Bridging Educational Gaps:

Enhancing 21st-Century Skills in Ayta Mag-Indi Intermediate Learners through a Contextualized Intervention

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Research Report Developed by the **St. Paul University Quezon City** under the **SEAMEO INNOTECH Research Partnership Grant**

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Acronyms and Abbreviations

BEDP	Basic Education Development Plan 2030
CSIR	Center for Social Innovation and Research
DepEd	Department of Education
FAADI	Floridablanca Ayta Ancestral Domain, Inc.
ICT	Information and Communication Technology
IKSP	Indigenous Knowledge Systems and Practices
NCIP 3	National Commission on Indigenous Peoples Region 3
P21	Partnership for 21st Century Learning
SEAMEO	Southeast Asian Ministers of Education Organization
SEAMEO INNOTECH	Southeast Asian Ministers of Education Organization – Regional Center for Educational Innovation and Technology
SPUQC	St. Paul University Quezon City
UNSDG	United Nations Sustainable Development Goals

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Caritas Christi urget nos!

Foreword

INNOTECH, a leading force in transforming education in Southeast Asia, implements the SEAMEO INNOTECH Research Partnership Grant (SI RPG) to support collaborative and innovative research projects that address pressing educational challenges. Recognizing that education stands as a powerful catalyst for inclusive development, INNOTECH strengthens its role as a catalyst of innovation and technology through the SI RPG Batch 2 which specifically focuses on supporting research projects addressing marginalization in education.

This study conducted by St. Paul University Quezon City (SPUQC), "Bridging Educational Gaps: Enhancing 21st-Century Skills in Ayta Mag-Indi Intermediate Learners through a Contextualized Intervention", reflects a strong commitment to empowering indigenous learners to navigate the demands of the 21st century. Guided by the sub-theme of marginalization in education, this research examined the levels of knowledge and practice of critical 21st-century skills—including life and career skills, learning and innovation, and digital literacy—among Ayta Mag-indi intermediate learners. Grounded in the importance of cultural identity of Ayta Mag-indi, a contextualized intervention was designed and implemented not only to enhance the level of 21st-century skills of learners but to harness their cultural identity.

The study revealed encouraging improvements from the intervention, exhibiting the importance of inclusive and culturally responsive education. However, persistent challenges remain such as limited access to technology and digital literacy programs, low levels of reading comprehension, economic difficulties, and experiences of discrimination. This underscores the urgent need to provide a supportive learning environment to foster both 21st-century skills and integration of cultural identity.

INNOTECH extends its heartfelt appreciation to SPUQC for its commitment and meaningful engagement with the Ayta Mag-Indi community. We also recognize the invaluable contributions of teachers and learners whose participation made this study possible. This research highlights the importance of collaboration in educational research, demonstrating how we can create together inclusive learning pathways that respect diversity, promote equity, and prepare learners as changemakers of tomorrow.

Majah-Leah V. Ravago, PhD
Centre Director
SEAMEO INNOTECH

Preface

Pursuing quality education for all is a fundamental commitment to recognizing the importance of inclusivity, cultural sensitivity, and empowerment through learning. This report, titled Bridging Educational Gaps: Enhancing 21st-Century Skills in Ayta Mag-Indi Intermediate Learners through a Contextualized Intervention, is a testament to the collaborative efforts of SEAMEO INNOTECH, intermediate-level teachers at Camachile Elementary School, researchers, and the Ayta Mag-Indi community in bridging skills gaps and fostering meaningful learning experiences.

This study was conducted out of profound concern for the educational challenges Ayta Mag-Indi learners encounter, particularly in mastering critical 21st-century skills necessary for their holistic development and integration into a rapidly changing world. Despite their rich cultural heritage and strong community values, Ayta Mag-Indi learners face difficulties in digital literacy, critical thinking, and technological proficiency. Given these challenges, this research assessed their current knowledge and practice of 21st-century skills and developed a culturally and contextually appropriate intervention program.

The research aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 4 - quality education, Goal 5 - reduced inequalities), and Goal 1 - no poverty. It is also profoundly rooted in St. Paul University Quezon City's (SPUQC) commitment to serve marginalized communities, embodying the Paulinian ethos of being "all to all." This study seeks to create an education environment that respects and uplifts Indigenous learners by integrating culturally responsive pedagogies and fostering community engagement.

We hope this report serves as a valuable resource for educators, policymakers, and advocates of indigenous education. May it inspire further research, policy development, and community-based initiatives that ensure no Indigenous learner is left behind in pursuing quality education and lifelong learning.

Sr. Lilia Therese Tolentino, SPC
President
St. Paul University Quezon City
Philippines

Executive Summary

The Ayta Mag-Indi community in Floridablanca, Pampanga faces challenges accessing quality education while striving to preserve their indigenous culture. This study assessed the learners' knowledge and practice of 21st-century skills and implemented an intervention program to address identified gaps. The project aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education), Goal 10 (Reduced Inequalities) and Goal 1 (elimination of poverty).

A mixed-methods research approach was used, integrating quantitative data from pre- and post-tests with qualitative insights from a focus group discussion (FGD) with teachers. Forty intermediate learners from Grades 4 to 6 participated in the study. The research process involved four phases: pre-assessment, intervention design, program implementation, and post-assessment. The pre-test findings revealed that digital and technological skills were among the weakest areas, especially for Grade 4 learners with minimal prior computer exposure. However, post-intervention assessments showed significant improvements, particularly among younger students who engaged enthusiastically in digital literacy activities. Critical thinking skills were moderately developed, though reading comprehension challenges hindered deeper analytical engagement. Collaboration and socio-civic engagement were among the strongest skills exhibited by learners, reflecting the collectivist values embedded in their indigenous traditions.

Despite these improvements, several challenges persisted. Key barriers include limited access to digital resources, economic constraints affecting learners' ability to practice skills outside school, and inconsistent attendance due to livelihood priorities. Teachers also highlighted the need for structured digital literacy training and culturally responsive pedagogy to sustain progress of learners. Given these findings, several recommendations are proposed. Sustained digital literacy programs should be implemented in collaboration with local governments and educational institutions to ensure continued access to technology. Literacy interventions should integrate culturally relevant texts to improve comprehension and critical thinking. In addition, teachers should receive specialized training on integrating 21st-century skills within Indigenous knowledge systems, and infrastructure investments should be made to enhance digital access through community tech hubs and mobile learning centers. Strengthening parental engagement and advocating for policy support will reinforce these efforts.

This study underscores the importance of structured and culturally sensitive educational interventions in equipping Ayta Mag-Indi learners with essential 21st-century skills. While notable progress was made, particularly in digital literacy, sustained efforts and multi-sectoral collaboration are necessary to bridge educational gaps and empower indigenous learners. Ensuring their inclusion in mainstream education while preserving their cultural identity will be vital in fostering long-term educational equity and opportunity.

PART 1

Introduction

The Ayta Mag-Indi encounter greater challenges from discrimination and marginalization, stemming from cultural insensitivity and misunderstandings by lowland teachers and students, than from issues related to the accessibility and availability of educational facilities. Currently, they are struggling to balance the pressures of modern life with the preservation of their indigenous culture.

The project titled "Knowledge and Practice of the 21st Century Skills among Ayta Mag-indi Learners" aims to assess the knowledge and practice of the 21st-century skills among Ayta Mag-indi intermediate learners and to create and implement an intervention program to help them develop these skills. The project aligns with the United Nations Sustainable Development Goals, specifically Goal 4 (quality education), Goal 10 (reduction of inequalities), and ultimately Goal 1 (elimination of poverty). These objectives resonate with the researchers and SPUQC, which are dedicated to serving marginalized communities and embodying the Paulinian Traits of being gleaners, serving the least, the last, and the lost, and being all to all. This project is significant as it addresses the lack of knowledge about the Ayta Mag-Indi community. By raising awareness, it aims to reduce their marginalization. Highlighting their educational needs ensures they are not left behind, fostering inclusivity and equity in education.

Research Objectives

This study aimed to determine the level of knowledge and practice of the 21st Century Skills by the Ayta Mag-indi intermediate learners. The result was used to develop a contextualized skills enhancement program. Specifically, the study sought to determine the following:

1.) the level of knowledge of the Ayta Mag-indi intermediate learners of the following 21st-century skills:

- Life and Career Skills
- Learning and Innovation Skills
- Information, Media, and Technology Skills

2.) the level of practice of the Ayta Mag-indi intermediate learners of the 21st-century skills;

3.) the significant difference in the level of knowledge and practice of the 21st-century skills of the Ayta Mag-indi intermediate learners before and after the implementation of the intervention program; and,

4.) the challenges encountered by Ayta Mag-Indi intermediate learners in acquiring and practicing 21st-century skills based on the perspective of teachers.

The Ayta Mag-indi of Sitio Camachile, Barangay Nabuclod, Floridablanca, Pampanga

The Ayta Mag-Indi are indigenous people living in Pampanga, specifically in Floridablanca and Porac, with some in San Marcelino, Zambales. Together with the Ayta Mag-Antsi of Porac and Angeles, Pampanga, they are among the various tribal communities of what can be called the Ayta Nation in the Philippines. The Ayta Mag-indi live in two areas in Zambales: Barangay Nabuclod and Barangay Mawacat. Specifically, the respondent community is in Sitio Camachile, initially a barangay (constituted as barangay during the administration of President Ramon Magsaysay) until it was dissolved and incorporated into Barangay Nabuclod due to some election-related concerns. While they live in a political unit, they see themselves as belonging to one ancestral domain and not as a separate barangay. There are around 800 Ayta Mag-indi families in Brgy. Nabuclod today (Ibera, 2022).

The Ayta Mag-indi ancestral domain covers an area of 5,457,71017 hectares. They were displaced during the 1991 Mt. Pinatubo eruption but returned and reconstituted their community. They eventually reclaimed their land on 17 April 2009, with the award of a Certificate of Ancestral Domain Title (NCIP, 2022). The Ayta Mag-indi in this project are those living in Nabuclod who represent a minority group and have a voice in education, health, social welfare, politics, and human rights.

Schools were introduced to the Ayta communities with the introduction of large-scale mining in the area in the 1960s. The Ayta viewed this as a positive development, recognizing the need to engage with lowlanders and their systems. However, their experience of lowland schools was rather traumatic and discriminatory, and most of them never finished their elementary education. Aside from this, their low income and lack of economic opportunities and support further marginalized them. Only one secondary school is accessible, yet relatively far from the Ayta Mag-indi community - the Floridablanca National Agricultural School (Ibera, 2022).

Although there is existing research on other indigenous communities in the country, studies on the life and culture of the Ayta Mag-indi are notably scarce, if not lacking. The lack of research contributes to their marginalization, as their needs and practices remain undocumented and misunderstood. Academic institutions, as advocates for culture and minority groups, are responsible for amplifying Indigenous voices and ensuring that social institutions address their concerns.

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The 21st Century Skills

Access to Quality Education and Development of 21st Century Skills

Developments towards achieving the Sustainable Development Goals have benefited only some learners. The indigenous peoples are being left behind. According to the United Nations Inter-Agency Support Group (IASG) on Indigenous People's Issues (2014, p.1), "Indigenous learners tend to have less access to education, have to contend with poorer quality education, and do not enjoy the same benefits from education as non-indigenous learners." Article 14 of the UN Declaration on the Rights of Indigenous Peoples stated, "Indigenous peoples have the right to establish and control their educational systems and institutions providing education in their languages, in a manner appropriate to their cultural methods of teaching and learning". However, support and empowerment are still lacking in fully realizing this right.

Quality education in the 21st-century demands skills "that can be taught or learned to enhance ways of thinking, learning, working, and living in the world." These include creativity and innovation, critical thinking/problem-solving/decision making, learning to learn/metacognition, communication, collaboration (teamwork), information literacy, ICT literacy, citizenship (local and global), life and career skills, and personal and social responsibility (including cultural awareness and competence) (GPE, 2020). These skills are deemed necessary for quality education in the 21st-century and are supposed to be accessible to all.

Given this, the Sustainable Development Goal (SDG) 4 on education espoused the principle that learning should not only be about literacy and numeracy but also encompass broad skills like technical and vocational skills for employment, jobs, and entrepreneurship, knowledge and skills related to sustainable development and lifestyles, human rights, gender equality, a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity.

Since education is for all, the Ayta Mag-Indi learners must be given equal opportunity to develop 21st-century skills, integrate into mainstream society, and enjoy a quality life.Acquiring 21st-century skills will empower them to treasure, develop, and practice their culture, build self-esteem and confidence, become aware of and enjoy their rights as citizens, gain equal access to education, and improve their lives.

Adedeji (2023) underscored the importance of 21st-century skills as he described that the emerging era has significantly changed how we live, work, and communicate. The rapid pace of technological advancement, the globalized nature of the economy, and the increasing complexity of society have all led to new challenges and opportunities. To succeed in this rapidly changing world, individuals need a set of skills that go beyond traditional academic knowledge. These skills, often called "21st-century skills, " include literacy, learning, innovation, and life and career skills. Developing and acquiring Learning and Innovation Skills by every learner, along with Life and Career Skills and Information, Media, and Technology Skills, is necessary to successfully traverse the challenging and complex academic environment.

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Learning and Innovation Skills

Creativity, Collaboration, Communication, and Critical thinking skills are among the requisite skills that help 21st-century learners perform tasks and produce expected outputs in the current teaching-learning milieu (P21, 2019).

Communication and Critical Thinking. The importance of developing practical communication skills in oral and written forms and even in the non-verbal aspects of language use in communication cannot be discounted. Communication in the 21st-century is characterized by the nature of communication, which tends to be increasingly globalized (Pattiwael, 2016). This entails fluency in the communication medium and understanding and applying the dynamics and principles of effective communication to achieve the group/organization's goals. Communication is no longer carried out in the typical communication model, like one-to-many, top-down mass communication. Still, we are moving to a communication model that is more open, interactive, multidimensional, and participatory, reflecting a pattern of globalized communication. Language should be harnessed as a medium through which culture is transmitted. In the case of the Ayta Mag-indi of Sitio Nabuclod, Floridablanca, Pampanga, the learners' communication skills in their native language should be honed to preserve and transmit their culture to future generations of the Ayta Mag-indi tribe and, more importantly, to enable them to participate actively in socio-cultural and even economic activities that affect their tribe.

The 21st-century skillset is generally understood to encompass a range of competencies, including critical thinking and problem-solving. Reasoning and problem-solving are among the most common elements of critical thinking. Research on young children's thinking shows early childhood educators can promote children's critical thinking skills through classroom practice. Nevertheless, the teaching practices toward critical thinking must manifest developmentally to facilitate effective learning (Whittaker, 2014 in Kim, 2019). Developing critical thinking skills among learners through enhancing their reasoning and problem-solving skills is possible across different subject areas like mathematics, reading comprehension, science, and the like, and across levels. In the study of Kim (2019), a comparative example of how critical thinking was adapted and made developmentally appropriate to the level of learners was explained. In the case of an early childhood classroom, a teacher may need to do more scaffolding to lead a child through their reflection and thinking processes than an older student who may be able to reflect and evaluate with less prompting and more independence. These reflection and thinking processes can be adapted to the case of younger Ayta Mag-Indi learners who are developing their critical thinking skills. Still, it should be aligned with concepts and activities that help promote their culture and traditions.

Creativity and Collaboration. Current problems and concerns need creative and collaborative solutions. Creativity is a core human skill crucial in human and sustainable development. For this reason, it is considered an essential skill that every 21st-century learner must develop and apply. The 21st-century workplace values creative individuals, as creativity is key to confronting the complex challenges facing our world today (Future Learn, 2023; World Economic Forum, 2023). While the world increasingly relies on artificial intelligence, service technologies, automated work processes, and autonomous robots, creativity remains a skill that differentiates us from machines. The rapid obsolescence of knowledge and technology accelerates change, and for humans to thrive and adapt in such conditions, creativity is essential. It enables us to develop new behaviors, perceive differently, and find novel approaches to everyday problems. Creativity is part of our unique ability to actively sense and adapt to the demands of our environment (World Economic Forum, 2015).Creativity empowers us to imagine, innovate, and devise new ways of addressing problems and expressing meaning.It involves imagination – the ability to envision novel ideas, scenarios, and possibilities-; originality - in creating unique and fresh solutions or expressions; problem-solving -the application of creative thinking to address complex issues; flexibility - openness to change and the capacity to adapt creatively; and risk-taking – the courage to explore unconventional paths.

On the other hand, collaboration in the context of 21st-century skills refers to the ability to work effectively with others, combining diverse perspectives, skills, and knowledge to achieve common goals. It involves communication, compromise, and recognition of individual contributions within a team (Trilling, 2009). Many contemporary problems are complex and require diverse expertise to solve them.Collaboration allows everyone to pool their knowledge and skills to tackle multifaceted issues. Moreover, globalization challenges us to transcend borders and divisions. Effective collaboration bridges these gaps by engaging people from different cultures, backgrounds, and time zones. Such collaboration brings about fresh ideas that cultivate innovations to address problems creatively. Lastly, collaboration fosters community learning and growth. It exposes individuals to different perspectives, helping them learn and grow personally, professionally, and socially.

Information, Media, and Technology Skills

Digital Literacy. The developments brought about by information technology and the demands of the 21st-century environment have resulted in various changes and challenges not only in business and operational processes but also in the skills and competencies expected from students. UNESCO defines digital literacy as the ability to safely and appropriately access, manage, understand, integrate, communicate, evaluate, and create information through digital devices and networked technologies to participate in economic and social life (Law et al., 2018). This means that more than having access to information through digital technologies like internet platforms, social media, and mobile devices , one needs to be categorized as digitally literate.It is more complex than just having “digital access.”

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The pandemic has brought attention to the disparities in the digital divide between countries, particularly for people living in underserved areas and in Indigenous communities that are geographically isolated and find it challenging to schedule vaccination appointments. The United Nations Department of Economic and Social Affairs (2021) highlighted that people worldwide have increasingly depended on ICTs for various essential functions, including accessing information, working, conducting business, pursuing education, receiving healthcare, utilizing services, and maintaining safe connections. Nonetheless, Indigenous communities continue to be underserved because they are among the least likely to be connected to the Internet and lack equal access to digital technology and the skills required to make the most of ICTs. Fang et al. (2022) identified four factors of the digital divide in Malaysian Indigenous communities: physical access, motivational access, skills, and usage. Van Dijk (2012) argued that the digital divide remains a significant issue in developing countries, with physical access as the primary challenge, especially to native groups in Sabah. While Sabah's Indigenous communities are eager to adopt technology, their lack of physical access may discourage them from doing so. Thus, physical access should be addressed before motivational access to close the digital divide among Indigenous people in developing countries like Malaysia.

UNESCO's ICT for Intercultural Dialogue (ICT4ID) way back in 2005 expressed similar concerns about inadequate access among indigenous people, which is characterized by low computer ownership, low computer literacy, low internet connectivity, and low access to other digital technologies such as cameras, filmmaking equipment, editing equipment, and so on. The isolation of many Indigenous groups, usually located in remote regions with limited connectivity and low literacy levels, particularly in the use of English, which is the primary computer language, exacerbates the dilemma. Similarly, because digital technology is costly, community poverty restricts access. Expenses escalate in remote areas where satellite internet connections are more expensive than regular phone lines or cable connections in cities. Additionally, maintenance and repair services are more costly, time-consuming, and subject to significant delays as workers must travel to reach these locations (Dyson et al., 2006).

The digital divide is evident not only in underdeveloped nations but also within developed countries such as Canada. In a 2017 survey, only 24% of indigenous communities in Canada had access to high-speed internet. Despite having the highest living standards in the world, many First Nations, Métis, and Inuit communities are still fighting for the fulfillment of basic human rights. They continue to struggle for digital equity which further exacerbates their marginalization (The Canadian Radio-television and Telecommunications Commission, 2019).

On the other hand, Asraf et al., 2015 unearthed a success story, showing that ICT training was critical in raising Indigenous people's awareness and improving their access to key areas such as income-generating activities, education, health, and living conditions among the Indigenous people in Bangladesh. As a result, ICT-based training has evolved as an educational tool to assist indigenous people in Bangladesh in overcoming barriers and discrimination.

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Technology Literacy. According to literature, earlier definitions of technology literacy focused on access to computers and other similar and related technology, such as using larger storage devices like floppy disks. In the late 1900s, technology literacy was often synonymously associated with computer literacy, which implied competence in writing a computer program and quickly became roughly equivalent to knowing how to use word processor programs (Mason & Fisher, n.d.) such as WordStar that could store and manage entire documents which later progressed to effectively navigating bundled set productivity applications consisting of Excel, Word, and Powerpoint, the first version of Office—these and many other new technologies distinct from earlier technologies emerged by the end of the 20th century.

Throughout the 21st century, new technologies continued to emerge and develop faster. With the internet gaining unprecedented popularity at the turn of the century, technology literacy was defined as a person's likelihood of owning a computer or being connected. However, as evidenced by the literature, this fundamental definition has been the subject of academic debate, and schools have progressed beyond teaching basic computer skills and terminology over the years. The emphasis of technological literacy at the beginning of the 21st-century has been students' use of computers to solve problems, foster creativity, and stimulate the discovery of new ideas and techniques. According to Martinez (n.d.), the State Educational Technology Directors Association (2007) defines technological literacy as the ability to use appropriate technology responsibly to communicate, solve problems, and access, manage, integrate, assess, and create information. In contrast, Santoso and Lestari (2019) define technological literacy as the capacity to use digital tools to access, manage, integrate, analyze, and create information in ways that are, collaborative, ethical, and accurate. However, since the beginning of the COVID-19 pandemic, this definition has evolved further. It has led to learning online, which encompasses accessing information, skills, competencies, and online platforms such as Zoom, Microsoft Teams, Google Classrooms, and other learning management systems correctly, accurately, ethically, and responsibly.

Information and Media Literacy. According to UNESCO (2011), as cited by Tibaldo (2021), media and information literacy is a composite of 12 literacies, including media literacy, information literacy, library literacy, freedom of expression (FOE) and freedom of information, digital literacy, computer literacy, internet literacy, games literacy, cinema literacy, television literacy, news literacy, and advertising literacy. These include abilities to responsibly access, use, and contribute information and media content, as well as knowledge of how to manage one's online rights, stop cyberbullying and hate speech, and engage with media and ICTs to advance equality, freedom of speech, and tolerance as well as intercultural and interreligious dialogue and peace. It focuses on different intersecting competencies to transform people's interactions with information and learning environments online and offline (UNESCO, 2022). Thus, a digitally literate student must be able to critically evaluate what is being said and who is saying it, especially now that misinformation and disinformation are rampant in the online space, and understand that information published on the internet may not be a reliable, credible, or accurate source of information.

Media, and information literacy has long been a concern for both educators and parents. Tibaldo (2021), citing Voss (2011), stated that today's students are like Midas, surrounded by gold but unable to translate their ICT education into functional literacy. Similarly, Yuan (2015) was recognized in the same study for identifying a considerable gap between students' meaning-making when utilizing digital texts at home and their digital literacy practices at school. Haider and Sundin (2020) assert that higher levels of media and information literacy lead to more capable and well-informed citizens, fostering responsible individuals and supporting the development and sustainability of communities grounded in conscientious democratic values. Nevertheless, one of the fundamental tenets of this practice is weakening, as the debate over the importance of critical examination of information and information sources intensifies. There are indications that people are losing trust in institutions, such as the media, particularly in democratic societies (Kavanagh & Rich, 2018). This can be attributed to the fact that massive digital misinformation is becoming pervasive in online social media to the extent that it has been listed by the World Economic Forum (WEF) as one of the main threats to our society, as cited by Howel (2013). This was supported by Muhammed and Matthew (2022), who stated that the spread of misinformation in social media has become a severe threat to public interests, particularly the several incidents of public health concerns that arose from social media misinformation during the COVID-19 pandemic.

Given the preceding discussions, regularly incorporating media and information into the classroom is essential. As stated by Shellow (2016), the goal of education is to prepare students for their future, and not teaching these skills to students puts them at a considerable disadvantage.

Life and Career Skills

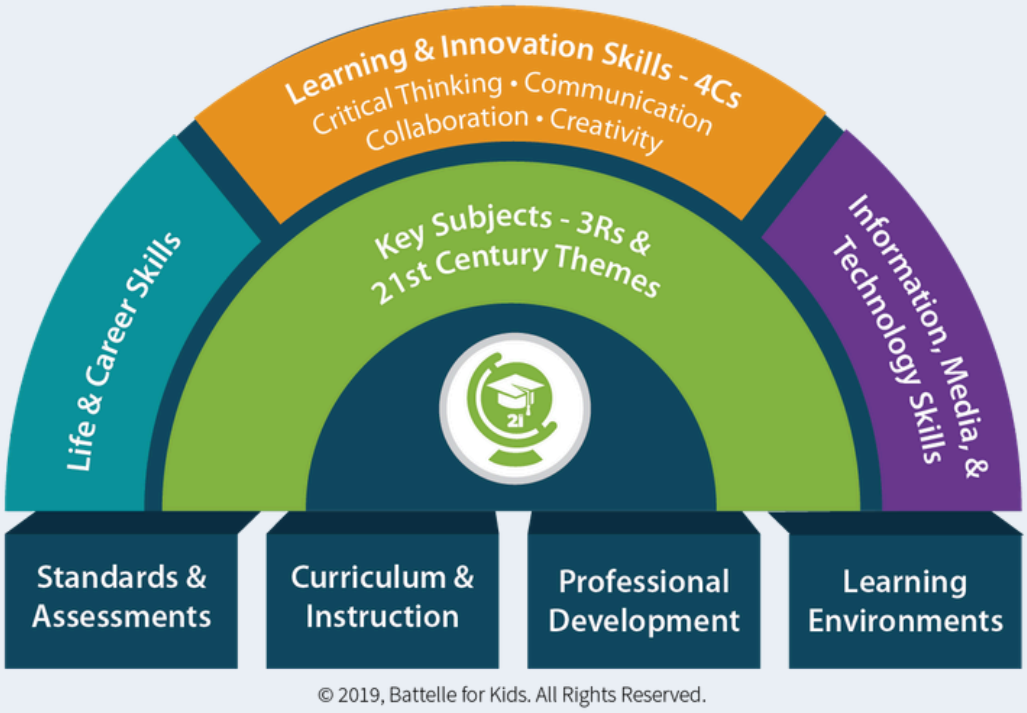
Today's life and work environments require more than thinking skills and content knowledge. Learners must be able to navigate the complex life and work environments in a globally competitive age, driven by information and artificial intelligence while also giving rigorous attention to developing the necessary life and career skills. The P21 Framework identified the following five (5) essential life and career skills for the 21st-century:

1. **Flexibility and adaptability.** Today's learners must develop the ability to adapt to varied roles, job opportunities, schedules, and contexts, and they must be able to work effectively in a climate of ambiguity, constantly changing priorities and quick obsolescence. They must also have flexibility, incorporate feedback effectively, deal positively with praise, setbacks, and criticisms, and understand, negotiate, and balance diverse views and beliefs to reach workable solutions, particularly in multicultural settings.
2. **Initiative and self-direction.** This encompasses the abilities to manage goals and time, work independently, and be self-directed learners.
3. **Social and cultural skills.** This includes the ability to respect cultural differences and work effectively with people from a range of social and cultural backgrounds, respond open-mindedly to different ideas and values, and leverage social and cultural differences to create new ideas and increase both innovation and quality of work.
4. **Productivity and accountability.** The 21st-century learners must be able to manage their projects and work, produce expected and desired results, work positively and ethically, participate actively, collaborate and cooperate with others, and be accountable for results and their actions. Lastly, leadership and responsibility can guide and lead others toward goals and be responsible for others (P21, 2009; Zoe, 2023).

Conceptual Framework

The research project adopted the Framework for 21st-Century Learning (a.k.a. P21) and UNESCO's Competencies for the 21st-Century Framework. The P21 is "a unified vision for learning to ensure student success in a world where change is constant, and learning never stops" (P21, 2019, p.1).

Figure 1.
Framework for 21st century learning (P21)



Source: https://keys.edu.ph/applying-21st-century-skills/

As shown in Figure 1, the skills necessary to thrive in the 21st-century are life and career skills, including flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility. Second, learning and innovation skills include creativity and innovation, critical thinking and problem-solving, communication, and collaboration, and third, information, media, and technology skills, including information literacy, media literacy, and ICT (Information, Communications, and Technology) literacy (P21, 2009).

However, these skills can only be developed or acquired with mastery of key subjects and 21st-century themes like English, reading, or language arts, world languages, arts, mathematics, economics, science, geography, history, government, and civics. These skills and themes must be integrated into educational standards and assessments, curriculum and instruction, professional development, and learning environments.

P21 (2009) emphasizes the acquisition and practice of essential skills for the 21st-century, such as life and career skills, learning and innovation skills, and information, media, and technology skills. According to P21, combining these skills with the necessary support systems will make students more engaged in learning and better prepared to thrive in the 21st-century world.

The Philippines Department of Education (DepEd) used the same framework in their DepEd Order No. 55, 2016 – Policy Guidelines on the National Assessment of Student Learning for the K to 12 Basic Education Program. According to the DepEd, the following are 21st-century skills Filipino learners must acquire:

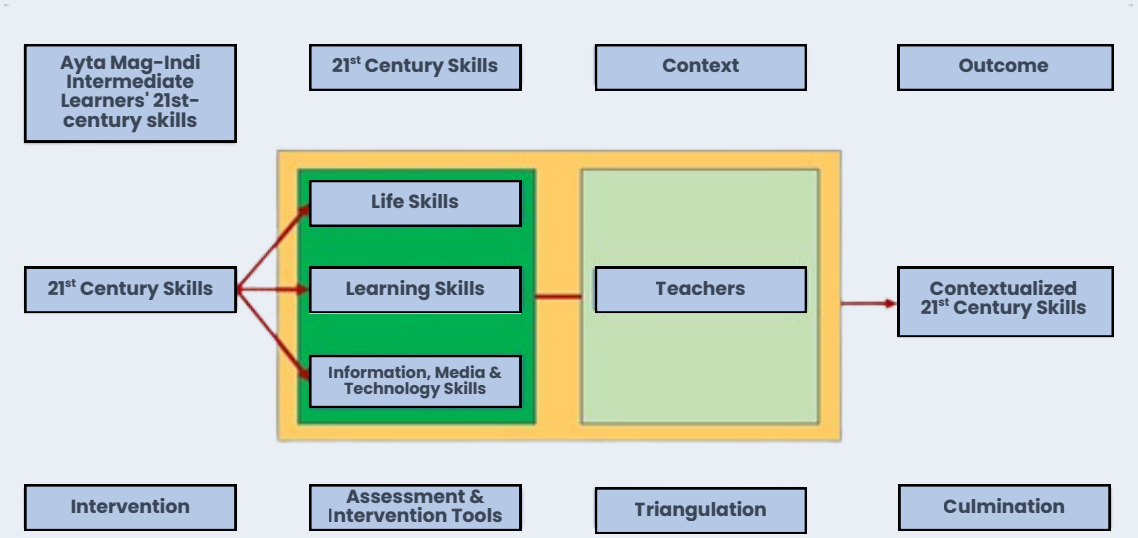
- Communication skills, which refer to the ability to express oneself clearly and Collaboration with others.
- Information, Media, and Technology skills, which refer to the ability to gather, manage, evaluate, use, and synthesize information through media and technology,
- Learning and Innovation skills, which refer to the ability to think critically, analyze and solve problems, create and implement innovations, and generate functional knowledge.
- Life and Career skills refer to intrinsic and socialized personal values, ethics, and attitudes for life after basic education and learning within the workforce.

According to UNESCO (2016, 2019), the following knowledge, values, attitudes, and skills are integral to life in the 21st-century:

- Critical and innovative thinking (creativity, entrepreneurship, resourcefulness, application skills, reflective thinking, reasoned decision-making)
- Interpersonal skills (communication skills, organizational skills, teamwork, collaboration, sociability, collegiality, empathy, compassion)
- Intrapersonal skills (self-discipline, ability to learn independently, flexibility C adaptability, self-awareness, perseverance, self-motivation, compassion, integrity, self-respect)
- Global citizenship (awareness, tolerance, responsibility, respect for diversity, ethical understanding, intercultural understanding, ability to resolve conflicts, democratic participation, respect for the environment, national identity, sense of belonging)
- Media and Information Literacy (ability to obtain and analyze information through ICT, ability to critically evaluate information and media content, ethical use of ICT)
- Physical, Mental, and Religious health

The two frameworks are integrated in Figure 2, a contextualized learning framework that was used for this study. It describes how the frameworks support each other by linking broad educational strategies with localized application, ensuring that 21st-century competencies are not only taught but also contextualized and reinforced through community engagement and practical enhancement activities.

Figure 2.
Conceptual Framework for 21st Century Skills for Ayta Mag-indi Learners



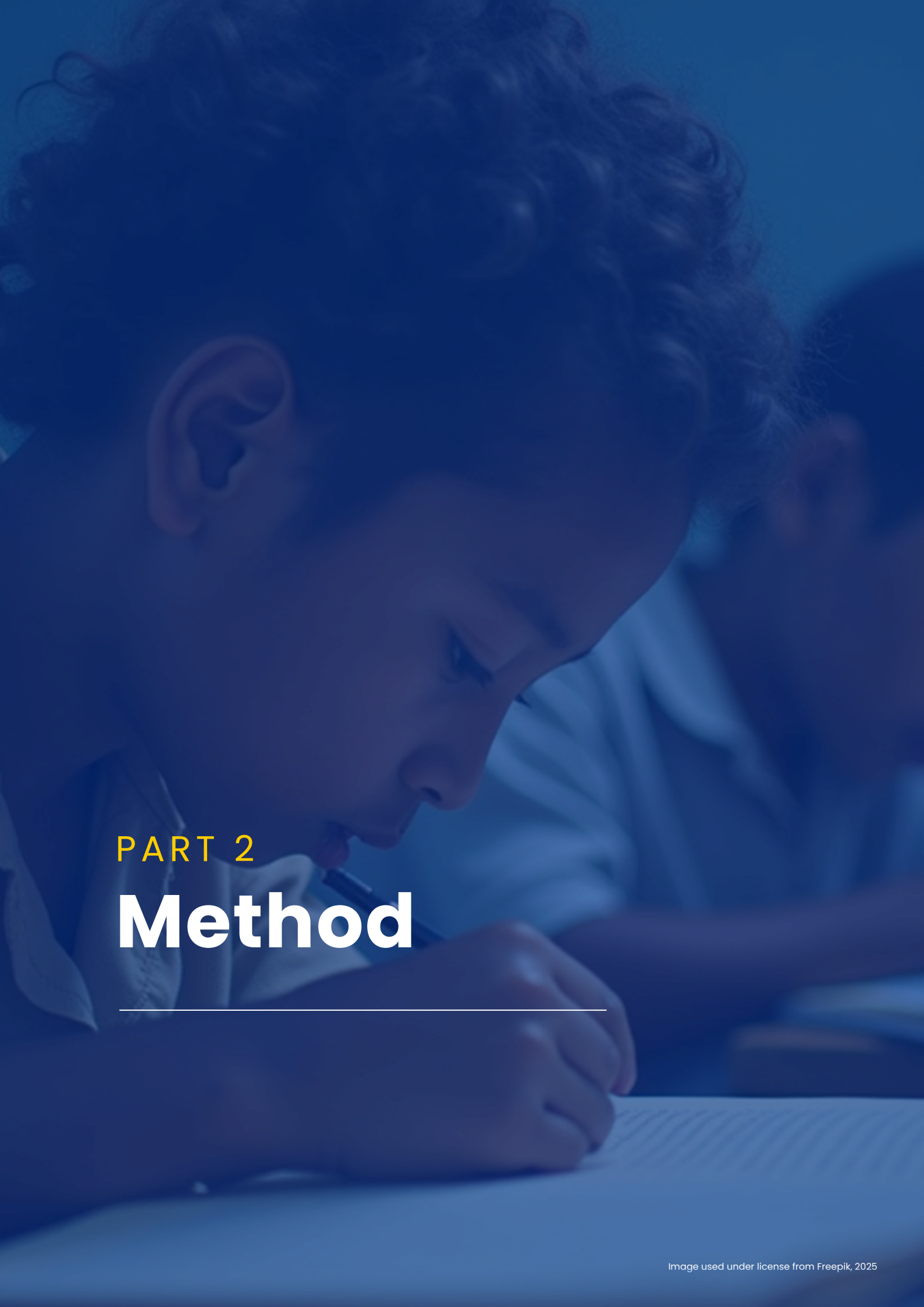
The context of the research project is the Ayta Mag-Indi culture. Incorporating cultural backgrounds, especially those related to indigenous peoples (IPs), is crucial to understanding their epistemological and pedagogical orientations. While the concept of 21st-century skills may be modern and new to the IPs, some of the competencies required are already being practiced in their context, and we can even learn from them when it comes to the acquisition and practice of specific 21st-century skills such as environmental and cultural skills/intelligence.

According to Monroe et al. (2013), a 21st-century approach to education must respect diverse cultures, recognize the value of knowing multiple languages, including IP languages, and acknowledge the need for cultural preservation. Moreover, they also see that "both Indigenous perspectives on education and 21st-century approaches call for education to emerge from context and appreciation of the interconnectedness of all things" and that learning is rooted in place, and understanding the local context is a prerequisite to understanding the global context. The 21st-century skills are globally recognized skills that are better understood by examining the regional context of the learners. In the context of the Ayta Mag-indi, there is a need to go global and exhibit globalskills underpinned by local culture.

In addition, indigenous and 21st-century perspectives and approaches to learning recognize the need to develop sophisticated and complex responses to multifaceted phenomena. Battiste (2002) believes that sophisticated and complex response demands creativity and innovation in a collaborative setting. For Battiste (2002), the IP perspective on education advocates for comprehensive learning methods and acknowledges that Indigenous knowledge is deeply interconnected with relationships within a distinct ecological environment.

This paper explored, documented, and applied the cultural context of 21st-century skills, serving as a foundation for designing an intervention program that integrates these skills within the context of Ayta Mag-Indi. The intervention included hands-on, community-based learning experiences that incorporated indigenous practices. For example, cultural values were woven into critical thinking tasks within reading comprehension and math lessons. In addition, digital and technological skills were taught by coming up with creative outputs using their cellphones to capture pictures and create captions that reflect their community and cultural practices and values. These images were then used to create a presentation in MS Word. Monroe et al. (2013) emphasize that incorporating Indigenous perspectives rooted in traditional wisdom can enrich modern educational approaches, particularly in acquiring and practicing 21st-century skills. Similarly, Brant Castellano (2000) highlights that the knowledge essential for future survival is not merely a relic of the past but a dynamic force continuously revitalized by Indigenous communities and adapted to contemporary advancements.

This study focuses on assessing the level of knowledge and practice of 21st-century skills among Ayta Mag-indi intermediate learners. It examines key competencies, including life and career skills, learning and innovation skills, and digital and technological skills, while involving teachers to reinforce the intervention. However, the study is limited by its small sample size, which may restrict the generalizability of the findings to other indigenous or non-indigenous groups. In addition, the short intervention period may not capture the long-term effects of the program, and external factors, such as learners' prior exposure to similar skills or varying levels of community support, could influence the results.



PART 2

Method

The study had four (4) phases. Phase 1 included applying for permission, designing an instrument to determine current knowledge and practice of 21st-century skills, and conducting a pre-test. The instrument was first designed with knowledge-based questions to measure learners' understanding and practice-based scenarios to evaluate their application of skills in real-life contexts. To ensure cultural relevance, the items were contextualized with familiar situations, such as community interactions and traditional practices. The instrument was translated into Tagalog and then back-translated into English to verify linguistic and semantic accuracy. It underwent expert validation by educators and indigenous education advocates, who assessed its content accuracy, clarity, and cultural appropriateness. Revisions were made based on their feedback to enhance the instrument's validity. The final version was administered as both pre-test and post-test assessments, providing data to measure the learners' skill development before and after the intervention.

A letter was sent to the National Commission for Indigenous Peoples Region 3 (NCIP-3) requesting permission to conduct the research. The NCIP-3 acknowledged the receipt of the letter, and the Regional Director created an Indigenous Knowledge Systems and Practices (IKSP) Team and mandated the constituted members to execute Certification Precondition activities. Meetings and a community consultation and a caucus were facilitated by NCIP Floridablanca Office personnel. The details and benefits of the project were discussed, and all parties in the research approved the implementation plan. Before the meeting, dialogues between community leaders and the research team were held.

The NCIP Regional Office 3 eventually signed the memorandum of agreement and issued the Certification Precondition. The SPUQC Research Team also secured a written permit from the Floridablanca Ayta Ancestral Domain, Inc. (FAADI) President and the Principal of Camachile Elementary School. These partnerships and agreements were made to ensure the legality and ethical compliance of the research work.

Figure 3.
The Research Process

Phase 1	Phase 2	Phase 3	Phase 4
• Securing permit • Instrument development • Sampling • Pre-testing	• Pre-test data analysis on the level of knowledge and practice of the 21st century skills among Ayta Mag-indi intermediate learners • Intervention program design	• Intervention program implementa-tion	• Post-intervention test on the level of knowledge and practice of the 21st century skills among Ayta Mag-indi intermediate learners • FGD with teachers

Phase 2 mainly involved analyzing pre-test data and designing the intervention program. The intervention program was developed based on the pre-test results from Ayta Mag-Indi learners in Grades 4, 5, and 6, assessing their knowledge and practice of 21st-century skills. The pre-test revealed that learners were not proficient in digital and technological skills. Although their critical thinking scores were generally high, they were classified between high and low categories. Therefore, the intervention program was deemed necessary in these three areas.

Three subject experts designed the intervention program, using pre-test results to determine the objectives, content, and methodologies. Critical thinking skills were enhanced through reading comprehension and mathematics lessons that integrated Ayta Mag-Indi cultural practices and values. Meanwhile, digital and technological skills were developed through practical hands-on computer activities, emphasizing the proper and ethical use of technology. Learners produced creative outputs that reflected their community and cultural practices and values using MS Word and MS PowerPoint.

Phase 3 involved implementing the intervention program, which lasted one month. During this phase, the program was executed according to the plan developed by the subject experts. The activities and lessons were delivered to the learners, focusing on enhancing their critical thinking, digital, and technological skills while integrating cultural practices and values.

The pre-test was given at the start of the project to establish a baseline for the learners' skills and knowledge. This initial assessment helped in identifying the areas that needed improvement and provided a benchmark for measuring progress.

The post-test was conducted one week after the intervention program ended to evaluate improvement. This follow-up assessment aimed to measure the effectiveness of the program by comparing the learners' performance before and after the intervention. The results of the post-test provided valuable insights into the success of the program and highlighted areas for further development.

A focus group discussion with teachers of Ayta Mag-indi learners was conducted in Phase 4 to validate the results of the pre-test and post-test and to gain further insights in improving and developing the 21st-century skills of Ayta Mag-indi learners.

Research Design

The present study follows a sequential explanatory mixed methods research design. The quantitative data were gathered first, followed by the qualitative data. Priority is given to quantitative data and its interpretation. This research design integrates data to interpret and discuss results (Hanson et al., 2006).

Participants

There are 40 participants from the Ayta Mag-Indi tribe of Floridablanca, Pampanga. Eleven (11) are Grade 4 students, while there are ten (10) and nineteen (19) students from Grade 5 and Grade 6, respectively. There are seven (7) male and four (4) female participants from grade 4. In Grade 5, there are six (6) male and four (4) female participants, while eleven (11) male and eight (8) female participants are in Grade 6. For the focus group discussion, the grade level teachers served as respondents.

Grades 4, 5, and 6 learners were chosen for this study because they are at a critical stage of cognitive and skill development, making them ideal participants for assessing and enhancing 21st-century competencies. At this level, students are progressively acquiring higher-order thinking skills, such as critical analysis, problem-solving, and collaboration, which are fundamental to learning and innovation skills (Morin, n.d.).

The contextualization of the intervention program was consistent across all grade levels, ensuring a uniform approach. However, the difficulty of the tasks was adjusted to match the learners' grade levels, providing age-appropriate challenges for each group.

Instruments

The learner instrument measures two dimensions: knowledge and practice. Nine (9) skills are being measured in the knowledge dimension and ten (10) skills are in the practice dimension. The tool was designed based on three sources: the 21st-century skills described by P21, informal dialogues with parents, leaders, and teachers, and cultural dialogue with community leaders. The conversations were informal because of the availability of the informants and to avoid unnecessarily disturbing their daily activities, considering they are working in the mountains and the downtown areas for daily living expenses and sustenance, especially the parents and community leaders. The instrument was translated into Tagalog and then back-translated into English to verify linguistic and semantic accuracy. The instrument underwent several reviews and revisions to make it simpler, contextualized, and understandable to the respondents before it was finalized and printed for administration to the respondents. The assessment result, however, can be used to improve the pre-tests and post-test items for future similar research. The FGD interview guide was designed based on the assessment results.

Table 1

Knowledge and Practice Dimensions of 21st-Century Skills Among Ayta Mag-Indi Intermediate Learners: Sample Items and Total Number of Items per Skill

Knowledge	Dimension	Sample Items	Practice	Dimension	Sample Items
Skills	Total no of items		Skills	Total no of items	
Critical Thinking	3	I can analyze issues facing our community from both modern and cultural perspectives.	Critical Thinking	4	I can apply traditional knowledge and cultural teachings to solve problems.
Digital Skills	3	I feel comfortable using digital tools to document and share our cultural practices.	Digital Skills	3	I actively explore new digital platforms to connect with other Indigenous communities
Technological Skills	3	I feel comfortable using technology to connect with other Indigenous communities.	Technological Skills	3	I use technology to document and share our traditional practices in a culturally respectful manner.

Knowledge	Dimension	Sample Items	Practice	Dimension	Sample Items
Skills	Total no of items		Skills	Total no of items	
Communication	3	I feel confident expressing our cultural values and perspectives in writing.	Communication	3	I enjoy participating in discussions that highlight the richness of our cultural heritage.
Collaboration	3	I am open to listening to and learning from the cultural experiences and insights of my peers.	Collaboration	3	I take on different roles within our community initiatives to achieve shared cultural goals.
Life Skills	3	I reflect on my cultural learning journey and seek ways to contribute to its continuation.	Life Skills	3	I actively seek feedback from elders and community members to identify areas for cultural growth.
Career and Civic Readiness	3	I am aware of both traditional and contemporary issues affecting our community.	Career and Civic Readiness	3	I contribute to community discussions about preserving and adapting our cultural practices.
Social and Emotional Intelligence	2	I understand and can express my emotions in ways that are culturally appropriate.	Social and Emotional Intelligence	4	I am considerate of the cultural sensitivities and emotions of others in our community.
Adaptability	2	I embrace uncertainty and view it as a chance to learn, grow, and contribute to our community.	Adaptability	4	I actively seek feedback to learn from our cultural experiences and adapt accordingly.
			Creativity	6	I actively contribute to preserving and revitalizing our cultural heritage through creative projects.

Data Gathering Procedure

The research team obtained Free, Prior, and Informed Consent (FPIC) from the Ayta Mag-Indi community, including the elders, parents, and community leaders. This was followed by the preparation of the Memorandum of Agreement (MOA) to formalize the collaboration and ensure the study aligned with cultural values and community expectations. The pre-test was then conducted to assess the learners' baseline 21st-century skills. Afterward, the intervention program was implemented, aiming to enhance the targeted skills. Following the intervention, a post-test was conducted to measure any significant differences in the learners' skills. A focus group discussion (FGD) was held afterward to gather qualitative insights from the teacher participants. Finally, the validation phase took place, where the study results were shared with the community, promoting empowerment, confirming the findings, and strengthening trust and collaboration. Furthermore, the research team complied with NCIP regulations and legal requirements, including securing approval and permits released through NCIP Regional Office 3.

Data Analysis

Descriptive Statistics such as frequency, percentage, and standard deviation were applied to describe the phenomena. Kaizer-Mayer- Olkin and Bartlette's Test were used to establish the adequacy of the data for factor analysis.

Confirmatory factor analysis was used to establish the validity of the subscales of the instruments. Cronbach's alpha was computed to establish the reliability or internal consistency of the subscales. This measures the degree of correlation among a set of questions, providing an estimate of the reliability of the items and indicating the overall accuracy of the measurement Shapiro-Wilk test was applied to test the assumptions of normality of the data. A high p-value suggests the data set follows a normal distribution, while a low p-value shows a deviation from normality. This provided guidance on choosing the suitable statistical method, deciding between parametric and non-parametric approaches.

Wilcoxon Signed-Rank Test was applied to test the significant differences between the participants' pre-test and post-tests of the dimensions of knowledge and practice whose data are not normally distributed. A paired T-test was used to compare the differences between the pre-test and post-test of the knowledge and practice dimensions, the data of which are normally distributed.

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PART 3

Results and Discussion

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Table 2 shows the mean and standard deviation scores of the Grades 4, 5, and 6 participants across ten (10) areas of 21st-century Skills identified as skills to be acquired by 21st-century learners. In the knowledge dimension, it was noticed that the mean scores in critical thinking and digital and technological skills are low across the three grade levels. Similar results were observed in the practice dimension across all grade levels.

The higher standard deviation (SD) values in Grade 5 reflect greater variability in students' responses, suggesting inconsistent proficiency levels within this group. In contrast, the lower SD values in Grade 6 indicate more consistent skill levels, highlighting a more uniform demonstration of competencies. Nonetheless, the results imply that learners might grasp a skill before using it successfully. For instance, when practice scores increase in later grades, technology skills show lower knowledge scores in earlier grades. This reinforces the claim made by Singleton et al. (2009) that, especially for Indigenous students who include digital tools into attempts at cultural preservation, practical exposure to technology might work as a catalyst for better understanding.

Table 2

Descriptive Statistics

21st-Century Skills	Grade 4	(n=11)	Grade 5	(n=10)	Grade 6	(n=19)
	M	SD	M	SD	M	SD
Knowledge						
Critical Thinking	2.00	0.87	3.00	0.97	3.21	0.51
Digital Skills	2.00	0.47	2.80	0.98	3.30	0.47
Technological Skills	1.18	0.60	1.40	0.84	3.00	0.60
Communication	3.52	0.46	2.87	0.80	3.38	0.59
Collaboration	3.27	0.47	3.07	0.60	3.47	0.48
Life Skills	3.00	0	3.03	0.97	3.30	0.61
Career and Civic Readiness	3.35	0.32	2.98	0.90	3.39	0.36
Social and Emotional Intelligence	3.23	0.61	2.61	0.96	3.03	0.79
Adaptability	3.45	0.93	2.50	1.39	3.55	0.40

21st-Century Skills	Grade 4	(n=11)	Grade 5	(n=10)	Grade 6	(n=19)
	M	SD	M	SD	M	SD
Practice						
Critical Thinking	3.27	0.41	3.48	0.51	3.29	0.44
Digital Skills	1.91	0.47	2.20	0.98	3.23	0.47
Technological Skills	1.18	0.60	1.37	0.84	3.42	0.70
Creativity	3.20	0.60	3.28	0.67	3.36	0.35
Communication	3.47	0.50	2.93	0.81	3.32	0.59
Collaboration	3.35	0.42	2.97	0.81	3.43	0.45
Life Skills	3.03	0.10	2.8	0.92	3.65	0.42
Career and Civic Readiness	3.71	0.62	2.67	0.94	3.51	0.58
Social and Emotional Intelligence	3.09	0.50	2.93	1.03	3.55	0.40
Adaptability	3.45	0.93	2.63	1.02	3.41	0.38

Variations in various skill domains suggest that development is not always linear. For example, social-emotional intelligence and adaptability exhibit disparities in practice scores across grade levels, which could be related to external factors influencing how learners apply these skills in various educational phases. This is consistent with results from P21 (2019), which underline that acquiring flexibility and adaptability calls for exposure to many learning settings and organized interventions. Furthermore, Ayta Mag-Indi learners have shown great socio-civic and adaptive skills, strongly anchored in their cultural practices, thus, underlining the need of including culturally sensitive courses to improve skill acquisition (P21, 2019; BEDP 2030).

Moreover, the alignment between knowledge and practice varies across skill domains. While career and civic preparation show differences, most likely due to disparities in practical learning opportunities, some skills like communication and collaboration display parallel development. Structured interventions are necessary, according to BEDP 2030, to close these gaps and guarantee that students not only understand theoretical knowledge but also apply it in practical environments. Li, Brar, and Roihan (2021) point out that by encouraging participation and self-representation among Indigenous students, digital tools can help to close these gaps.

Furthermore, the research of Fang et al. (2022) has shown, restricted access to digital resources still poses a challenge to technological proficiency. With slow development noted in later grades, Grade 4 students showed the lowest competency in digital
and technology skills. This emphasizes the requirement of increased ICT availability, digital literacy teacher training, and community involvement to help to build technical skills (UNSDG 4.4; BEDP 2030).

Table 3 presents the pretest mean and standard deviation scores of critical thinking, digital skills and technological skills across the dimensions of knowledge and practice. Grade 4 students are noticed to have lower mean scores in the three areas of critical thinking (M=2.00, SD=0.87), digital skills (M=2.00, SD=0.47), and technological skills (M=1.18, SD=0.60). Similarly, they have also achieved lower mean scores in the practice dimensions in the three areas of critical thinking (M=3.27, SD=0.41), digital skills (M=1.91, SD=0.47), and technological skills (M=1.18, SD=0.60).

Table 3

Pre-Test Descriptive Statistics

21st-Century Skills	Grade 4	(n=11)	Grade 5	(n=10)	Grade 6	(n=19)
	M	SD	M	SD	M	SD
Knowledge Dimension						
Critical Thinking	2.00	0.87	3.00	0.97	3.21	0.51
Digital Skills	2.00	0.47	2.8	0.98	3.3	0.47
Technological Skills	1.18	0.60	1.40	0.84	3.00	0.60
Practice Dimension						
Critical Thinking	3.27	0.41	3.48	0.51	3.29	0.44
Digital Skills	1.91	0.47	2.20	0.98	3.23	0.47
Technological Skills	1.18	0.60	1.37	0.84	3.42	0.70

These results coincide with earlier research on skill development among Indigenous students, where restricted access to resources and infrastructure causes digital and technological competencies to stay low (Li et al., 2021). From Grade 4 to Grade 6, the slow increase in digital and technological skills points to students developing increasingly advanced skills as they advance academically, especially in light of structured learning chances (Singleton et al., 2009). Though students may understand theoretical concepts, differences between knowledge acquisition and practical application show that they need organized interventions to transform their knowledge into use (BEDP 2030). Moreover, the noted discrepancy between knowledge and practice in digital and technological skills points to the need for practical experience in strengthening knowledge. Fang et al. (2022) claimed that infrequent hands-on experiences are insufficient for developing basic digital literacy. Aringo and Diego's (2021) intervention study also showed that Indigenous students greatly enhanced their digital skills upon access to ICT resources and organized instruction.

Especially in Grades 4 and 5, the low beginning results in technological skills reveal another important trend. This trend corresponds with results from UNESCO (2016), which underline that infrastructure restrictions and financial constraints often prevent Indigenous students from easily using digital resources. As Dyson et al. (2006) pointed out, the digital gap still exists worldwide. Indigenous people in rural areas find it difficult to acquire digital literacy because of poor internet access and expensive equipment prices. Dealing with this disparity calls for increasing ICT access and including digitally literate initiatives with cultural relevance.

The pretest results generally show the early phases of 21st-century skill development and the need to bridge the gap between theoretical knowledge and practical application. These findings underline the requirement of tailored instructional strategies to guarantee knowledge transfers into practical proficiency even if students start a program with a basic awareness of critical thinking and digital and technology skills. According to P21 (2009), including opportunities for experiential learning is crucial to provide learners with the tools they need to flourish in a technologically advanced environment.

Table 4 displays the mean and standard deviation scores of the post-test in the areas of critical thinking, digital skills, and technological skills of the knowledge and practice dimensions of the participants across the three grade levels of four, five, and six. In the area of critical thinking (M=3.73, SD=0.27) in the knowledge dimension, it was observed that the grade four students have a higher mean score compared to the other grade levels. This also appears to be true in digital skills (M=3.64, SD=0.53). While in the area of technological skills (M=3.45, SD=0.52), the Grade 6 participants have higher mean scores compared to the Grades 4 and 5 participants. In the practice dimension, compared to Grades 5 and 6 participants, Grade 4 participants have higher mean scores in the three areas of critical thinking (M=3.70, SD=0.36), digital skills (M=3.58, SD=0.26), and technological skills (M=3.76, SD=0.31).

Table 4

Post-Test Descriptive Statistics

Post-Test of 21st-Century Skills	Grade 4	(n=11)	Grade 5	(n=10)	Grade 6	(n=19)
	M	SD	M	SD	M	SD
Knowledge Dimension						
Critical Thinking	3.73	0.27	3.40	0.29	3.42	0.32
Digital Skills	3.64	0.21	3.27	1.38	3.72	0.33
Technological Skills	3.36	0.53	2.67	0.52	3.45	0.52
Practice Dimension						
Critical Thinking	3.70	0.36	3.10	0.44	3.31	0.44
Digital Skills	3.58	0.26	2.77	0.50	3.45	0.33
Technological Skills	3.76	0.31	3.10	0.55	3.58	0.42

The data suggests that Grade 4 students consistently performed better than the Grade 5 and Grade 6 learners in both knowledge and practice dimensions across most areas, particularly in critical thinking and digital skills. This indicates that younger students may be more adaptable to new learning experiences, as evidenced by their active involvement in lessons during the intervention program. Grade 6 students, however, demonstrated stronger performance in technological skills within the knowledge dimension, suggesting that as students progress, they develop more specialized skills. The lower scores for Grade 5 students across most areas could reflect a transitional phase where students are adapting to more complex material, compounded by significant absenteeism among them during the conduct of the intervention program. Overall, the findings emphasize the need for customized educational strategies to support students at various stages of their learning journey, ensuring equitable access to digital technology and skills for all learners (Law et al., 2018).

Table 5 presents the results of the test of normality. Using Shapiro-Wilk Test, normality was established by its p-value. If the p-values are significant ($p<0.05$) it suggests that there is a deviation from normality. Majority of the results of the analysis showed that there are no deviations from normality except for Grade 6 pre and post-test digital and technological skills.

Table 5

Test of Normality Results for Practice (Shapiro-Wilk)

			W	p
G4 Pretest Critical Thinking	-	G4 Posttest Critical Thinking	0.963	0.803
G5 Pretest Critical Thinking	-	G5 Posttest Critical Thinking	0.950	0.672
G6 Pretest Critical Thinking	-	G6 Posttest Critical Thinking	0.922	0.126
G4 Pretest Digital Skills	-	G4 Posttest Digital Skills	0.934	0.457
G5 Pretest Digital Skills	-	G5 Posttest Digital Skills	0.913	0.302
G6 Pretest Digital Skills	-	G6 Posttest Digital Skills	0.852	0.007
G4 Pretest Technological Skills	-	G4 Posttest Technological Skills	0.868	0.073
G5 Pretest Technological Skills	-	G5 Posttest Technological Skills	0.882	0.137
G6 Pretest Technological Skills	-	G6 Posttest Technological Skills	0.807	0.001

Note. Significant results suggest a deviation from normality.

Table 6 shows the results of the analysis of the difference between the pre-test and post-test across grade levels of the practice dimensions using the Wilcoxon Signed-Rank Test. The results showed that there are significant differences between the pre-test and post-test scores of the grade four students in the areas of digital skills ($z=-2.934$, $p<0.05$) and technological skills ($z=-2.934$, p,0.05). It was also found that there is a significant difference in the pre-test and post-test scores of Grade 5 participants in the area of technological skills. The remaining areas across different grade levels showed no significant differences between the pre-test and post-test scores of the participants.

Table 6

Pre-test and Post-test Results for Practice using Wilcoxon Signed-Rank Test

Measure 1		Measure 2	W	z	p
G4 Pretest Critical Thinking	-	G4 Posttest Critical Thinking	6.000	-1.955	0.057
G5 Pretest Critical Thinking	-	G5 Posttest Critical Thinking	24.000	1.690	0.107
G6 Pretest Critical Thinking	-	G6 Posttest Critical Thinking	80.000	0.166	0.886
G4 Pretest Digital Skills	-	G4 Posttest Digital Skills	0.000	-2.934	0.004
G5 Pretest Digital Skills	-	G5 Posttest Digital Skills	15.000	-1.274	0.221
G4 Pretest Technological Skills	-	G4 Posttest Technological Skills	0.000	-2.934	0.004
G5 Pretest Technological Skills	-	G5 Posttest Technological Skills	0.000	-2.666	0.009

Note. Wilcoxon signed-rank test.

The significant improvements in digital and technological skills among Grade 4 students suggest that younger learners may be more receptive to interventions aimed at enhancing these skills. This aligns with the earlier observation that Grade 4 students are more adaptable to new learning experiences. The significant improvement in technological skills among Grade 5 students indicates that they can also benefit from targeted interventions, despite the overall lower performance observed in other areas. The lack of significant changes in critical thinking skills across all grade levels suggests that this area may require different or additional strategies to achieve measurable improvements.

These findings highlight the importance of designing and implementing customized educational strategies that cater to the specific needs and developmental stages of students. Interventions should be tailored to maximize the impact on different skill areas, ensuring that all students have equitable access to the resources and support they need to succeed. Addressing factors such as absenteeism, particularly among Grade 5 students, is also crucial to improving overall performance.

Table 7 compares the pre-test and post-test scores of the participants in digital skills and technological skills in the knowledge dimensions. Analyses showed that there is a significant difference between the pre-test and post-test scores of the Grade 6 learners in digital skills ($t=2.109$, $p<0.05$) while there is no significant difference between the pre-test and post-test scores of learners in technological skills.

Table 7

Paired T-test Results for Practice

Measure 1		Measure 2	t	df	p
G6 Pretest Digital Skills	-	G6 Posttest Digital Skills	2.109	18	0.049
G6 Pretest Technological Skills	-	G6 Posttest Technological Skills	2.056	18	0.055

The significant improvement in digital skills among Grade 6 learners indicates that the intervention program effectively enhanced their ability to navigate digital technologies. This suggests that Grade 6 learners are better equipped to handle the demands of the modern world, which requires proficiency in digital technologies and the ability to critically evaluate and utilize information. This aligns with the literature emphasizing the importance of digital literacy for participating in economic and social life and succeeding in the 21st-century environment. According to UNESCO, (2022), digital literacy involves the ability to safely and appropriately access, manage, understand, integrate, communicate, evaluate, and create information via digital devices and networked technologies.

However, no significant difference was observed in technological skills between the pre-test and post-test scores of the Grade 6 learners. This can be attributed to their prior exposure and practice with electronic devices. During the intervention program, it was noted that many Grade 6 students were already proficient in using computers, especially in basic computer operations and programs, which likely explains why the intervention program did not significantly impact their performance.

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Table 8 presents the results of the test of normality. Using Shapiro-Wilk Test, normality was established by its p-value. If the p-values are significant ($p<0.05$) it suggests that there is a deviation from normality. All pre-test and post-test measures across areas and grade level did not deviate from normality except for Grade 6 digital skills pre-test post-test.

Table 8

Test of Normality Results for Knowledge (Shapiro-Wilk)

Measure 1		Measure 2	W	p
G4 Pretest Critical Thinking	-	G4 Posttest Critical Thinking	0.970	0.882
G5 Pretest Critical Thinking	-	G5 Posttest Critical Thinking	0.898	0.210
G6 Pretest Critical Thinking	-	G6 Posttest Critical Thinking	0.951	0.417
G4 Pretest Digital Skills	-	G4 Posttest Digital Skills	0.933	0.438
G5 Pretest Digital Skills	-	G5 Posttest Digital Skills	0.908	0.269
G6 Pretest Digital Skills	-	G6 Posttest Digital Skills	0.803	0.001
G4 Pretest Technological Skills	-	G4 Posttest Technological Skills	0.920	0.318
G4 Pretest Technological Skills	-	G5 Posttest Technological Skills	0.956	0.742
G6 Pretest Technological Skills	-	G6 Posttest Technological Skills	0.925	0.142

Note. Significant results suggest a deviation from normality.

Table 9 shows the results of the analysis of the difference between the pre-test and post-test across grade levels of the knowledge dimensions using the Wilcoxon Signed-Rank Test. The results showed that there are significant differences between the pre-test and post-test measures of Grade 4 critical thinking ($z=-2.934$, $p<0.05$), digital skills ($z=-2.934$, $p<0.05$), and technological skills ($z=-2.934$, $p<0.05$). There is also a significant difference between the technological skills pre-test and post-test of Grade 5 participants. The remaining pre-test and post-test comparisons showed no significant differences.

Table 9

Results Pre-test and Post-test for Knowledge using Wilcoxon Signed-Rank Test

Measure 1		Measure 2	W	z	p
G4 Pretest Critical Thinking	-	G4 Posttest Critical Thinking	0.000	-2.934	0.004
G5 Pretest Critical Thinking	-	G5 Posttest Critical Thinking	10.500	-1.422	0.172
G6 Pretest Critical Thinking	-	G6 Posttest Critical Thinking	28.000	-1.223	0.233
G4 Pretest Digital Skills	-	G4 Posttest Digital Skills	0.000	-2.934	0.004
G5 Pretest Digital Skills	-	G5 Posttest Digital Skills	14.000	-1.376	0.184
G4 Pretest Technological Skills	-	G4 Posttest Technological Skills	0.000	-2.934	0.004
G5 Pretest Technological Skills	-	G5 Posttest Technological Skills	3.000	-2.497	0.014
G6 Pretest Technological Skills	-	G6 Posttest Technological Skills	43.000	-1.851	0.067

Note. Wilcoxon signed-rank test.

The significant differences in critical thinking, digital skills, and technological skills among Grade 4 students suggest that the intervention program was highly effective in enhancing these competencies. This aligns with literature emphasizing the importance of developing 21st-century skills, which include critical thinking, digital literacy, and technological literacy. According to the Global Partnership for Education (GPE, 2020), these skills are essential for quality education and are necessary for students to thrive in the modern world. The significant improvements in these areas indicate that younger students are highly receptive to interventions aimed at enhancing their knowledge and skills.

The significant improvement in technological skills among Grade 5 learners indicates that the intervention program effectively addressed this area. This improvement suggests that Grade 5 students developed the capacity to use digital tools effectively and responsibly, despite occasional absenteeism.

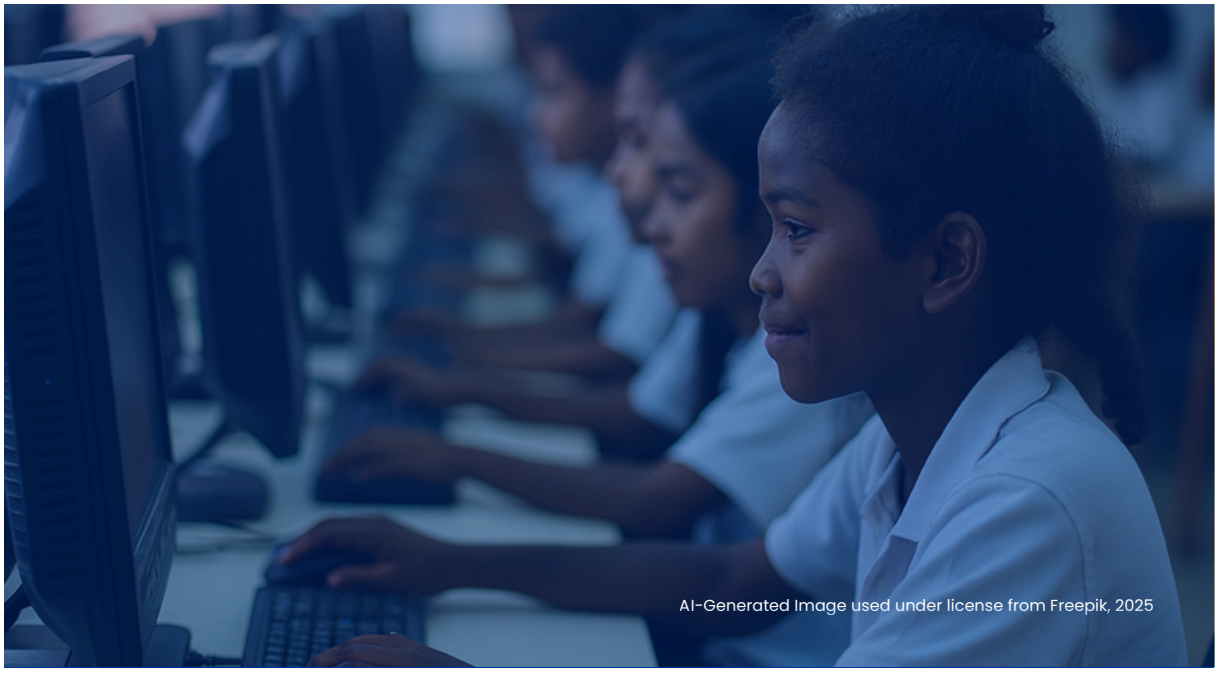
In summary, the significant improvements in critical thinking, digital skills, and technological skills among Grade 4 students, as well as the improvement in technological skills among Grade 5 students, highlight the effectiveness of targeted interventions in these areas. However, the lack of significant changes in other areas suggests that additional strategies may be needed to achieve measurable improvements across all competencies.

Table 10 shows that the paired t-test results indicate no significant difference between the pre-test and post-test scores of learners, suggesting that the intervention program did not lead to measurable improvements. This lack of significant change could be due to various factors, including the effectiveness of the intervention, the sensitivity of the assessment tools, learner engagement, duration of the intervention, and external influences such as the learning environment and support systems. To enhance future interventions, it is essential to reassess the program design, improve assessment tools, increase learner engagement, create a supportive environment, and establish continuous monitoring and evaluation processes. These steps will help ensure that educational interventions effectively address learners' needs and contribute to their overall development.

Table 10

Knowledge Paired T-test Results

Measure 1		Measure 2	t	df	p
G6 Pretest Digital Literacy	-	G6 Posttest Digital Literacy	1.023	18	0.320



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Challenges Encountered

The teachers shared the challenges and difficulties faced by Ayta Mag-Indi learners in acquiring and practicing 21st-century skills. The following issues emerged during focused group discussions with the teachers.

1. Limited Access to Digital Resources - One of the most significant challenges identified is the lack of access to digital and technological resources. The survey showed that learners scored very low in digital literacy and technological skills, especially in Grade 4. The FGD confirmed this, with teachers stating that most learners had never used a computer or laptop before the intervention. The school lacked a dedicated computer room, and learners had to rely on the few laptops provided for teachers. Additionally, the community had no internet shops or reliable connectivity, limiting opportunities for learners to engage with digital technology.

2. Low Reading Comprehension Affecting Critical Thinking - Teachers reported that many learners struggled with reading comprehension, affecting their critical thinking abilities. While learners could read, they often failed to understand and process the information, making it difficult to apply critical thinking skills in problem-solving tasks. The survey results supported this, as critical thinking had one of the lowest scores across grade levels. This aligns with research indicating that literacy is foundational to developing higher-order thinking skills (Kim, 2019).

3. Economic Constraints and Parental Support - The economic situation of the learners' families was another major barrier. Teachers noted that many learners did not own personal digital devices due to financial constraints, making it difficult to practice digital literacy skills outside the school. Additionally, while parental support for education had improved, there were still cases where parents prioritized livelihood over schooling, leading to absenteeism among learners, especially in Grade 5. This economic struggle directly impacts learners' ability to consistently engage in learning activities promoting 21st-century skills.

4. Lack of Structured Digital Literacy Training - Teachers highlighted that, before the intervention, learners had no structured exposure to digital literacy. This resulted in a lack of confidence and interest in using technology. However, post-intervention, learners showed increased engagement and willingness to explore digital tools. The teachers emphasized that sustained digital literacy programs are necessary to reinforce these skills, as sporadic exposure is not enough to build long-term competency (Li, Brar, & Roihan, 2021).

5. Cultural Perceptions and Identity Issues - Some learners struggle with self-perception and cultural identity, particularly in mainstream educational settings. The FGD revealed that some Ayta learners feared discrimination and felt uncomfortable in non-indigenous environments. This affected their confidence in communication and participation in broader educational and technological spaces. However, initiatives like celebrating Indigenous Peoples' Month and exposing learners to competitions and external engagements helped them gain more confidence and awareness of their rights as Indigenous students.

PART 4

Conclusions

Based on the findings, several conclusions can be drawn regarding the development of 21st-century skills among Ayta Mag-Indi learners:

The pre-test and post-test results indicate variability in skill development across different grade levels. Grade 4 learners showed significant improvement in critical thinking, digital skills, and technological skills, both in knowledge and practice dimensions. Grade 5 learners demonstrated notable progress in technological skills, while Grade 6 learners exhibited significant gains in digital skills. However, the higher standard deviation values in Grade 5 suggest greater variability in proficiency levels within the group, indicating inconsistent skill development. In contrast, Grade 6 learners showed more uniform skill levels, reflecting consistent demonstration of competencies.

The findings underscore the importance of practical exposure to technology in enhancing learners' understanding and development of digital and technological skills. The marked improvements among Grade 4 and Grade 5 learners suggest that hands-on activities and structured interventions play a vital role in building these competencies. Moreover, the integration of community and cultural practices into the intervention program added meaningful context, with learners producing creative outputs that reflected their heritage and values. This culturally responsive approach helped make learning more engaging and relevant to the learners' identities.

Finally, the qualitative findings reveal that Ayta Mag-Indi learners face significant challenges in developing 21st-century skills. These include limited access to digital tools, low reading comprehension, economic constraints, and issues related to cultural identity and discrimination. While interventions have sparked increased engagement and growing confidence among learners, these gains emphasize the importance of sustained, culturally sensitive support. Continued collaboration among schools, communities, and policymakers is essential to ensure that Indigenous learners are provided with equitable, inclusive, and empowering educational experiences.

PART 5

Recommendations

Based on the study's findings, the following recommendations can be made:

To effectively enhance learners' digital and technological skills, school administrators should work towards gradually increasing access to digital tools such as computers, tablets, and internet connectivity in schools. Community leaders can support these efforts by promoting community involvement and sourcing resources to improve the school's technological infrastructure. Alongside this, teachers must develop instructional strategies that cater to the specific developmental needs of each grade level. For instance, foundational digital literacy activities are appropriate for Grade 4 learners, while more advanced technological tasks suit higher grade levels.

Moreover, teachers should integrate community and cultural practices into the curriculum, encouraging learners to engage in projects that reflect their cultural values while using digital tools. This approach not only enriches learning but also deepens students' connection to their identity. In line with this, emphasizing practical, hands-on activities can further enhance learners' digital competence. Structured interventions that demonstrate real-world applications of technology can help students better understand and retain key skills.

In developing well-rounded digital learners, teachers should also prioritize strengthening critical thinking through lessons that challenge students to analyze, evaluate, and create. Reading comprehension and mathematics can serve as effective platforms for integrating higher-order thinking activities. Equally important is educating students about the ethical and responsible use of technology. Promoting digital citizenship ensures that learners not only acquire skills but also understand the importance of proper behavior in digital spaces.

Collaboration between school administrators, teachers, and the community is essential in this process. Engaging parents and other stakeholders can provide additional support and resources, making the learning experience more holistic and impactful. Finally, to inform and improve future practices, researchers should consider increasing the sample size of studies. A larger and more representative sample would enhance the reliability and validity of data, particularly in skill development research, thereby providing more robust insights for educational planning.

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