Administratively, Ethiopia is divided into 12 administrative regions. Each region is divided into zones, each zone is divided into woreda, each woreda is divided into kebeles and schools are located in kebeles.

6.1.1.1.1 SAMPLE DESIGN APPROACH

This Educational survey of students nearly always involves a multiple stage random sampling approach. At the first stage, a group of schools is selected, and then a group of students is selected from the sampled schools. The selection of students within schools may be split into separate

steps, for example, the selection of a class at a level, and then the selection of individual students from that class.

This sampling approach is known as cluster sampling. The population of students is clustered into schools, and within schools, is further clustered into classes. Cluster sampling is employed because it is cost-effective. A larger group of students from the same school can be surveyed at the same time, rather than possibly just one or two students if a simple random sample of students from the population were to be drawn.

This saves on the costs of administering the survey. Cluster samples also allow for multi-level analyses of data, where the level of the school or the class within the school can be incorporated into the survey analysis. A further advantage of cluster sampling is that it reduces the reporting burden on the Researcher of the survey to the set of schools sampled for the project.

Cluster samples will usually require a substantially larger sample size to achieve the same level of accuracy as a simple random sample. This is because students from the same school tend to be more similar to each other with respect to the survey outcome variables than a group of students randomly selected from the population. This within school homogeneity reduces the effective size of the sample to something less than the number of children actually sampled. If an intact class is selected from the sampled school this may add another level of cluster from a particular class may be more similar with respect to the outcome variables compared to students across the school as a whole. This reduction in the effective sample size as a result of using a clustered sampling design is known as the design effect, relative precision and it can be estimated for the proposed survey using data from previous surveys conducted under the same design. Design effects for this survey in Ethiopia have been calculated at four or higher. A design effect of four means that the cluster-based sample size needs to be four times larger than a corresponding simple random sample in order to achieve an equivalent level of precision. Nevertheless, it will often be more cost efficient for example to sample five students from one school, than 30 students from six schools.

The design effect will generally increase as the number of students sampled from the school increases, and so an issue in the design of the sample is to determine a within school sample size that balances the positive aspects of clustering (cost-effectiveness, Limiting the burden on the school system, having enough data to enable multi-level analyses) with the increase in the design effect as the within school sample size becomes larger.

Despite the relative inefficiency of cluster samples compared to simple random samples and the corresponding need to sample more students to achieve the desired level of precision, the reduced cost and burden on schools, and the capacity for multi- level analyses offered through cluster sampling will normally substantially balance the disadvantages.

6.1.1.1.2 SAMPLE SIZE DETERMINATION AND SURVEY PRECISION

There are no hard and fast rules about the correct sample size for an educational sample survey. The larger the sample size, the greater the range of analyses that can be sustained with the survey data. The question of sample size usually amounts to balancing the demands of analysis with factors such as the burden on the school system and costs. The Educational survey requires that the effective sample size for the main survey outcome variables should be at least 400 to 500 students (Green, P.J., Herget, D., and Rosen, J. (2009). User's Guide for the Program for International Student Assessment (PISA): 2006 Data Files and Database with United States Specific Variables (NCES 2009-055). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.).

In the calculation is an effective sample size that for a variable will generate 95% confidence intervals of +/- 5% around a proportion of 50%, design factor (Deft) 2.5, and expected Relative precision or Standard Error (RSE) 6.95% of 95% Confidence level were used to represent the expected precision is very good on the National level of indicators (refer it, Kish Sample Survey 1965).

To select representative sample from this Educational survey, first, the initial sample size was determined by using the following scientific formula:

$$n = Deft^2 \frac{4P(1-P)}{d^2}\left(IRR^{-1}\right)$$

Where the *deft* is the design factor defined as the ratio between the square root of standard error using the given sample design and the standard error that would result if a simple random sample had been used, α^2 relative precision/RSE and using absolute error in terms of relative standard error. Finally adjusted by student response rate 1.1%. Based on the above scenario total sample size $n = 6{,}630\ number\ of\ studentss$, 3,315 Student Class and $Number\ of\ School = 450$.

6.1.1.1.3 SAMPLE SELECTION TECHNIQUES

The Sampling strategy is a Complex Sample design and also the 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey is stratified and will be selected in three stage Stratified cluster Sample design methods adopted.

In the first stage, totally 450 Schools selected with probability proportional to the school size and with independent selection in each sampling stratum with the sample allocation given in **Error! Reference source not found.**. The school size is the number of students in the school according to the sampling frame. A students' listing operation will be carried out in all the selected class and

the resulting lists of students will serve as sampling frame for the selection of students in the ultimate stage.

In the second stage, we select the student class from the selected school using a proportional to measure of student size.

Table 1: Sample allocation of Schools and Students

Sample allocation of Number of Schools and Students by region, according to Students Grade, 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey								
Region	Grade Nine		Grade Ten		Grade Eleven		Grade Twelve	
	School	Student	School	Student	School	Student	School	Student
Tigray	30	150	25	125	15	75	14	70
Amhara	80	400	70	350	60	300	50	250
Afar	15	75	10	50	6	30	5	25
Oromiya	90	450	80	400	70	350	60	300
Benishangul	20	100	15	75	12	60	8	40
Somali	25	125	20	100	15	75	10	50
SNNPR	60	300	40	200	35	175	25	125
Sidama	25	125	20	100	15	75	8	40
Gambella	20	100	15	75	6	30	6	30
Harari	10	50	10	50	5	25	5	25
Addis Ababa	60	300	50	250	40	200	30	150
Dire Dawa	15	75	10	50	6	30	5	25
Ethioipa	450	2,250	365	1,825	285	1,425	226	1130

In the third stage of sample selection, a fixed number of one to five students per class will be selected with an equal probability systematic selection from the newly created students listing.

Error! Reference source not found. shows the allocation of selected students and Schools according to regions the survey will be conducted in 6,630 students, 2,250 in grade 9, 1,825 in grade 10, 1,425 in grade 11 and 1,130 in grade 12.

6.1.1.1.4 ESTIMATION OR REPORTING LEVELS OF THE SURVEY

The reporting levels are the survey domains for which the major findings of the surveys are reported. Accordingly, the 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey is designed to provide an estimate divided in three parts. These are:

- At national level Grade Nine
- At national level Grade Ten
- At national level Grade Eleven
- At national level Grade Twelve
- Totally four survey domains are decided for the surveys at country level.
- National estimates will be obtained by aggregating the respective domain estimates.

6.1.1.2 ALTERNATIVE 2: SAMPLING USING HOUSE HOLDS

To achieve the objectives of the 2021 Ethiopian Digital Literacy Maturity Level Survey, a national stratified representative sample of about 4,000 households will be selected in 160 clusters.

The sampling frame used for the Ethiopian Digital Literacy Maturity Level Measurement Survey 2021 is the census frame of the enumeration areas (EA) as prepared by CSA in 2019. Ethiopia is divided into 12 Administrative regions; each region is subdivided into zones, each zone is subdivided into woreda/district, each woreda is subdivided into kebele (collection of communities) and kebeles into EAs.

The frame consists of 147,602 Enumeration Areas (EA), which covers the entire country. CSA has an electronic file of the frame. An EA is a geographical grid consisting of a convenient number of housing units. The frame file contains information about the location, administrative attribution, the type of residence (urban or rural), EA ID which is the key that links the EA to the census data, and the estimated number of housing units for each of the EAs.

A housing unit can be a single household structure or a multi-household structure. Satellite maps are also available for each EA, which delimit the geographic locations and boundaries of the EA. The EA size on number of housing unit is a rough count with an average of 171 housing units for major urban EA, 172 for other urban areas, and 119 per rural EA, with an overall average of 131 housing units per EA.

6.1.1.2.1 SAMPLE SIZE AND EXPECTED PRECISION

The issue of sample size determination is only partly a technical one. Under the same survey conditions, the larger the sample size, the better the survey precision and the more elaborate the

analyses that can be sustained. The challenge in deciding on the sample size for a survey is to balance the demands of analysis with the capability of the implementing organization and the constraints of funding.

An appropriate sample size for the 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey is the minimum number of households which will allow core indictors to be calculated with a reasonable level of precision.

The desired level of accuracy for the survey is set to a confidence level of 95% and relative precision (Relative standard error) of 5%. The basic formula used in the calculation of the sample size is given by:

$$n = deft^2 \frac{(1/p - 1)}{\alpha^2}$$

Where *n* is the number of Households; p is the estimated prevalence rate or proportion, α is the expected relative standard error; Deft is the design factor. A similar survey on household and small business access and usage conducted by Research ICT Africa (RIA) [3] used the same precession and confidence level.

Due to the sampling method chosen for the survey the minimum sample size had to be multiplied by the design effect variable (Lwanga & Lemeshow, 1991). In the absence of empirical data from previous surveys that would have suggested a differed appropriate value, a value between one and two was chosen for the design effect $deft$ =1.78 (UNSD, 2005) and also the acceptable relative standard error (α) is 5% at national estimation level. Based on the above scenario, the total sample size is determined to be: $n = 4000\ HHs$ and $EAs = 160$.

While the above sample size is for the survey, the qualitative data will be collected through semi-structured interview from selected stakeholder institutions.

6.1.1.2.2 SAMPLE DESIGN AND SELECTION TECHNIQUES

[3] *Stork, C. (2012). Household and small business access & usage survey 2011 (Policy Brief No. 1; ICT Survey Methodology). Research ICT Africa. https://researchictafrica.net/polbrf/Research_ICT_Africa_Policy_Briefs/2012_Policy_Brief_1_ICT_Survey_Methodology.pdf*

For the 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey, a two-stage stratified cluster sample design method will be used. For the purpose of the survey the master sample frame was split into three categories as major urban, other urban, and rural by region yielding twelve, nine and eleven sampling strata respectively. Major urban refers to the capital cities of administration regions and any other metropolitan areas.

In the first stage, a total of 160 (76 Major urban, 42 other urban and 42 rural) EAs are selected with a probability proportional to the EA size with independent selection in each sampling stratum. The sample allocation is presented in Table 2.

Table 2: Sample allocation of clusters and households

Sample allocation of clusters and households by region, according to residence, 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey

	Number of Clusters allocated					Number of Households allocated			
Region	Major Urban	Other Urban	Rural	Total		Major Urban	Other Urban	Rural	Total
Tigray	6	4	4	14		150	100	100	350
Afar	4	4	3	11		100	100	75	275
Amhara	10	7	6	23		250	175	150	575
Oromiya	12	8	6	26		300	200	150	650
Somali	4	4	3	11		100	100	75	275
Beni Gum	4	4	3	11		100	100	75	275
SNNP	5	5	5	15		125	125	125	375
Sidama	5	3	3	11		125	75	75	275
Gambela	4	3	3	10		100	75	75	250
Hareri	4		3	7		100	-	75	175
Addis Ababa	14			14		350	-	-	350
Dire Dawa	4		3	7		100	-	75	175
Ethiopia	76	42	42	160		1,900	1,050	1,050	4,000

Table 2 shows the allocation of selected households according to regions and Major urban, Other urban and rural areas and the survey will be conducted in 4,000 residential households, 1,900 in major urban areas, 1,050 other urban and 1,050 in rural areas.

The EA size is the number of residential households in the EA according to the sampling frame. A household listing operation will be carried out in all the selected EAs, and the resulting lists of households will serve as sampling frame for the selection of households in the second stage. Some of the selected EAs might be of large size. In order to minimize the task of household listing, for the selected EAs which have more than 250 households, each large EA will be segmented. Only one segment will be selected for the survey with probability proportional to the segment size. Household listing will be conducted only in the selected segment. So, a 2021 Ethiopian Digital Literacy Maturity Level Measurement Survey cluster is either an EA or a segment of an EA.

In the second stage of selection, a fixed number of 25 households per cluster will be selected with an equal probability systematic selection from the newly created household listing. Because from the sampling frame a moderately average EA size of 100-300 households, the optimum sample size ranges from 20 to 40 households (Aliaga and Ren, 2004). The survey interviewer will interview only the pre-selected households. No replacements and no changes of the pre-selected

households are allowed in the implementing stages in order to prevent bias. All Adults aged 15 and above who are usual members of the selected households are eligible for the survey.

6.1.1.3 RECOMMENDED SAMPLING FRAME FOR THIS PROJECT

Many of the countries surveyed in this study use students, mainly in secondary schools, to measure the national digital literacy maturity level. Although, this approach does not cover all sectors of the society, conducting the survey at school level is believed to allow the government to introduce meaningful policy interventions through the curriculum. This student-based survey is recommended in most surveys because data that is found in student survey most likely will trickle down, at a later stage or within 1-7 years, into all work environments including: financial, education, industry, agriculture, business sectors as well as civic society.

The drawback of the second option is that when collecting data from households, most residents may not be found at home due to different reasons. This is problematic for many reasons: a). the ones found at home could be stay home mothers, maids (home assistants), who cannot give information about the digital literacy level of the residents and b) taking residents present at home as the inclusion criteria will provide a different problem which biases the finding about the digital literacy level to be almost non-existent. This is because most digitally literate people will not be at home but at school or working.

Therefore, we recommend using alternative 1 for this study.

6.1.2 Reporting Levels of the Survey

The reporting levels (estimation) are the survey domains for which the major findings of the survey will be reported. Accordingly, the 2021 Ethiopian digital literacy maturity level survey is designed to provide an estimate divided in three parts. These are:

- At national level major urban towns
- At nationally other urban towns.
- At nationally rural levels
- Totally three survey domains are decided for the survey at national level.
- National estimates will be obtained by aggregating the respective domain estimates.

7 BENCHMARKING

7.1.1 Objective and Approach of Benchmarking

As part of the Digital Literacy Level Assessment Project, this section of the inception report presents benchmarking on digital literacy assessments. By benchmarking, we are referring to

lessons taken from similar rigorous digital skill assessments elsewhere. The objective of the benchmarking exercise is to select the path well-travelled by other organization/countries in assessing digital maturity level. Specifically, the methodology followed, target population and sampling adopted, the dimension/constructs used, and the levels of maturity employed are of interest for the work at hand.

The benchmarking was entirely done based on document review of publicly available resources with search terms "digital literacy level assessment", "ICT literacy", "digital literacy maturity", "digital literacy assessment framework" on ScienceDirect, Google Scholar and emerald insight. Accordingly, six digital assessment studies were considered for the benchmarking. The studies reviewed were selected based on two major criteria. These criteria, in order of preference, were:

- Accessibility of sufficient detail: the pertinent detail about the conduct of the assessment
- Coverage of the assessment study: relatively wider (national) coverage of the study was required
- Researches conducted after 2015

7.1.2 Review of related works

Digitization, digitalization and digital transformation are taking center stage in the lives of private citizens and organizations. A digitized enterprise/nation is characterized by the use of digital technologies and networks to carry out activities. These include the purchase and sale of products and services, interactions with customers and partner companies, as well as the execution of transactions and communication within the company (Xu, 2014)4. A digitally aware or mature citizen could use information technology (IT) in order to engage in society, politics, and government. According to Chetty (2018)5 digital literacy comprises at least 5 dimensions and 3 perspectives; namely the dimensions of information literacy, computer literacy, media alliteration, communication literacy and literacy technology. Each dimension consists of 3 perspectives, namely technical, cognitive and ethical.

[4] Xu, J. (2014). Managing Digital Enterprise: Ten Essential Topics. Australia: Atlantis Press. https://doi.org/10.2991/978-94-6239094-2

[5] K. Chetty, L. Qigui, N. Gcora, J. Josie, L. Wenwei, and C. Fang, "Bridging the digital divide: measuring digital literacy," Econ. Open-Access, Open-Assessment E-Journal, vol. 12, no. 2018–23, pp. 1–20, 2018.

There are several efforts to measure digital maturity of individual citizens as well as digitization level of organizations and nations at large. One such effort is a research titled: Turkish Adaptation of Digital Literacy Scale and Investigating Pre-service Science Teachers' Digital Literacy by Üstündağ (2017)6. The main argument of the research was that determining the digital literacy skills of teachers, preservice teachers and students is important in terms of developing the required teacher education programs. In this study, participants were intently selected from pre-service science teachers from 13 state universities in Turkey based on PISA results and the importance of science teaching on students' science literacy. A total of 979 pre-service science teachers were involved in the study. They were particularly selected among junior (530 participants) and senior (431) preservice science teachers, because the technology enhancement courses were already taken at those levels. The 5-point Likert mode (from 1=strongly disagree to 5=strongly agree) of the ten-item digital literacy skills scale originally developed by Ng (2012)7 was used for the research. Convenience sampling was applied to reach the maximum number of sampling.

Analysis includes validation of the scale results and descriptive statistics. The descriptive scores include each item's mean (M), standard deviation (SD), minimum and maximum score. Result showed that, pre-service science teachers' digital literacy skills were found to be generally qualified. Moreover, participants' digital literacy scores related to solving technical problems, learning new technologies and collaborating by ICT is closer than their scores related to issues of web-based activities and utilization of internet connection for their own university work.

Yu Jina (2020)8 conducted a survey to develop a test appropriate for measuring DL performance at different ages and a comprehensive DL assessment framework has been adopted for the purpose. The Authors argued that little is known about how DL may vary among different age cohorts, and whether and at which age performance gaps emerge with respect to gender do. The survey adopted a cross-cohort panel design to examine performance differences among students in three different age cohorts, including one cohort of primary school students (Primary 3) and

[6] Üstündağ (2017). Turkish Adaptation of Digital Literacy Scale and Investigating Pre-service Science Teachers' Digital Literacy

[7] Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065-1078.

[8] Yu Jin et al (2020). Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance differences

two cohorts of secondary students (Secondary 1 and Secondary 3) in Hong Kong. Primary and secondary schools located in four district areas in Hong Kong were sampled—18 primary schools and 14 secondary schools participated in the study, and the materials were administered to 715, 705, and 569 students in Primary 3, Secondary 1, and Secondary 3, respectively.

According to the authors the development of the DL test was largely informed by the DigComp 2.1 framework which covers five major competency areas. It is reported that secondary school students fared better than primary school students in DL. A gender gap in DL was also found among secondary school students. The analysis found no statistical differences in male and female primary school students' DL performance but significant gaps between both genders at the secondary school level.

Lazondera et al (2019)9 conducted a longitudinal assessment of digital literacy in children. The study among others aimed at finding out how digital literacy develops in upper-elementary schoolchildren; and whether the skills to collect, create, transform, and safely use digital information develop at similar pace. Sample was drawn from a large public elementary school in the eastern part of the Netherlands. Though the plan was to start the longitudinal assessment with 182 children, a sample of 151 fifth- and sixth- graders were tested three times at yearly intervals to monitor how their skills to collect, create, transform, and safely use digital information progressed. The research employed internet, word processing, presentation applications as well as mathematics tests to measure skills to collect, create, transform, and safely use digital information. Findings at the group level showed a steady linear increase in all four skills, but individual children tended to alternate substantial growth in one year with minimal progress during the next or vice versa. Children made most progress in their ability to collect information whereas their ability to create information improved the least. Development of most skills was moderately related and independent of gender, grade level, migration background, and improvements in reading comprehension and math

[9] Lazondera et al (2020) Longitudinal assessment of digital literacy in children: Findings from a large Dutch single-school study

Kusumastuti and Nuryani (2020)10 investigated Digital Literacy Levels among ASEAN countries through a comparative Study. The purpose of the study was to measure the difference in digital literacy levels of ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The research used quantitative research based on secondary data, which was then compared with contexts from several ASEAN countries. Data was obtained from the 2018 Inclusive Internet Index, as compiled and analyzed by the Economist Intelligence Unit (EIU) in collaboration with Facebook. According to the authors, the data used is derived from several questions to measure the level of digital literacy with indicators of mainly information literacy research, computer literacy, media literacy, communication literacy and literacy technology. The test uses the Kruskall Wallis comparative test with a significance of 10%. This test was used because this test is appropriate to compare data on non-parametric statistics with ordinal data ranking (ranking) on independent samples to obtain test results.

The results show that there is no marked difference in the level of digital literacy among the eight ASEAN countries. Despite the absence of a difference, attempt was made to measure the average levels of digital literacy. Accordingly, the highest average ranking was obtained by Singapore, while the lowest was Cambodia.

7.1.3 Summary and Lessons learned from benchmarking

Key lessons obtained from the task of benchmarking are presented in table 3.

Table 3: Summary of the benchmarked DL studies

Sources/ Survey	Purpose	Target population and sample size	DL Dimensions/ Constructs	DL Levels
Üstündağ (2017)	*Investigating Pre-service Science Teachers' Digital Literacy*	A total of 979 pre-service science teachers from 13 state universities in Turkey	ten-item digital literacy skills scale originally developed by Ng (2012)	Not specified
Kim (2019)	*to develop and validate a test for measuring Korean elementary and middle school students' information and communications*	Requiring a sample size of 0.5% of all elementary and middle school students in Republic of Korea, we systematically formed a sample by following	Problem-solving strategies, Information analysis and evaluation, Information searching, Computational thinking, Information communication, Information	Based on bookmark method (Lewis et al. 1998), achievement levels are divided into

[10] Kusumastuti and Nuryani (2020). Digital Literacy Levels in ASEAN (Comparative Study on ASEAN Countries)

Sources/ Survey	Purpose	Target population and sample size	DL Dimensions/ Constructs	DL Levels
	technology (ICT) literacy and to make suggestions for improving ICT literacy across Republic of Korea	a three-stage stratified sampling method. 15,000 students in Korea	organization and creation, Information utilization and management	**four** levels: below basic, basic, average, and excellent
Yu Jina (2020)	to develop a test appropriate for measuring DL performance at different ages	Primary and secondary schools located in four district areas in Hong Kong. 18 primary and 14 secondary schools participated in the study, and the materials were administered to 715, 705, and 569 students in Primary 3, Secondary 1, and Secondary 3, respectively	DigComp 2.1 framework which covers five major competency areas	Not specified
ACARA (2018)	To assess Year 6 and Year 10 student achievement in ICT literacy in Australia	Data were provided by students sampled randomly 5,439 Year 6 students in 327 schools and 4,885 Year 10 students in 313 schools	Based on three strands: (a) Working with information, (b) Creating and sharing information and (c) Using ICT responsibly	Six achievement levels (level 1-6) based on Rasch Item Response Theory (IRT) model
Kusumastuti and Nuryani (2020)	to measure the difference in digital literacy levels of ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam	data obtained from The 2018 Inclusive Internet Index, as compiled and analyzed by the Economist Intelligence Unit (EIU) in collaboration with Facebook	information literacy, computer literacy, media literacy, communication literacy and technology literacy	Not specified
Lazondera et al (2019)	To find out how digital literacy develops in upper-elementary schoolchildren	A public elementary school in the eastern part of the Netherlands. sample of 151 fifth- and sixth-graders	skills to collect, create, transform, and safely use digital information	Not specified

As can be seen from the table 3, most digital literacy assessments target schools and educational environments. With respect to the DL dimensions, though there exist variations in naming most are in line with the UNESCO's framework for DL assessment. As to the levels of digital literacy, most studies did not specify levels rather presented their result based on relative statistical values. Most cited DL framework of European Commission however provided proficiency levels

based on the difficulty level of items. Accordingly, the latest version of DigComp 2.1 by European Commission defined eight proficiency levels by improving the 4 proficiency levels namely; foundation, intermediate, advanced and Highly specialized of its predecessor DigComp 2.0.

Thus, targeting younger population, and adopting UNESCO's DL assessment framework and the latest eight proficiency levels proposed in DigComp 2.1 could be considered.

8 DIGITAL LITERACY FRAMEWORK

Technological advance in 21st-century has changed all aspects of human life. Technology has become the main medium to communicate, do business, and attend education etc. It changes how every aspect of works, from hardcopy to paperless, from book to tablet, and from physical interaction to virtual collaboration. Internet is no longer complementary tool but primary need in today's era.

In digital society, citizen should have basic knowledge and skills of ICT, here called "digital literacy", to access and utilize resources through digital devices. It has become the basic skills everyone should possess to attend education, get job opportunities and to be productive at workplace. A study conducted by the British Educational Communications and Technology Agency (BECTA) reveals that integrated use of technology enables a range of positive outcomes for children and young people, including improved progress in their education for both girls and boys. The large majority of jobs requires an understanding of technology to process work related data and communicate and collaborate with other colleagues. Digital literacy aims to improve employability because it is a gate skill, demanded by many employers when they first evaluate a job application. Individuals lacking such skills, and a way to obtain them, are at an increasing disadvantage in both the local and global economy.

8.1.1 Conceptualization of Digital Literacy

The importance of digital literacy is evidenced by the many national and regional efforts to develop and implement digital literacy frameworks and strategic plans to bolster citizens' digital literacy. Countries undertook digital literacy program with different purposes. For example, the Republic of Korea conducted a study to enhance the digital literacy of public officials to increase

the efficiency, transparency and delivery of services to citizens through public administration[11]. On the other hand, the Digital Literacy Programme (DLP) is a programme borne out of the Government of Kenya's vision to make sure every pupil is prepared for today's digital world, and to transform learning in Kenya into a 21st century education system.

The definition of digital literacy varies according to the purpose of digital literacy program. In addition, the concept of digital literacy also evolves with the development of technological devices. At first digital literacy implied computer literacy. Computer literacy is associated with proficiency in programming[12]. "Computer Literacy" has since evolved to include information technology, or, "IT Literacy", then later, information and communication technologies, or "ICT Literacy". The emergence of Web 2.0, or online social media applications, introduced the additional dimensions of comprehending authorship, privacy and plagiarism which involves a mixture of information literacy, technology literacy, creativity and ethics.

Digital literacy is a complex concept which combines ideas from different disciplines. Covello presented sub disciplines of digital literacy by reviewing different literature as shown in Table 3.

Table 3: Sub-Disciplines of Digital Literacy

Sub-Discipline	Definition
Information Literacy	Finding and locating sources, analyzing and synthesizing the material, evaluating the credibility of the source, using and citing ethically and legally, focusing topics and formulating research questions in an accurate, effective, and efficient manner
Computer Literacy	An understanding of how to use computers and application software for practical purposes
Media Literacy	A series of communication competencies, including the ability to access, analyze, evaluate and communicate information in a variety of forms including print and non-print messages

[11] *UNESCO, 2018. A Global Framework of Reference on Digital Literacy Skills for Indicator*

[12] Covello, S. (2010). A review of digital literacy assessment instruments. Syracuse University School of Education/IDD & E, IDE-712: Analysis for Human Performance Technology Decisions. http://www.apescience.com/id/fulltext/research-on-digital-literacy-assessment-instruments

Sub-Discipline	Definition
Communication Literacy	Learners must be able to communicate effectively as individuals and work collaboratively in groups, using publishing technologies (word processor, database, spreadsheet, drawing tools...), the Internet, as well as other electronic and telecommunication tools
Visual Literacy	The ability to 'read,' interpret, and understand information presented in pictorial or graphic images; the ability to turn information of all types into pictures, graphics, or forms that help communicate the information; a group of competencies that allows humans to discriminate and interpret the visible action, objects, and/or symbols, natural or constructed, that they encounter in the environment
Technology Literacy	Computer skills and the ability to use computers and other technology to improve learning, productivity, and performance

Digital literacy includes broader skills that include ability to operate digital devices and use and evaluate resources available in digital devices. Vuorikari et al (2016)[13] definition of digital devices a comprehensive definition that reflects the 21st century digital literacy requirements:

> *Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy, and media literacy.*

The above definition includes three important themes: technology, content and safety. Technology is core infrastructure of the 21st century society to manage its day-to-day activities. Knowledge and skills to operate technologies is the basic requirement to access and use contents available in digital devices. An individual should have basic technological skills to solve their daily

[13] Vuorikari, R., Punie, Y., Gomez, S. C., & Van Den Brande, G. (2016). DigComp 2.0: The digital competence framework for citizens. Update phase 1: The conceptual reference model (No. JRC101254). Joint Research

problems such as sending and receiving emails, storing and retrieving information relevant to various tasks and the like. It also includes knowledge of different digital devices and their functions and how the different devices are integrated to provide more specialized services.

There is also too much content available in digital devices which is growing with staggering speed. Technology literacy is not sufficient to effectively operate this digital society. Citizens should also possess basic information literacy knowledge and skills. This literacy includes finding and locating sources, analyzing and synthesizing the material, and evaluating the credibility of the source. As we are living in the knowledge-based society, our success depends on how we access and apply information in our daily activities. Without these information management skills, citizens cannot be beneficiaries of the opportunities offered by digital devices.

The convergence of portable personal technologies, unfiltered access to information, and user-generated content profoundly impacts how this generation grows and learns. There are more threats through digital revolution such as violence, cyber bullying, online predator and cultural colonization. Ethical use of digital devices is also necessary for safe use of digital contents for individual as well as societal development.

8.1.2 Existing Frameworks for Digital Literacy

Frameworks are usually organizational instruments that indicate the necessary components and relationship among components to achieve some predefined goals. Development of a more clear-cut conceptual framework may improve the understanding of the skills encompassed by the term "digital literacy," and provide designers of digital environments with more precise guidelines for effective planning of learner-oriented digital work environments. There are different digital literacy frameworks developed and used by different organizations and countries. Ferrari provides an exhaustive list of digital literacy frameworks that includes for different target user groups[14]. Only frameworks that deal with all citizens are given in the following table.

Table 4: Review of Digital Literacy Framework (Adopted from Ferrari, 2012; Covello, 2010)

[14] *Ferrari 2012 et.al.(2012), Understanding digital competence in the 21st century: An analysis of current frameworks*

Framework name	Brief summary of Framework
ACTIC	ACTIC stands for "acreditación de competencias en tecnologías de la informacióny la comunicación" (Certification of ICT competences). This initiative is being carried out in Catalonia and is targeted at all citizens above the age of 16. Digital literacy is considered to be the safe and critical use of Information Society Technologies for work, leisure and communication.
DigEuLit	This project was set up by the European Commission (EC) eLearning initiative and led by the University of Glasgow to develop a general framework for Digital Competence. The main output of the project was a series of publications on a conceptual framework for the development of Digital literacy, which is seen as the convergence of several literacies.
ECDL	ECDL is one of the leading authorities of computer skills certification programs. It is a not-for-profit organization providing about ten certification programs ranging from entry-level for beginners to advanced level professional programs. The main focus of the most widespread programs (ECDL/ICDL) is on the development of skills and knowledge necessary to use word processing, database, spreadsheet, and presentation applications.
Eshet-Alkalai's Conceptual framework	This paper by Eshet-Alkalai reports on the different aspects of digital literacy and on the multiple literacies that are needed for people to be functional in a digital era. It proposes a conceptual framework to clarify the skills pertinent to digital literacy.
IC3 Internet and Computer Core Certification	IC3 certifies critical entry-level skills needed to effectively use the latest computer and Internet technology to achieve business objectives, expand productivity, improve profitability, and provide a competitive edge.
Microsoft Digital Literacy Curriculum	The goal of Digital Literacy is to teach and assess basic computer concepts and skills so that people can use computer technology in everyday life to develop new social and economic opportunities for themselves, their families, and their communities (URL: https://alison.com/publisher/microsoft).
DigComp	This framework is developed to improve citizens' digital competency, help policymakers formulate policies that support digital competence building, and plan education and training initiatives to improve the digital competence of specific target groups

There is no one standard framework that can be applied in every country because of differences in the purpose of digital literacy programs. DigComp 2.1 competency framework has been synthesized from other, major digital literacy frameworks and undergone a long consultation and development process, thus presenting a comprehensive view on competence areas and competences from economically advanced countries. It includes five competency areas: information and data literacy, Communication and collaboration, Digital content creation, safety and problem solving.

While DigComp 2.1 covers a wide range of competences, UNESCO's study found that it lacked two critical areas: (i) fundamentals of familiarity with hardware and software, which is often taken for granted in richer countries; This relates to basic operations of the digital devices, such as turning them on and off, understanding basic concepts of hardware and software, and operations on a graphical user interface and (ii) career-related competences, which would help make the generic competences more relevant to country contexts through practical examples of their use. These refer to competences in the use of digital technologies that are important productivity tools for particular business sectors. Examples include competences in using Learning Management Systems for teachers, computer-aided design (CAD) and computer aided manufacturing (CAM) applications for architects, engineers and construction workers, health information systems for medical practitioners, and social media for marketing professionals.

As a result, UNESCO developed a global digital literacy framework by reviewing more than 40 digital literacy frameworks used by countries across all regions and income levels as well as those at the regional and international level. These different frameworks were mapped against the European Commission's Digital Competence Framework for Citizens (DigComp 2.1)[15]. UNESCO also define digital literacy as follows:

> *Digital literacy is the ability to define, access, manage, integrate, communicate, evaluate and create information safely and appropriately through digital technologies and networked devices as well as attitude to use digital technologies for participation in economic and social life. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy, data literacy and media literacy.*

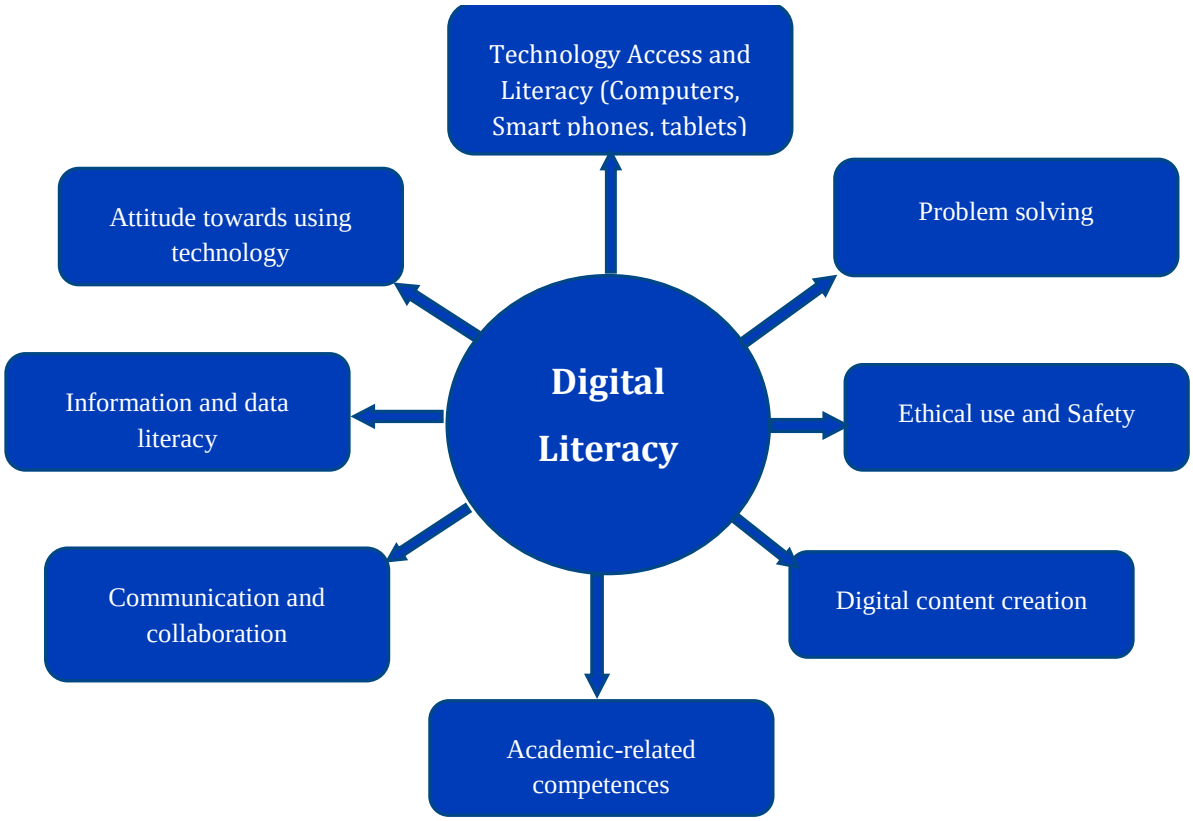
In this project, UNESCO's framework is adapted for the following reasons. First, it is a framework developed for developing countries. Second, the framework is a comprehensive framework that can be used to develop the digital literacy for students in the schools as well as employees in the workplace. Third, it is an international standard. Digital literacy assessment conducted based on this international standard can be used to evaluate Ethiopian's digital literacy status in

[15] *UNESCO, (2018). A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2.* http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf

comparison to other similar countries. Empirical data collected based on this international standard can reliably measure digital literacy. It is also safe to use this measurement results for policy input and training program development to improve the digital literacy level of the country.

The global framework proposed by UNESCO which covers a total of seven areas of competence is customized and used in this project by adding a new construct to measure attitude towards using technology. The following digital literacy maturity level assessment framework is proposed for use as shown **Error! Reference source not found.**.

Figure 1: Digital Literacy Assessment framework



Each of the components of the proposed framework are explained in Table 5.

Table 5: Components of the proposed framework

Digital Literacy Assessment Mapping		
Competency area	**Competences**	**Questions**
1. Technology Access and Literacy (Computers, smart phones, tablets),	1.1 Access to digital tools such as smart phones, computers 1.2 Access to the internet, email account/ social media use 1.3 Basic knowledge of hardware such as turning on/off, charging, locking devices, and basic troubleshooting etc. 1.4 Basic knowledge of software such as user account and password management, login, and how to do privacy settings, etc. 1.5 Basic knowledge of operating system such as handling files and printing	1.1 I have access to a computer/laptop/ at home/school 1.2 I have access to smart phone/tablet 1.3 I use internet (wireless and/or data) on a regular bases 1.4 I have an email account 1.5 I can access, create, delete, modify files (text/image/video) on windows/ android/ ios/ systems 1.6 I access social media apps from a smart phone/computer/tablet 1.7 I post information on social media (fb/twitter/telegram)/blogs ex. to submit assignments etc. 1.8 I can use the Internet to access different services such as browsing

Digital Literacy Assessment Mapping		
Competency area	**Competences**	**Questions**
		1.9 I can do basic hardware troubleshooting such as checking cables, connecting printer 1.10 I can do basic software troubleshooting such as installing drivers
2. Information and data literacy	2.1 Browsing, searching and filtering data, information and digital content 2.2 Evaluating data, information and digital content 2.3 Managing data, information and digital content	2.1. I use search engines to look for information I need on the internet 2.2. I can use advanced search strategies to find reliable information on the internet 2.3. I know that some online information may not be reliable. 2.4. I use some filters when searching to compare and assess the reliability of the information I find. 2.5. I can assess the validity and credibility of information using a range of criteria 2.6. I can save files or content and retrieve them when needed.
3. Communication and collaboration	3.1 Interacting through digital technologies 3.2 Sharing through digital technologies 3.3 Engaging in citizenship through digital technologies 3.4 Collaborating through digital technologies 3.5 Netiquette 3.6 Managing digital identity	3.1. I actively use a wide range of communication tools (e-mail, chat, SMS, instant messaging, blogs, micro-blogs, social networks, VoIP (viber, whatsup)) for online communication 3.2. I can share/exchange files and content using tools like Bluetooth 3.3. I can create and manage content with collaboration tools (e.g., project management systems, online spreadsheets) 3.4. I use features of online services (e.g., public services from MoE, e-banking, online shopping …etc.) 3.5. I pass on or share knowledge with others online (e.g., via social networking tools or in online communities)
4 Digital content creation	4.1 Developing digital content 4.2 Integrating and re-elaborating digital content 4.3 Copyright and licenses 4.4 Programming	4.1. I can produce simple digital content (e.g., text, tables, images, audio files) in at least one format using digital tools 4.2. I can produce simple digital content (e.g., text, tables, images, audio files) in at least one format using digital tools 4.3. I can make basic editing to content produced by others (e.g., adding and deleting) 4.4. I know how to reference and reuse content covered by copyright 4.5. I can modify simple functions of software and applications such as changing default settings

Digital Literacy Assessment Mapping		
Competency area	**Competences**	**Questions**
5 Ethical use and Safety	5.1 Protecting devices 5.2 Protecting personal data and privacy 5.3 Protecting health and well-being 5.4 Protecting the environment	5.1. I can take basic steps to protect my devices (e.g., using anti-viruses and passwords) 5.2. I have installed security programmes on the device(s) that I use to access the Internet (e.g., antivirus, firewall) 5.3. I frequently check the security configuration and systems of my devices and/or of the applications I use on a regular basis to access the Internet. 5.4. I am aware that my credentials (username/password) can be stolen. 5.5. I know I should not reveal private information online 5.6. I use different passwords to access equipment, devices and digital services and I modify them on a periodic basis 5.7. I understand the health risks associated with the use of digital technology (e.g., risk of addiction) 5.8. I can make use of ICT to take basic measures and action to avoid physical and psychological health problems 5.9. I can protect myself and others from possible dangers in digital environments (e.g., cyber bullying). 5.10. I understand the positive and negative impact of technology on the environment
6 Problem solving	6.1. Solving technical problems 6.2. Identifying needs and technological responses 6.3. Creatively using digital technologies 6.4. Identifying digital competence gaps 6.5. Computational thinking	6.1. I can find support when faced with a technical problem or when using a new program 6.2. I can solve many of the frequently problems that arise when using digital technologies 6.3. I know that digital tools can help me solve problems 6.4. I know how to use the right digital tools to solve (non-technical) problems 6.5. I can solve technological problems by exploring the settings and options of the program or tools 6.6. I am aware that I need to update my digital skills regularly 6.7. I regularly update my digital skills to fill my skill gaps and/or improve my digital knowledge.
7 Academic-related competences	7.1. Knowledge and skills required to operate hardware/software for education	7.5. I can identify and use specialized digital tools and technologies for my academic subjects

Digital Literacy Assessment Mapping		
Competency area	**Competences**	**Questions**
	7.2. Knowledge of how to use online tools for education 7.3. Understanding outputs from education software 7.4. Knowledge of how to use learning management systems to attend online or blended courses.	7.6. I can understand, analyze and evaluate information outputs from specialized digital tools and technologies 7.7. I can use specialized software tools to improve my academic performance 7.8. I can use specialized software tools to improve collaboration (ex. For group assignments) 7.9. I can use specialized software tools to generate incomes

Digital Literacy Assessment Mapping		
Competency area	**Behavior**	**Questions**
8 Attitude towards using technology	8.1. Belief in safety of using technology 8.2. Fear of using technology 8.3. Belief in security of using technology 8.4. Belief in benefits of technology	8.1. I believe digital technology helps me to organize my work 8.2. I believe using digital technology saves time and effort 8.3. I enjoy using digital technology 8.4. I believe digital technology makes me more productive 8.5. I am not scared of using digital technologies at all 8.6. I believe digital technologies are safe to use 8.7. I believe digital technologies are secure to use 8.8. I believe digital technology allows me to do interesting and imaginative work 8.9. Using digital technology never makes me feel uncomfortable 8.10. I believe it is important to keep up with the latest trends in digital technology 8.11. I believe that digital technology provides solutions to many of our problems 8.12. I feel that I get more accomplished because of digital technology 8.13. I believe that digital technology is not a waste of time 8.14. I believe digital technology makes life easier 8.15. I believe digital technology makes people more socialized rather than isolated 8.16. I believe digital technology gives me opportunities to learn many new things

9 DATA COLLECTION INSTRUMENT

There are numerous instruments that have been developed by national, regional, international and commercial agencies for assessing digital literacy. The digital literacy assessment instruments that exist have been developed to serve different purposes, from certification to evaluation of individuals or population groups, to research, etc. Carretero, et.al. (2016) [16] conducted a comprehensive review of 22 assessment instruments and categorized them into four major categories: performance assessment, knowledge-based assessment, self-assessment and secondary data-gathering and analysis. Performance assessment requires the individual to demonstrate how he/she performs certain tasks, while knowledge-based assessment requires the individual to explain how he/she would perform certain tasks. Self-assessments are subjective evaluations of one's own competence and may not really reflect a person's competence in real-life situations. Secondary data-gathering and analysis may provide some information about competence at the group or population level but not at the individual level. Performance assessment is the instrument of choice for certification or comparison of digital literacy achievements (such as in the International Computer and Information Literacy Study 2013 and 2018).

UNESCO recommends developing context-sensitive and fit-for-purpose digital literacy indicators and assessment instruments. For example, digital literacy assessment for farmers may not require assessing the farmer's skill to use desktop computer. However, farmer's digital literacy may be assessed considering their mobile use to retrieve and read SMS message about agriculture product prices. In addition, it is necessary to clarify for what purpose the digital literacy assessment is conducted. Is it conducted to assess skills for learning, for employment, productivity in the office or for entrepreneurship?

Therefore, the purpose of the assessment and the area must be clearly defined before the assessment instruments is developed. The instrument developed for this project is attached in Appendix 1.

[16] Carretero, Vuorikari and Punie (2016): The digital Competence Framework for Citizens. DigComp 2.1

10 PROJECT MANAGEMENT

10.1 ASSUMPTIONS/CONSTRAINTS

The following are the major assumption of the project

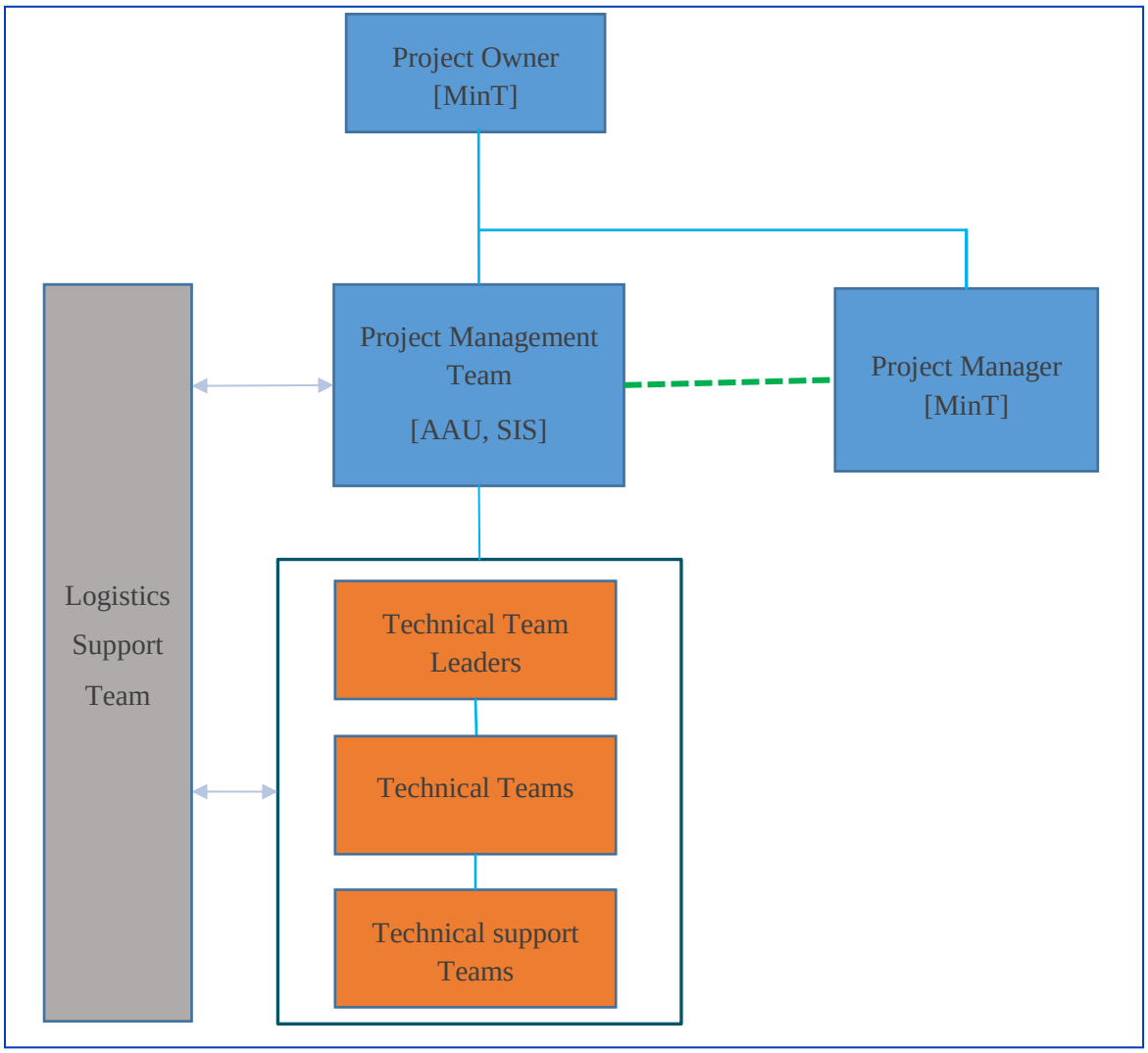
a) Technical and political environment is assumed to be convenient for data collection
b) Appropriate support will be provided by the client organization (MinT)
c) Timely response and communication (including Payment) is to be made from MinT

10.2 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITY ASSIGNMENT

10.2.1 Organizational Structure

In this project, we will use the project team structure presented below for the successful implementation of the project. The project structure is created to facilitate an environment that fosters interactions among the team members. It defines the relationship among members of the project management from MinT and AAU-SIS and the experts from the same institutions.

Figure 2: Project Organizational Structure



A. Project Owner

The project owner is the Ministry of Innovations and Technology (MinT) and is responsible to approve project deliverable and any major deviations in the project.

B. Project Manager (MinT)

The MINT project manager will be an appointed expert from the ministry who will be responsible to facilitate project working environment and expert engagement from MinT side. The project manager will be responsible to facilitate the communication between the owner and the consulting team.

C. Project Management Team (SIS)

The School has constituted a project management team composed of academic staff who do have project management experience. The team will be responsible to facilitate project execution and expert engagement from AAU side and will assign a project lead who will be responsible to serve

as a single point interface for project communication with MinT. The project leader will be responsible to mediate the communication between the various ad-hoc teams at AAU and MinT.

D. AAU Team

The AAU team is composed of two sub-teams – the technical team and the logistics support team. The technical team will have technical support staff under a team leader. The technical team will be responsible for undertaking all technical tasks as per the agreement with MinT. The tasks include, but not limited to, desk study, benchmarking, preparing instruments, piloting and conducting the survey, interviewing resource people, and report writing. Within the technical teams, there will be technical support teams who will be responsible for distributing and collecting questionnaires as well as data entry and analysis. The technical support teams will have members from both AAU and other collaborating local universities.

The Logistics support team will on the other hand provide administrative and logistics support including transportation management, liaising between different offices of the university and MinT etc. to the project management, and technical teams.

10.2.2 Responsibility Assignment Matrix

The responsibility matrix shown in Table 6 shows the responsibility of the team members shown in the organization chart above. The meanings of **R, A, C**, and **I** is given below,

Responsible: Those who do work to achieve the task. There can be multiple resources responsible.

Accountable: Those who sign off or approve when the task, objective or decision is complete.

Consulted: Those whose opinions are sought. Two-way communication.

Informed: Those who are kept up to date on progress. One-way communication.

Table 6: Project management responsibility matrix

Project Activity	PM Team	PM	MinT PM	Team Leader(s)	Technical Support Team	Logistics Support Team	Project Sponsor
Planning							
Clarify purpose and topics	A/R	A	C/I	I/C			I
Review other surveys for overlap	A/R	A	C	C	I		C
Identify target population	R	A	C	I	I	I	C
Draft survey instruments	A/R	A	C	C	I		C
Determine Sampling Frame and Sample	A/R	A	C	C	I		C

Project Activity	PM Team	PM	MinT PM	Team Leader(s)	Technical Support Team	Logistics Support Team	Project Sponsor
Prepare and submit inception report	A/R	A	I	A			I
Present Inception Report and Get Approval							
Present Inception Report	A/R	A	C	A			
Get approval of inception report	A	C	A	C			
Survey Preliminary Preparation							
Develop a respondent communication plan (invitation, reminders, etc)	A	A	C	R/A	R		I
Recruit survey personnel	A/R	A	I	A/R	C	R	I
First Draft of Survey	A/R	A	C	C	I		C
Internal review and revision of draft survey	A/R	A	I	I	I	I	I
Translate survey instruments	A/R	A	C	A/R	R	R	C
Pre-test survey instruments	A	A	C	A/R	R	R	C
Revise Survey based on pre-test	A/R	A	I	I	I	I	I
Prepare Final versions of instruments	A/R	A	I	I	I	I	I
Prepare survey manual	A/R	A/R	I	A/R	R	I	I
Pilot test	A	A	C	A/R	R	R	C
Analyse Pilot data and revise instruments	A	A	C	A/R	R	R	C
Survey Administration							
Constructing the survey protocol and get approval	A	A	C	A/R	R		C
Training data collectors	A	A	C	A/R	R		C
Field work (data gathering)	A	A	C	A/R	R	R	C
Data entry and cleaning	A	A	C	A/R	R	R	C
Data analysis	A	A	C	A/R	R	R	C
Consultation on findings	A/R	A/R	C/R	R	R	R	C/A
Report Writing & Presentation							
First Draft of Report	A/R	A	C	A/R	R	R	C
Review of Draft report	A/R	A/R	C/R	R	R	R	C/A
Final write-up	A/R	A	C	A/R	R	R	C
Presentation of the survey report	A/R	A/R	C/R	R	R	R	C/A
**** Multiple Roles - can be filled by one individual**							

10.3 PROJECT QUALITY PLAN

10.3.1 Project Quality Plan Purpose

The project quality management plan defines the project management processes that will be applied ensure that the survey is managed in accordance with relevant methodologies and standards so that the delivery of project outputs can be confirmed by MinT as 'fit for purpose'. The plan is to increases certainty and reduces the risk of failure attributable to inadequate project management processes.

The terms of reference (as amended) and the contractual agreement between MinT and AAU SIS will make up the needs and objectives to be met by the survey.

10.3.2 Methodologies and Standards

The following methodologies, processes, standards and guidelines are identified for use in the digital literacy maturity survey to ensure that the quality project management processes are being applied.

PROCESSES QUALITY PLAN

In this project we will deploy a widely used statistical business process which has nine phases, each having sub-processes. A summary of the processes with their respective quality dimensions and indicators is presented in the "Project Quality Assurance" Section of this document. A detailed process catalogue is maintained internally for daily quality assurance.

QUALITY STANDARDS

The Ethiopian Data Quality Assessment Framework (EDQAF) that provides for six process quality dimensions that reflect on methodology, standard operating procedures, data and metadata management, human resource management, quality assurance, and reporting burden is adopted. In general, the following survey quality standard frameworks and guidelines will be consulted.

i) Ethiopian Data Quality Assessment Framework (EDQAF), September 2011
ii) United Nations National Quality Assurance Frameworks Manual for Official Statistics: including recommendations, the framework and implementation guidance, 2019.
iii) African Charter on Statistics, 2009
iv) Statistics Canada Quality Guidelines, 6th Edition, 2019
v) Statistics Canada's Quality Assurance Framework, 3rd Edition, 2017
vi) National Statistics Code of Practice: Ensuring Official Statistics Serve the Public, 2nd Edition, 2018

QUALITY TOOLS

a) Contract Management: common project management processes, templates, and tools will be used for the effective management of the contract. The Lead project manager and the project management teams will be responsible for the implementation of the project as per the contractual agreement and observing sound project management principles.
b) MS Project will be used to develop the project schedule and resource utilization plan.
c) SPSS/Kobo Toolbox will be used to code and analyze the survey data.

QUALITY MANAGER'S RESPONSIBILITIES

While the project management team is jointly responsible to maintain high-quality standards, a quality manager is assigned for this project. The quality assurance manager shall ensure the observation of quality standards in survey design, implementation, analysis and reporting. The technical team leaders shall continuously interact with the quality manager to achieve the goals of the survey efficiently.

10.3.3 Project Quality Assurance

Quality assurance helps to establish if a deliverable is acceptable to MinT based on the processes used to create it. Following the EDQAF, the following points will be addressed as part of quality assurance process.

i) Methodological Soundness
    - Methodological soundness refers to the degree to which statistical outputs are produced by application of international and/or peer-agreed standards, guidelines, and best practices.
ii) Human Resource Management
    - Human resource management refers to extent to which responsibilities for the statistical process are well defined and are assigned to well trained and dedicated staff.
iii) Standard Operating Procedures
    - Standard operations refer to the extent that operational procedures are defined, standardized, documented, used, and give a clear indication of the data to be collected, the collection and processing activities to be undertaken, and the outputs to be produced.
    - It includes ensuring data collection tools (questionnaires and checklists) exist and are uniformly standardized across all organizational levels through which the data pass
iv) Data Management and Security

- Data management refers to the extent to which data are managed from initial collection, through data entry, processing, aggregation, transmission to higher levels within the organization, and dissemination.
- It includes ensuring source documents are retained and available for subsequent checking or audit. It also includes the degree of computerization.
- Security refers to the provisions for security of transmission and storage, including encryption, back-up and disaster recovery.

v) Quality Assurance/Control

- Quality assurance/control refers to the extent to which quality is assured either by procedures embedded in the statistical processes or through quality gates at key points in these processes.
- It includes verification of input data, quality control of data entry procedures, identification and correction of errors and discrepancies, and feedback of identified quality problems to their source.

vi) Reporting Burden

- Reporting burden refers to the extent to which the reporting burden on the individuals and businesses and institutions that provide the raw input data is minimized and seen to be minimized.

QUALITY ASSURANCE PROCEDURES

Following the international standards of quality assurance, we will undertake the following activities. While a detailed list of activities is maintained in the hands of the project manager and the quality manager, here we present a summary description of the activities for the benefit of the reader.

1. Specify Needs

In this process, we identify and state objectives of the survey, include specific requirements for the data and their uses, key quality expectations, issues related to the protection of privacy, budget constraints, business cases and expected delivery dates. Further, relevant concepts, the unit of analysis and the target population are defined during this phase to allow the intended users and potential users to determine if, and to what extent, the expected project results meet their expressed needs.

The quality dimensions and indicators at this phase are:

a) A description of MinT's needs of the data and of its intended use
b) Analysis plans that include a description of tables to be released

2. Design

The design phase of the statistical business process involves describing the design, creation, development and research activities needed to create statistical outputs, concepts, variables, methodologies, data acquisition methods and operational processes. In this phase, the dimensions/variables are defined.

We will adapt and reuse design elements from previous surveys at national, regional, and international levels so that we can reduce the length and cost of the design process.

The quality dimensions and indicators at this phase are:

a) Quality dimensions: Relevance, accuracy, coherence and interpretability
b) Indicators of quality:
    - Detailed description of the main statistical concepts, including statistical measures, population, variables, units, domains and reference period
    - Accurate references for the concepts, variables and standard classifications used
    - Report to check adequate coverage of the target population
    - Detailed description of the instruments and methods for data collection, preparation and analysis. A detailed description of the methodology used will also be available for surveys or data integration.

3. Build

In this phase we will build and test the complete survey model to the point where it is ready for use. For statistical outputs produced on a regular basis, this phase only takes place the first time or following a change in the methodology or technology used.

The quality dimensions and indicators at this phase are:

a) Target population is identified
b) Sampling design is completed
c) Data collection instrument is pilot tested
d) Data acquisition mechanisms, tools and the components of the model and dissemination process are functional and ready to be used as intended.
e) A ledger is used to record operations, systems and transformations used in the statistical business processes, from data collection to dissemination.

4. Data Acquisition

The Acquisition phase involves acquiring or facilitating the acquisition of all necessary information (data) through different channels. Once acquired, the information is loaded into an

appropriate environment to prepare it for use and analysis. Data acquisition could serve as the main link between the data collector and the public from whom data is collected. It also allows to establish a link with the Ethiopian Central Statistics Authority (CSA) which could avail statistical or administrative databases, GIS maps, registers or other non-statistical databases etc.

The quality dimensions and indicators at this phase are:

a) Quality dimension: Accuracy
b) Indicators of quality:
    - Coverage rate of the databases used
    - Rate of proxy reporting
    - Total and partial response rate
    - Refusal rate
    - Impact of follow-up strategies
    - Errors attributable to survey eligibility or ineligibility
    - Distribution of interviews according to average duration
    - Impact of the collection mode (suggestion: mode effect)
    - Edit failure rate
    - Capture or coding error rate.

5. Profile and Prepare Data

Data profiling and preparation involves using profiling to identify incomplete, incorrect, inaccurate or irrelevant data in the original source and then modify, correct or suppress it when needed. This phase can also involve suppressing typographical errors and correcting values in relation to a list of known entities. Another common practice of data preparation is improving the data by adding related or complementary information. The goal of this phase is to ensure that the acquired source information is consistent and ready for the next phases.

The quality dimensions and indicators at this phase are:

a) Quality dimensions: Accuracy, interpretability, coherence
b) Indicators of quality:
    - A description and justification of the methodology used for each phase of data profiling and preparation is available, with supporting results
    - Quality indicators, accuracy measures and/or quality assurance measures are available for the various phases
    - Where models have been used, a description of the models' assumptions and an assessment of their likely effects on data quality is available

- The generalized systems and the parameters used have been tested, modified as necessary, and validated
- A data dictionary and a user guide are available, as needed.

6. Estimate and Compile

Data compilation involves creating aggregate data and population counts from microdata or lower-level aggregates. As part of statistical business processes involving multiple input data sources, data compilation involves mapping multiple types of statistics, concepts, classifications, and conventions through an iterative process leading to aggregate data. In this case, integration and compilation are performed simultaneously.

The quality dimensions and indicators at this phase are:

a) Quality dimensions: Relevance, accuracy, interpretability, coherence, accessibility.
b) Indicators of quality:
   - A data validation report
   - A data dictionary

7. Analysis

The analysis phase involves examining, interpreting, and preparing the data for release, as well as developing answers to specific questions. The activities in the Analysis sub-processes also help statistical analysts understand the data. These activities include identifying the topics of analysis, determining the availability of appropriate data, selecting, and applying the methods to use to answer questions of interest, and evaluating, summarizing and conveying the results.

The quality dimensions and indicators at this phase are:

a) Quality dimensions: Relevance, accuracy, accessibility, interpretability, coherence.
b) Indicators of quality:
   - Availability of a data validation report
   - Availability of an analysis report
   - Availability of a data dictionary
   - Availability of quality indicators
   - Availability of information on the methods used
   - Measures in place for disclosure control
   - Revision of the text and data to be disseminated.

8. Disseminate

The disseminate phase involves making the collected and processed data available to MinT by various means. In this project, the findings of the survey will be communicated to MinT and other stakeholders through a workshop and written report in soft and hard copy formats. In addition, the raw statistical data will be delivered to MinT for possible future use. A copy of the statistical data shall also be maintained in the University for Future Research Purposes. All future users will be required to acknowledge the ministry wherever the use the data.

Quality dimensions and indicators at this phase are:

a) Quality dimensions at this phase: Relevance, accessibility, timeliness, accuracy, coherence, interpretability (all six dimensions of the survey production process).
b) Indicators of quality at this phase:
    - Availability of a dissemination schedule and a follow-up strategy
    - Documented communication strategy in place
    - Reasonable amount of time between the reference period or date, and the product dissemination date
    - Reasonable amount of time between the planned and actual dissemination dates
    - Availability of documentation of errors detected before and after dissemination, and evaluation of repercussions
    - Availability of the frequency at which users access the information product over time, and assessment of the product's utility.

9. Evaluate

The study team will evaluate the survey process at the end of the project and a formal project report will be written identifying the lessons learned during the study.

Quality dimensions and indicators at this phase are:

a) Quality dimensions: Interpretability, relevance.
b) Indicators of quality:
    - Evaluation report for the statistical business process.
    - Lessons learned will be included in the project closing report

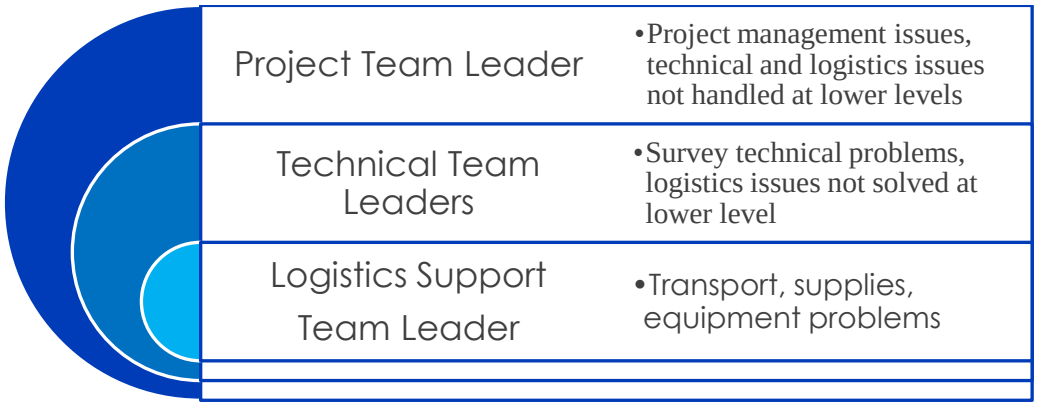
10.3.4 Change Control and Escalation Plan

CHANGE CONTROL

Changes in project planning may happen in the course of the project life cycle. However, such changes should be managed properly as they could impact the time, cost, and quality of the process and the product.

In this project, all change requests that come from any of the parties should be presented in writing. The project teams of the two parties should jointly assess the impacts of the change and decide whether to allow without the need for additional cost or time changes. If the impact on cost and time is assessed to be significant, then the matter should be presented to relevant officials and a contract extension or an addendum should be signed reflecting the changes. The escalation plan is presented in **Error! Reference source not found.**.

Figure 3: Escalation Plan



10.4 COMMUNICATION PLAN

The project team will work closely with the MinT staff assigned for the project and report to the project owner as provided in Table 7.

Table 7: Project communication plan

Stakeholder	Information	Communication Method	Frequency	Due	Sender
MinT Project Team	Kick-off meeting Meeting	Meeting, Minutes	1	In one week from signing of contract	AAU SIS/MinT
MinT	Inception Report	Written Report	1	In 20 working days from kick-off meeting	AAU SIS

Stakeholder	Information	Communication Method	Frequency	Due	Sender
MinT	Inception report meeting	Meeting	1	Within one week from the submission of the inception report	AAU SIS
MinT	Monthly Status Report	Written Report	3	At the end of every two months except the first and last month	AAU SIS
MinT	Draft Final Report	Written Report	1	After completion of the draft report	AAU SIS
MinT, MoSHE, MoE, other stakeholders	Draft Final Report Presentation	Workshop	1	After completion of the draft report	AAU SIS
MinT	Final Report (assessment, and intervention strategies)	Written Report	1	After completion of the final report	AAU SIS
MinT, MoSHE, MoE, other stakeholders	Final report presentation	Workshop/conference	1	Within one week from the submission of the final report	AAU SIS
MinT/AAU SIS	Project Issues and change requests communication	Email, Formal Letter, telephone	As required	As required	AAU SIS/MinT

10.5 LOGISTICS & SUPPORT

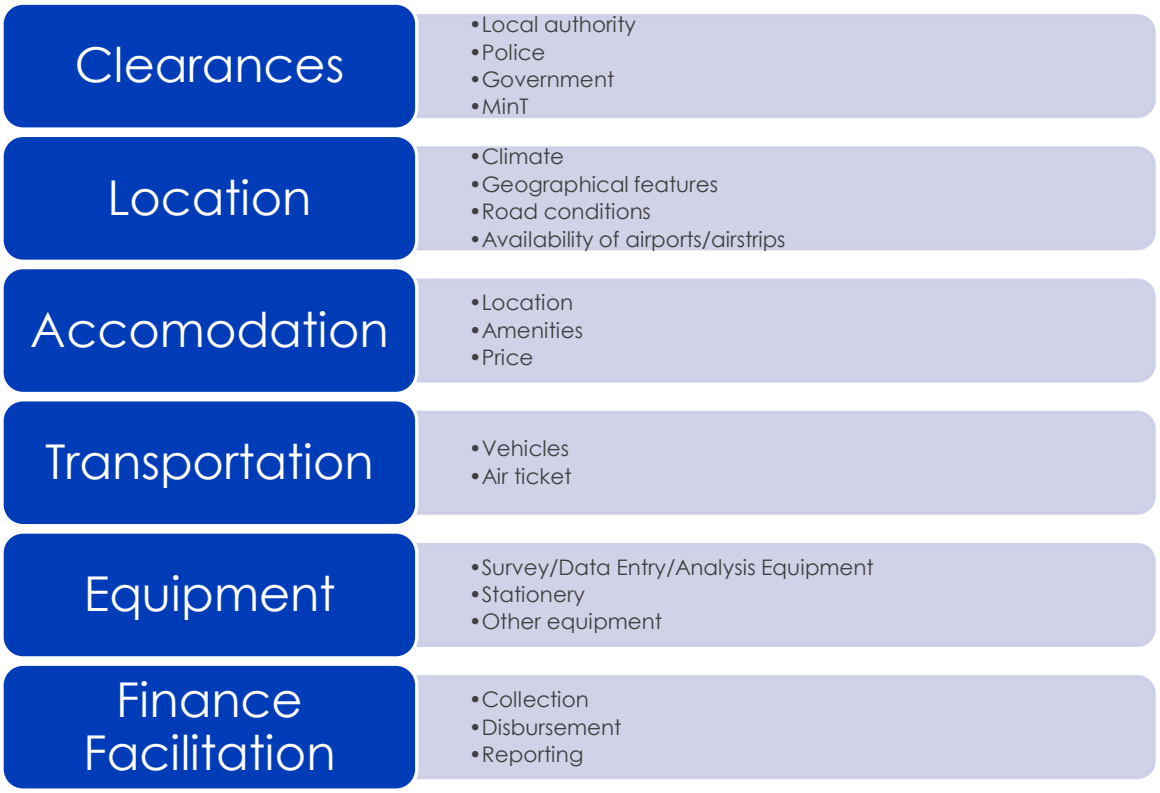
Office space, printing and internet facilities for the duration of the project will be provided by the School of Information Science. The Ministry shall provide resource people when required by the consulting team. The Ministry shall also facilitate communication with governmental and non-governmental entities upon the request of the consulting team.

Transport is essential in most cases to collect survey data. Transportation of experts for data collection shall be handled by the School of Information Science

Good **financial management** is essential for staff morale. Wages including allowances need to be paid on time, and petty cash should be available for emergencies. A detailed record of expenditure is necessary, together with receipts, as the most senior staff member will have to account for all funds issued and spent. MinT is expected to pay on-time as per the contract for smooth operation of the data collection and analysis.

Some of the major logistic related responsibilities are listed in **Error! Reference source not found.**.

Figure 4: Logistics support team responsibilities (not exhaustive)



10.6 RISK AND MITIGATION STRATEGY

Risk management includes identifying, analyzing and responding to project risks when initiating a project. During project execution, monitoring and controlling risk factors are ongoing activities to manage the uncertainty of risks. Planning for risks reduces costs, secures the project success and provides the customer with confidence to reach the defined project goals. Risks are best managed if they are identified well before they occur. Without knowing and being aware about the risks, it is impossible to avoid or mitigate the risks or to plan appropriate contingency to lower the impact of the occurring risk.

The anticipated risk factors and associated mitigation strategy is presented here in Table 8.

Table 8: Risk and mitigation strategy

Risk Factor	Risk Mitigation
Schedule Though a project schedule that covers the anticipated span of the project and agreement has been made, as the project	• Workshops, retreats and other similar methods that will allow more work to get done in a short period of time will be employed.

Risk Factor	Risk Mitigation
being in the early stages, it is possible that management, communication, and environmental issues surface which may result in additional effort required and changes to the current project schedule.	• The consultant will provide sufficient staff to get the job done within schedule • Through effective communication based on continuous status communication and stage progress review, the project team will try to check time and cost overruns. • If additional requirements are identified and deemed necessary, the project managers will prepare an impact assessment and all approvers will have to sign off on the impact to schedule and budget before they will be implemented.
Restrictions due to COVID-19 Difficulty conducting face-to-face meetings and workshops due to COVID-19	• Alternative online communication means such as Zoom and Google Meet will be used.
Communication Flawless communication is a prerequisite for the successful implementation of projects. This is especially true for projects with strict time requirements like this project. However due to factors related to workload in both sides of the project (the client and project team) there might be gap in communication	▪ The communications management plan will be implemented for better risk management. ▪ The MInT project manager will ensure that all feedback will be communicated within the shortest possible time. ▪ The project management teams will put in place an issues escalation mechanism (to be part of the inception report) that will expedite project decision making at all levels.
Clarity on Scope Lack of clarity on some aspects of the scope of the work.	▪ An understanding of the work by the consultant will be clearly presented to the client as done in this very document. ▪ The regular communications that will be established with the client will be used to avoid potential rooms for misunderstanding.
Security The security situation in some parts of the country could limit the movement of people. It may be very hard to find people willing to deploy to the regions.	▪ The project team will recruit staff of universities and other governmental organizations with local knowledge who reside nearby for data collection.

10.7 PROJECT PLAN

The total duration of the project as provided in the contract is 9 months. The work schedule is presented as a Gantt chart in Appendix 6.

11 APPENDICES

APPENDIX 1: SURVEY QUESTIONNAIRE

I. Socio-demographic characteristics

1. Gender

   ☐ Male ☐ Female

2. Age in years _____

3. Educational level

   ☐ Grade 9 ☐ Grade 10 ☐ Grade 11 ☐ Grade 12

4. Residence

   ☐ Urban ☐ Semi-Urban ☐ Rural

5. What is your family's income level?

   ☐ High ()

   ☐ Medium ()

   ☐ Low ()

II: Digital literacy measure

Instructions: Instruction: For the statements listed below indicate your level of agreement or disagreement by putting a "√" mark one of the options.

Technology Access

1. I have access to a computer/laptop/ at home/school ☐ Yes ☐ No
2. I have access to smart phone/tablet ☐ Yes ☐ No
3. I use internet (wireless and/or data) on a regular bases ☐ Yes ☐ No
4. I have an email account ☐ Yes ☐ No

	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	Technology Literacy					
Technology Literacy	1. I can access, create, delete, modify files (text/image/video) on windows/android/ios/ systems					
	2. I access social media apps from a smart phone/computer/tablet					
	3. I post information on social media(fb/twitter/telegram)/blogs ex. to submit assignments etc.					
	4. I can use application software such as word processor/ spreadsheet /presentation					
	5. I can use the Internet to access different services such as browsing					
	6. I can do basic hardware troubleshooting such as checking cables, connecting printer					
	7. I can do basic software troubleshooting such as installing drivers					

	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	Information and Data Literacy					
Information and Data Literacy	1. I use search engines to look for information I need on the internet					
	2. I can use advanced search strategies to find reliable information on the internet					
	3. I know that some online information may not be reliable.					
	4. I use some filters when searching to compare and assess the reliability of the information I find.					
	5. I can assess the validity and credibility of information using a range of criteria					
	6. I can save files or content and retrieve them when needed.					
	Communication and Collaboration					
Communication and Collaboration	1. I actively use a wide range of communication tools (e-mail, chat, SMS, instant messaging, blogs, micro-blogs, social networks, VoIP (viber, whatsup)) for online communication					
	2. I can share/exchange files and content using tools like Bluetooth					
	3. I can create and manage content with collaboration tools (e.g., project management systems, online spreadsheets)					
	4. I use features of online services (e.g., public services from MoE, e-banking, online shopping …etc.)					

	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	5. I pass on or share knowledge with others online (e.g., via social networking tools or in online communities)					
	Digital Content Creation					
Digital Content Creation	1. I can produce simple digital content (e.g., text, tables, images, audio files) in at least one format using digital tools					
	2. I can make basic editing to content produced by others (e.g., adding and deleting)					
	3. I know how to reference and reuse content covered by copyright					
	4. I can modify simple functions of software and applications such as changing default settings					
	Ethical Use and Safety					
Ethical Use and Safety	1. I can take basic steps to protect my devices (e.g., using anti-viruses and passwords)					
	2. I have installed security programmes on the device(s) that I use to access the Internet (e.g., antivirus, firewall)					
	3. I frequently check the security configuration and systems of my devices and/or of the applications I use on a regular basis to access the Internet.					
	4. I am aware that my credentials (username/password) can be stolen.					
	5. I know I should not reveal private information online					
	6. I use different passwords to access equipment, devices and					

	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	digital services and I modify them on a periodic basis					
	7. I understand the health risks associated with the use of digital technology (e.g., risk of addiction)					
	8. I can make use of ICT to take basic measures and action to avoid physical and psychological health problems					
	9. I can protect myself and others from possible dangers in digital environments (e.g., cyber bullying).					
	10. I understand the positive and negative impact of technology on the environment					
	Problem Solving					
Problem Solving	1. I can find support when faced with a technical problem or when using a new program					
	2. I can solve many of the frequently problems that arise when using digital technologies					
	3. I know that digital tools can help me solve problems					
	4. I know how to use the right digital tools to solve (non-technical) problems					
	5. I can solve technological problems by exploring the settings and options of the program or tools					
	6. I am aware that I need to update my digital skills regularly					
	7. I regularly update my digital skills to fill my skill gaps and/or improve my digital knowledge.					

	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	Academic Related Skills					
Academic Related Skills	1. I can identify and use specialized digital tools and technologies for my academic subjects					
	2. I can understand, analyze and evaluate information outputs from specialized digital tools and technologies					
	3. I can use specialized software tools to improve my academic performance					
	4. I can use specialized software tools to improve collaboration (ex. For group assignments)					
	5. I can use specialized software tools to generate incomes					

III: Attitude towards use of digital technology

SN	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Attitude Towards Technology						
Attitude Towards Technology	**1. I believe digital technology helps me to organize my work**					
	2. I believe using digital technology saves time and effort					
	3. I enjoy using digital technology					
	4. I believe digital technology makes me more productive					
	5. I am not scared of using digital technologies at all					
	6. I believe digital technologies are safe to use					
	7. I believe digital technologies are secure to use					
	8. I believe digital technology allows me to do interesting and imaginative work					

SN	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	9. Using digital technology never makes me feel uncomfortable					
	10. I believe it is important to keep up with the latest trends in digital technology					
	11. I believe that digital technology provides solutions to many of our problems					
	12. I feel that I get more accomplished because of digital technology					
	13. I believe that digital technology is not a waste of time					
	14. I believe digital technology makes life easier					
	15. I believe digital technology makes people more socialized rather than isolated					
	16. I believe digital technology gives me opportunities to learn many new things					

11.1 APPENDIX 2: PROJECT CHANGE CONTROL FORM

Project Name:		
Project Manager:		
Change Request:		
Description (background):		
Impact Assessment		
Impact on Service/Quality		
Impact on Schedule:		
Impact on Cost:		
Immediate Action Required? (Include communication/ notification of change requirements):		
Authorization		
Requested by:	***Name:*** ***Signature:***	***Date Requested:***
Approved by:	***Name:*** ***Signature:***	***Date Approved:***
Authorized by:	***Name:*** ***Signature:***	***Date Authorized:***

11.2 APPENDIX 3: MINUTES OF MEETINGS FORM

Minute No:
Date:
Time: **to**

Meeting called by:

Attendees:

----- Agenda Topics -----

Item 1:

Discussion:

Conclusions:

Action items:

Other information

Special notes:

11.3 APPENDIX 4: STATUS REPORT FORM

STATUS REPORT

Date:

Status as of:

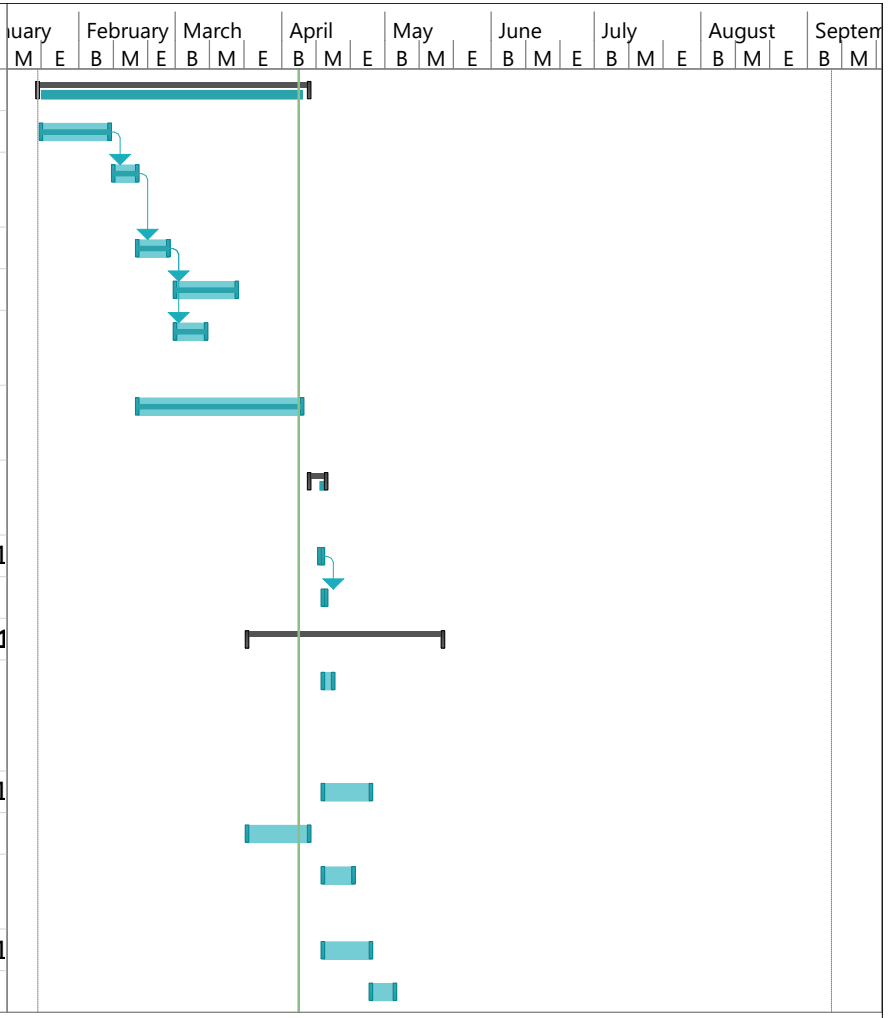
Name of Task	Owner	Origination Date	Current Due Date	Status

11.4 APPENDIX 5: ISSUE MANAGEMENT LOG

Prepared by:

Issue No	*Issue Description*	*Date Identified*	*Assigned To*	*Date Resolution Required*	*Resolution*	*Date Resolved*

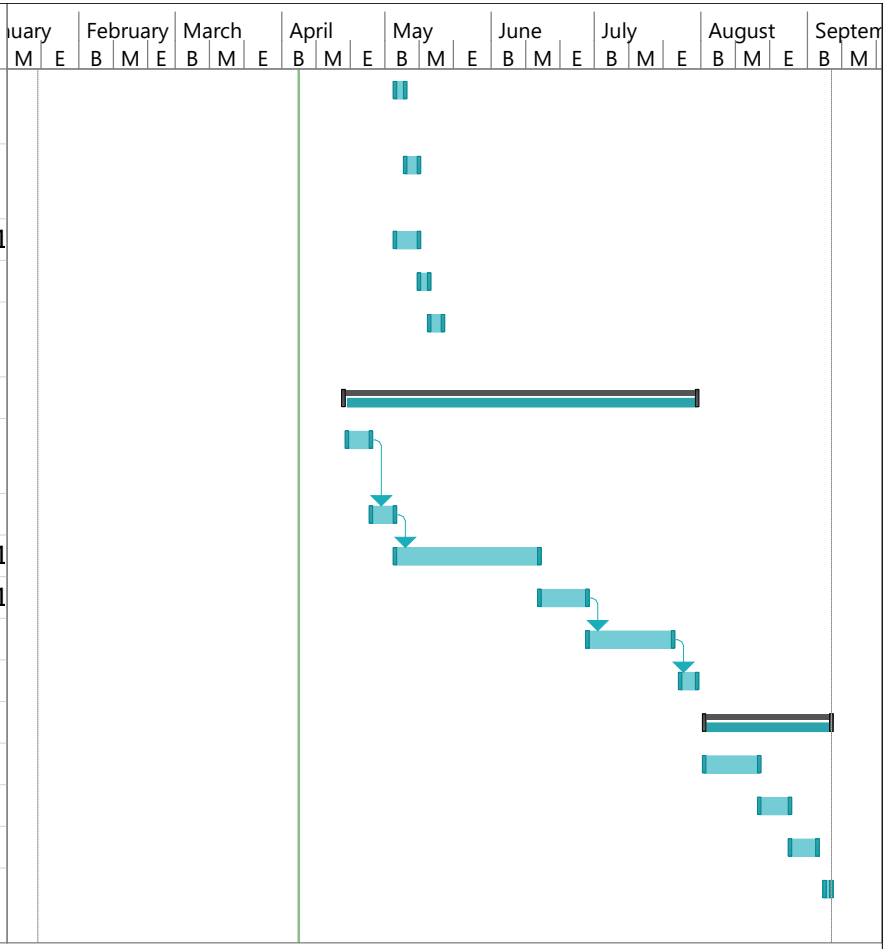
ID	Task Mode	Task Name	Duration	Start	Finish
1		**Planning**	**57 days**	**Wed 1/20/21**	**Thu 4/8/21**
2		Clarify purpose and topics	14 days	Thu 1/21/21	Tue 2/9/21
3		Review other surveys for overlap	5 days	Thu 2/11/21	Wed 2/17/21
4		Identify target population	7 days	Thu 2/18/21	Fri 2/26/21
5		Draft survey instruments	14 days	Mon 3/1/21	Thu 3/18/21
6		Determine Sampling Frame and Sample	7 days	Mon 3/1/21	Tue 3/9/21
7		Prepare and Submit Inception Report	34 days	Thu 2/18/21	Tue 4/6/21
8		**Present Inception Report and get approval**	**3 days**	**Fri 4/9/21**	**Tue 4/13/21**
9		Present Inception Report	1 day	Mon 4/12/21	Mon 4/12/21
10		Get approval	1 day	Tue 4/13/21	Tue 4/13/21
11		**Survey Priliminary Preparation**	**41 days**	**Mon 3/22/21**	**Mon 5/17/21**
12		Develop a respondent communication plan (invitation, reminders, etc)	3 days	Tue 4/13/21	Thu 4/15/21
13		Recruit survey personnel	10 days	Tue 4/13/21	Mon 4/26/21
14		First Draft of Survey	14 days	Mon 3/22/21	Thu 4/8/21
15		Internal review and revision of draft survey	7 days	Tue 4/13/21	Wed 4/21/21
16		Translate survey instruments	10 days	Tue 4/13/21	Mon 4/26/21
17		Pretest survey instruments	5 days	Tue 4/27/21	Mon 5/3/21



Project: MinT Digital Literacy As
Date: Tue 4/6/21

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

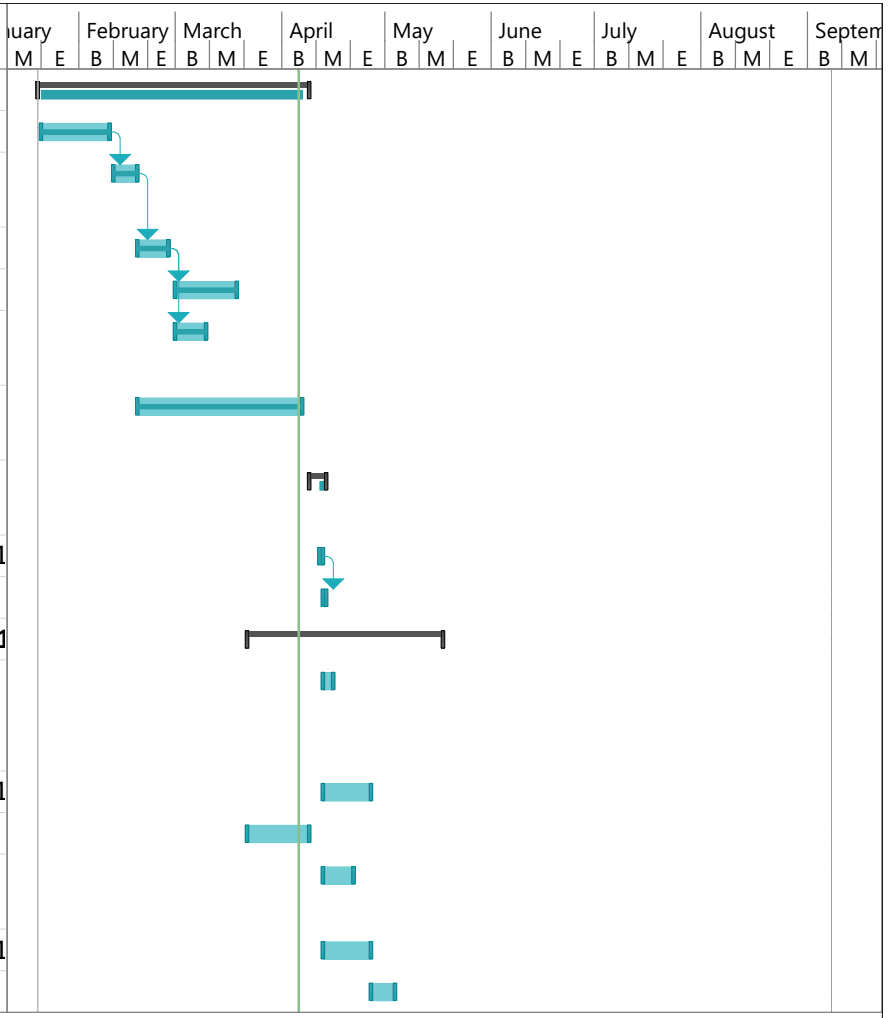
ID	Task Mode	Task Name	Duration	Start	Finish
18		Revise Survey based on pretest	3 days	Tue 5/4/21	Thu 5/6/21
19		Prepare Final versions of instruments	2 days	Fri 5/7/21	Mon 5/10/21
20		Prepare survey manual	5 days	Tue 5/4/21	Mon 5/10/21
21		Pilot test	3 days	Tue 5/11/21	Thu 5/13/21
22		Analyze Pilot data and revise instruments	2 days	Fri 5/14/21	Mon 5/17/21
23		**Survey Administration**	**75 days**	**Mon 4/19/21**	**Fri 7/30/21**
24		Constructing the survey protocol and get approval	5 days	Tue 4/20/21	Mon 4/26/21
25		Training data collectors	5 days	Tue 4/27/21	Mon 5/3/21
26		Field work (data gathering)	30 days	Tue 5/4/21	Mon 6/14/21
27		Data entry and cleaning	10 days	Tue 6/15/21	Mon 6/28/21
28		Data analysis	19 days	Tue 6/29/21	Fri 7/23/21
29		Consultation on findings	5 days	Mon 7/26/21	Fri 7/30/21
30		**Report Writing & Presentation**	**27 days**	**Mon 8/2/21**	**Tue 9/7/21**
31		First Draft of Report	12 days	Mon 8/2/21	Tue 8/17/21
32		Review of Draft report	7 days	Wed 8/18/21	Thu 8/26/21
33		Final writeup	6 days	Fri 8/27/21	Fri 9/3/21
34		Presentation of the survey report	2 days	Mon 9/6/21	Tue 9/7/21



Project: MinT Digital Literacy As
Date: Tue 4/6/21

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

ID	Task Mode	Task Name	Duration	Start	Finish
1		**Planning**	**57 days**	**Wed 1/20/21**	**Thu 4/8/21**
2		Clarify purpose and topics	14 days	Thu 1/21/21	Tue 2/9/21
3		Review other surveys for overlap	5 days	Thu 2/11/21	Wed 2/17/21
4		Identify target population	7 days	Thu 2/18/21	Fri 2/26/21
5		Draft survey instruments	14 days	Mon 3/1/21	Thu 3/18/21
6		Determine Sampling Frame and Sample	7 days	Mon 3/1/21	Tue 3/9/21
7		Prepare and Submit Inception Report	34 days	Thu 2/18/21	Tue 4/6/21
8		**Present Inception Report and get approval**	**3 days**	**Fri 4/9/21**	**Tue 4/13/21**
9		Present Inception Report	1 day	Mon 4/12/21	Mon 4/12/21
10		Get approval	1 day	Tue 4/13/21	Tue 4/13/21
11		**Survey Priliminary Preparation**	**41 days**	**Mon 3/22/21**	**Mon 5/17/21**
12		Develop a respondent communication plan (invitation, reminders, etc)	3 days	Tue 4/13/21	Thu 4/15/21
13		Recruit survey personnel	10 days	Tue 4/13/21	Mon 4/26/21
14		First Draft of Survey	14 days	Mon 3/22/21	Thu 4/8/21
15		Internal review and revision of draft survey	7 days	Tue 4/13/21	Wed 4/21/21
16		Translate survey instruments	10 days	Tue 4/13/21	Mon 4/26/21
17		Pretest survey instruments	5 days	Tue 4/27/21	Mon 5/3/21



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Task
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Manual Summary
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Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

ID	Task Mode	Task Name	Duration	Start	Finish
18		Revise Survey based on pretest	3 days	Tue 5/4/21	Thu 5/6/21
19		Prepare Final versions of instruments	2 days	Fri 5/7/21	Mon 5/10/21
20		Prepare survey manual	5 days	Tue 5/4/21	Mon 5/10/21
21		Pilot test	3 days	Tue 5/11/21	Thu 5/13/21
22		Analyze Pilot data and revise instruments	2 days	Fri 5/14/21	Mon 5/17/21
23		**Survey Administration**	**75 days**	**Mon 4/19/21**	**Fri 7/30/21**
24		Constructing the survey protocol and get approval	5 days	Tue 4/20/21	Mon 4/26/21
25		Training data collectors	5 days	Tue 4/27/21	Mon 5/3/21
26		Field work (data gathering)	30 days	Tue 5/4/21	Mon 6/14/21
27		Data entry and cleaning	10 days	Tue 6/15/21	Mon 6/28/21
28		Data analysis	19 days	Tue 6/29/21	Fri 7/23/21
29		Consultation on findings	5 days	Mon 7/26/21	Fri 7/30/21
30		**Report Writing & Presentation**	**27 days**	**Mon 8/2/21**	**Tue 9/7/21**
31		First Draft of Report	12 days	Mon 8/2/21	Tue 8/17/21
32		Review of Draft report	7 days	Wed 8/18/21	Thu 8/26/21
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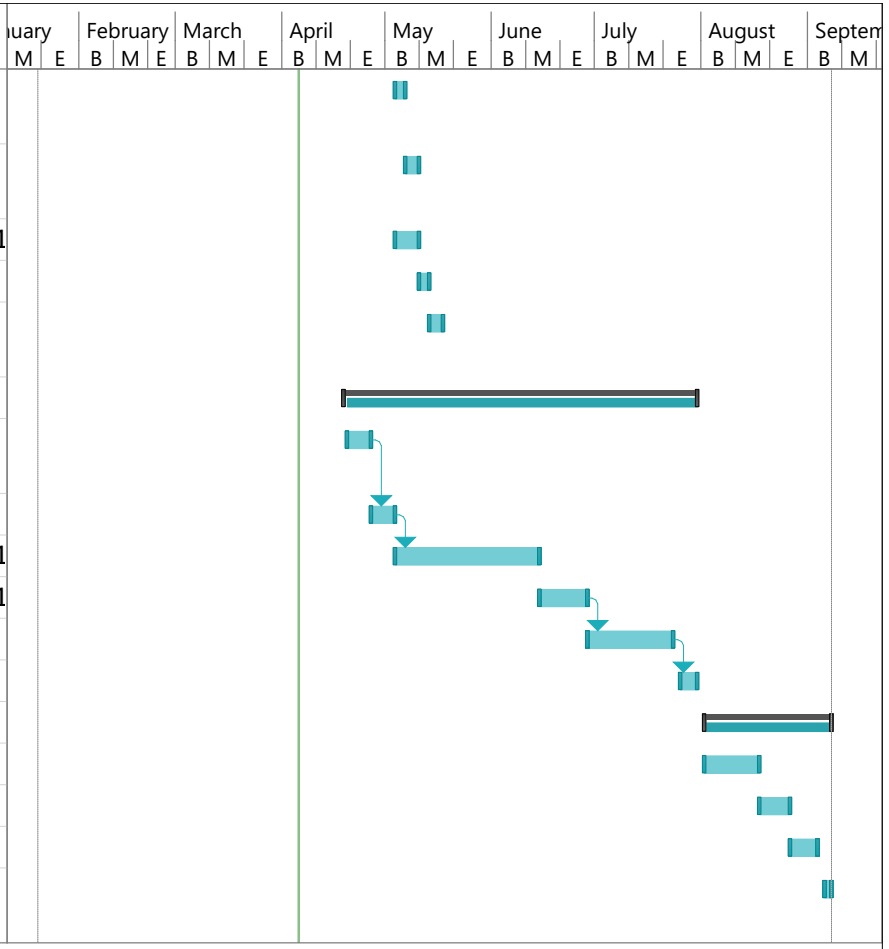

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