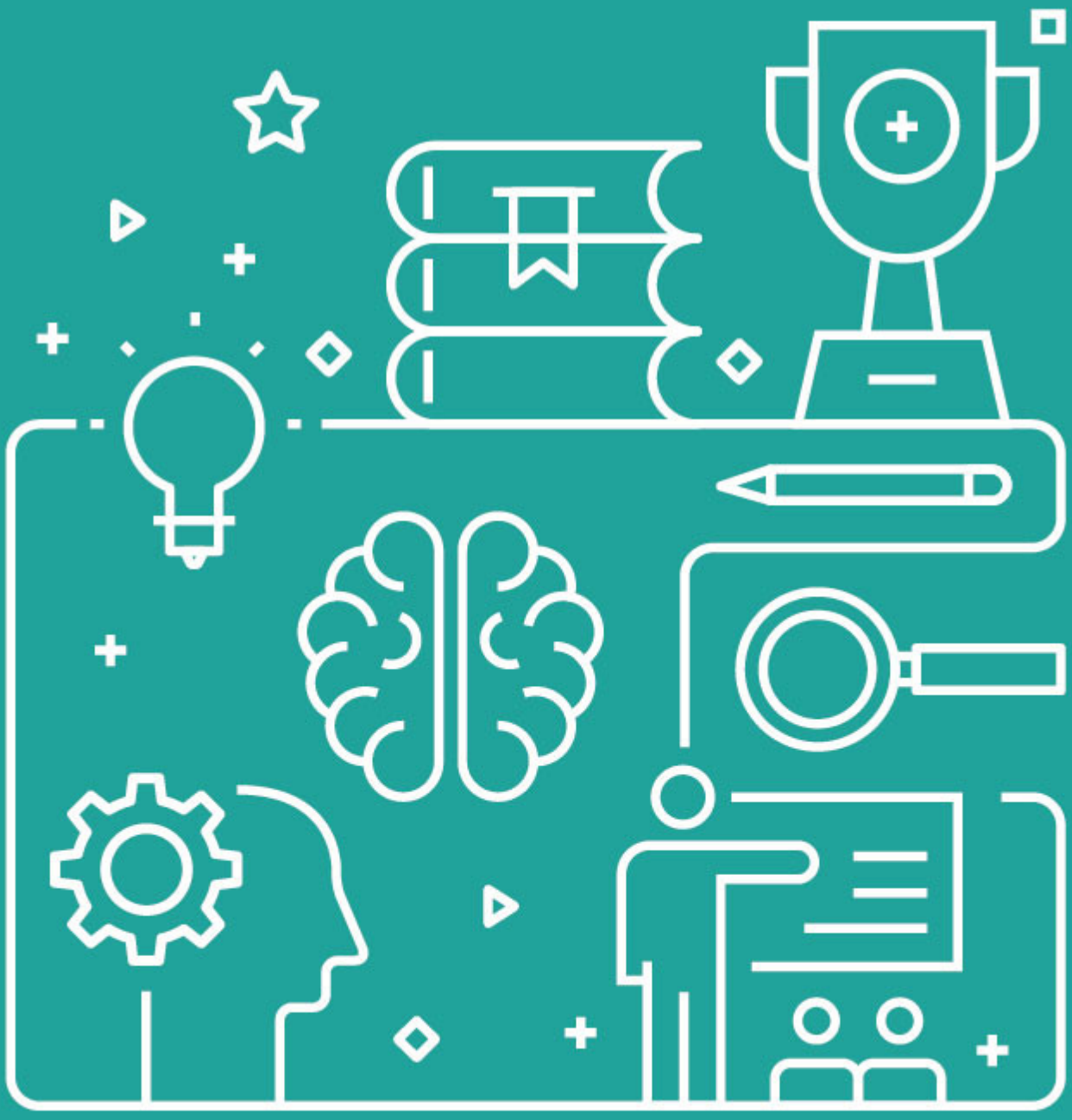
Mapping and analyzing national Learning Ecosystems for SDG4

The NetEdu Hub in Ghana



Report 3

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Report developed by the NetEduProject (PSITIC-Blanquerna, Ramon Llull University) international team, supported by UNESCO and Jacobs Foundation

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Gratitude

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The shared learning journey has been rich and complex, deeply impacted by the COVID 19 pandemic and post pandemic forces, but full of inspiration and meaning. It has been an honor to share this journey with a team of amazing human beings, extending our collaboration across more than 1000 thoughtful and committed educators and leaders from the five continents. They have all meaningfully enriched every single thought and piece of this Trilogy.

Executive Summary

The NetEdu Learning Ecosystem Tool emerges as a groundbreaking approach to reshape national education landscapes in alignment with Sustainable Development Goal (SDG) 4 objectives. This innovative tool operates as a "tool-as-process," designed to facilitate engagement and collaboration at multiple levels of the education system – from individual schools (micro) to districts and regions (meso), and up to national and potentially continental scales (macro). Its primary goal is to streamline the identification, connection, and utilization of diverse learning resources within a country.

Key to the tool's efficacy is its capacity to bridge communication gaps and dissolve silos within the educational sector, fostering improved access to learning resources and developmental opportunities. It not only visualizes the broader learning ecosystem but also promotes active communication, resource exchange, and collaboration among various stakeholders, thereby enhancing co-creative potential across different sectors.

The tool has proven to be a holistic and interoperable platform, enabling national education ministries and related bodies to effectively visualize and utilize all available learning resources within their contexts. It has been instrumental in fostering shared ownership and involvement in decision-making across diverse stakeholder groups, thereby reducing system-wide dissonances and misunderstandings.

A significant feature of the NetEdu tool is its support for an iterative process of information generation and reflection. This process facilitates deeper cycles of shared insight and understanding, which are critical for a mature learning ecosystem – one characterized by its adaptability to constant change.

Observations from the development and beta-phase trials indicate a strong demand for such tools at all system levels. The NetEdu tool has been effective in connecting data silos, generating interconnected maps, and building collaborative relationships. It has also proven instrumental in deepening shared purpose and co-creative capabilities within the learning ecosystem.

The tool's implementation in Ghana has generated considerable interest and shown potential for significant impact on the educational landscape. It supports the Ministry of Education in mapping stakeholders and understanding the complex interplay of relationships within the education system. This mapping is vital for developing and implementing strategies like the Education Sector Medium Term Development Plan for 2022-2025.

Further development of the tool is planned to include more ministries and departments, thus expanding its coverage and enhancing the understanding of the education ecosystem. The tool's design allows for ongoing evolution, integrating additional tools, data, and initiatives from various sectors to support the country's learning objectives.

In conclusion, the NetEdu Learning Ecosystem Tool offers a transformative approach for national education systems. It fosters a dynamic understanding of existing resources and potential growth areas, enabling stakeholders to connect and collaborate effectively. The tool's ongoing development and application promise to significantly contribute to the achievement of SDG 4 goals and the advancement of learning ecosystems globally.

Key Findings

1. **Holistic Integration Across Educational Levels**: The Learning Ecosystem Tool offers a unique "tool-as-process" solution that integrates learning resources at micro (school), meso (district/regional), and macro (national/continental) levels. This integration has positively supported stakeholders in identifying and connecting with key partners and resources, facilitating a more cohesive and efficient approach towards achieving SDG 4 goals.

2. **Enhanced Communication and Collaboration:** The tool has shown efficiency not just as a visualization of the broader learning ecosystem, but also has fostered communication and collaboration among stakeholders. It helps in breaking down silos and communication barriers within a country's learning landscape, promoting improved access to learning resources, coherence in learning interventions, and a strong sense of shared purpose

3. **Data-Driven Decision Making and Stakeholder Engagement:** The tool has provided a holistic and interoperable platform for collating and connecting data, enabling education ministries and associated bodies to visualize and utilize all available learning resources effectively. It also has enhanced shared ownership and involvement in decision-making across diverse stakeholder groups, thus harmonizing the educational ecosystem.

4. Recognition of the Tool's Necessity and Effectiveness: Throughout its development and beta-phase trialing, the tool has demonstrated its necessity where leaders and policy makers have been supported to start weaving the stakeholder social fabric towards SDG4. It effectively interconnects data silos and facilitates knowledge and resource transfer, building human relationships and fostering collaborative cultures.

5. **Expansion of Stakeholder Insight and Capacity:** The process enabled by the tool broadens stakeholders' understanding of their existing resources within their ecosystems, enhancing their sense of capacity, agency, and motivation. This expansion of insight is crucial for stakeholders to realize and activate national plans for achieving educational goals.

1. Introduction

> "Systems don't get 'solved'. At best, we hope to shift systems to a healthier state. Systems don't just need things fixed. They need the healing of relationships, historic inequities, destructive patterns, and the environment. Systems are infinite. There is no finish line that can be crossed in days, or even in a few years. Maintaining healthy systems is an ongoing task. Damage can be done when we try to 'fix' what needs to be healed or think we can solve that which is unsolvable. Rather, we must apply the appropriate approach to the type of problem being addressed."
>
> *— Rob Ricigliano, 2021*

To change course, transform and reimagine our futures, we need urgent and collective action, especially in our educational systems, which have shown critical dysfunctionalities around issues of inclusive and holistic learning, particularly noticeable during the COVID-19 pandemic (UNESCO, 2022; OECD, 2020). Many research reports such as those by UNESCO (2022), OECD (2017), Economist Impact (2022), and WISE (2021) are indicating that schools and other learning stakeholders can't be isolated and alone in addressing learning challenges, and that there is a need for further collaboration between local and global stakeholders within the system to enable greater inclusion, equity and personalized learning.

The global focus on the achievement of SDG 4 -to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all-, becomes a crucial opportunity to positively and progressively evolve our educational systems' design and implementation strategies across countries. However, it also poses major challenges that will require deep, structural and organizational changes across all sectors in society to effectively address. SDG 4 stakeholders and outcomes are interdependent, with complex coupling between human, technical and natural systems (Hanushek & Woessmann, 2012; Bengtsson, Barakat & Muttarak, 2018). The explicit interconnection of goals and targets demands deepening and more effective relational capacities between the actors involved to allow them to respond to the complex challenges nested in SDG4 goals.

SDG4 requires that we start to understand our educational system as an open, interconnected, dynamic, and systemic ecosystem of learning. The recent publication of The Learning Ecosystems Framework by The Economist Impact (2022) highlights the opportunities offered by a Learning Ecosystem approach, and the progress made by actors who have embraced this approach in various regions around the globe, concluding that well-functioning learning ecosystems are crucial to ensure holistic learning and wellbeing for children and young people. According to WISE (2019), which studied the Learning ecosystem approach through an examination of a variety of entities already in existence, this approach is one which allows for the effective connection and activation of the multiple and diverse stakeholders, resources and other elements entailed in providing education directly to learners. Learning ecosystems thus are composed of open and evolving communities of diverse providers -such as schools, businesses, community organizations as well as government agencies, among others-, that cater to a wide and holistic variety of learner needs in a given context or area.

In terms of this report, Learning Ecosystems become much more than isolated innovative practices or convenors of intersectoral collaboration, but entail a major shift of perspective and shared understanding of our whole educational system and the approach taken to learning. We make the case that we already live in organic, contextualized and changing Learning Ecosystems, with multiple resources available to us that exist outside of our organizational borders - even if these are not yet fully recognised or optimized-. Our awareness of these resources are constrained by our habitual understanding of "how learning happens", and "what comprises education". What we lack is an ecosystemic approach that allows educational leaders across the system to visualize and integrate all available SDG4 stakeholders and existing resources, and properly leverage the systemic and collaborative potential of the wider ecosystem. Thus, the learning ecosystem model provides a holistic and evolutionary approach for existing educational systems around the globe that challenges our individual and collective learning beliefs, organizational cultures, professional mindsets, expectations and practices. Some reports outline the barriers to the emergence and uptake of this perspective, noting that the Learning Ecosystems approach is quite a new perspective, arguing that we need further research to better understand implications and outcomes of this approach. Nevertheless, this concept offers a major change in understanding that is challenging the traditional approach of a school centered-system.

Evidence (Economist Impact, 2022; U.S Surgeon General, 2023; Díaz-Gibson et al., 2020; Daly & Liou, 2018; among others), including the data gathered from this Trilogy, demonstrates an urgent need for new methods and tools that support education leaders to design and weave their local and national learning ecosystems in a synergistic way to enhance learning and flourishing of all students and wider community. The present report describes the initial results of a global project aiming to design a digital tool to support government leaders and policymakers to map and analyze the extensive learning resources available to them, and to weave together National Learning Ecosystems for SDG4.

LE Trilogy III. SDG4 Ecosystems Tool

The Learning Ecosystem Tool has been developed by the NetEduProject (Blanquerna, Ramon Llull University) in collaboration with DXtera Institute, T-Tel Ghana, UNESCO Ghana and the Ministry of Education in Ghana. The tool has been primarily commissioned and supported by UNESCO and will be built in the context of the Global Education Coalition, aimed at achieving a resilient and sustainable recovery from the pandemic.

The present report intends to offer opportunities for engaging with a learning ecosystem approach, and address the lack of guidelines and tools that government leaders and policy makers have to design learning ecosystems at a national level. With this purpose, the research-action processes undertaken aimed to design an initial conceptual framework and procedures to assist national education leaders to visualise, articulate, and bring to awareness the available resources that already exist within their educational landscape -stakeholders, relationships, resources, programs etc.- , to better organize and understand their learning ecosystems, and to find pathways for holistic improvement allowing for a greater level of SDG4 achievement. The report describes the prototyping process of the tool as used in Ghana for stakeholder mapping and project engagement. It makes a case for the way in which national leaders, working with a wide and diverse variety of professionals and local leaders who have a significant role in education and technology, can contribute to these efforts.

The research action process was carried out in two stages. The first stage entailed the design of the tool concept. To do this, we conducted an initial literature review, a collection and comparison of current stakeholder mapping tools, and an analysis of the learning and experiences of professionals involved in high-performing learning ecosystem practices. Once the conceptual framework for the tool had been developed, the second stage entailed the design of an initial prototype of the tool. We applied and tested the first prototype of the tool in Ghana, piloting the process through active engagement with the dynamics and interactions with learning stakeholders from 4 different regions and 2 districts. Through the application of a human-centered design approach, the tool process and approach was informed and strengthened through those user interactions.

As we enter into the third stage of development, the tool design is now presented and offered as a locally contextualisable digital platform for national education agencies to gather, map and analyze learning ecosystem data over time to enhance SDG4 achievement in Ghana. Such a mapping process is dynamic and ongoing, and requires a platform that allows for ongoing user interaction and engagement. We should clarify here that when we speak of a “Learning Ecosystem Tool”, we are referring to “tool as process”, rather than merely “tool as diagnostic approach”. To understand this better, a Vygotskian interpretation is necessary, alongside an understanding that such a tool facilitates both the “being and becoming” aspects of a system (Holtzman, L. 2018).

This approach asks for us to expand our definition and concept of "tool" beyond a mechanistic, inflexible, and externally mediated approach, and to rather understand it, in this context, as offering a way for system participants to visualise and interpret an ongoing, emergent and living developmental process. In this sense, the "Learning Ecosystem Tool" includes approaches for defining, articulating, visualising and connecting stakeholders within a country's learning system, methodologies for engaging, connecting and facilitating access and the flow of information between them, and processes for convening and deepening trust and relationship between them. The Learning Ecosystem Tool is thus capable of adaptation and emergence alongside the learning ecosystem which it is supporting, and becomes a facilitator of growth and evolution for the system. Its approach is agrarian (alive) rather than mechanical (static).

1.1 SDG4 as an opportunity to weave new synergies in our educational systems

We undoubtedly live in very challenging times in which humanity and the planet Earth are under threat. Some of the complex challenges we face include: severe climate change and decarbonization of our planet; the backsliding in democratic governance at a global level and a rise in identity-driven populist sentiment; widening social inequities; equity and gender parity issues; worldwide internet accessibility issues, digitization and the development of diverse digital environments; the challenge of creating decent human-centered work in an age of Artificial Intelligence; urbanization, migration and globalization and increasing longevity. These threats are already influencing learning and educational priorities and are accelerating the necessity for the re-imagination and transformation of education. The UNESCO report: A new social contract for education. Reimagining our futures together (2022), highlights that the COVID-19 pandemic has served to prove both our fragility and our interconnectedness, and urgent action, taken together, is needed to change course for humanity and the planet, and to reimagine our futures. However, the need for a transformation of our educational systems takes place in the context of economic uncertainty and an upcoming period of global budget austerity in educational expenditure (OECD, 2020).

These challenges directly affect the way we approach and support our educational systems across nations and regions, and at the same time challenge our existing, rigid, underfunded and consolidated school-centered system, which has shown critical dysfunctionalities during the COVID-19 pandemic (UNESCO, 2022; OECD, 2020). Many developing countries still lack basic infrastructure and facilities to provide effective learning environments. An estimated 617 million, more than 50 per cent, of children and adolescents of primary and lower secondary school age worldwide are not achieving minimum proficiency levels in reading and mathematics (UNESCO, 2018).

Despite this, our industrial and standardized educational systems generally remain based on unidirectional and transmissive learning and academic achievement, emphasizing lecturing and memorization and consequently, developing passive and disengaged learners (Global Education Futures, 2020 UNESCO, 2014; Clayton, 2016). At the same time, current forms of educational assessment are grounded on standardized and comparable testing approaches with narrow measures, reducing learning pathways through their standardization of experiences, tasks, and time conventions around learning and education (The Aspen Institute, 2014). In response to this experience, Mehta (2020) has shared thoughts around the need for humanizing our schools and educational systems to become more caring and inclusive, concluding that the pandemic highlighted a negative experience and image of our schools where learners experience low rates of wellbeing, and teacher feet undervalued, unfulfilled and underpaid.

Therefore, there is clear evidence that our global school-centered systems are overwhelmed and a high percentage of teachers are burnt out (OECD, 2013; Varkey Foundation, 2018). The ways in which our our educational systems function contributes to enhancing the social pressure on schools and teachers, causing them to struggle to meet the complex expectations projected beyond literacy and numeracy, to address a wide diversity of competences such as critical thinking, emotional intelligence, positive parenting, healthy eating, poverty, bullying, refugee inclusion, physical and moral education, sex education, climate change, response and recovery from the pandemic, and so on. Many research reports such as those by UNESCO (2022), OECD (2017) indicate that schools and other learning stakeholders should not be isolated and alone in addressing learning challenges, and need further collaboration between local and global stakeholders within the system to be successful. Hence, there is a crucial demand within societies and educational systems for strengthened partnerships to connect diverse stakeholders from different sectors and disciplines around shared purpose and practices, and for the provision of quality education and lifelong learning. This will require transitioning from a school-centered system to a learner-centered ecosystem (Menashi, 2016; Díaz-Gibson et al, 2017; Díaz-Gibson, Civís and Comas, 2022; UNESCO, 2020; Ridge and Kippels, 2019; Zancajo e al 2021). Thus, we need a shift in our collective focus and policies that will allow us to decentralize our learning and educational systems, advancing towards public-private partnerships and enabling us to visualize an extended ecosystem of stakeholders and professionals working with children and adolescents, with the collective purpose of enhancing learning and wellbeing opportunities for all.

Studies conducted before, during and after the pandemic tell us that developing greater interconnection of our learning systems is not an easy endeavor (UNESCO, 2021; Osher, et al., 2020; Darling-Hammond et al., 2019; Bartko et al., 2021; OECD, 2021; UNICEF, 2021; Díaz-Gibson, et al, 2020; WISE, 2022; UNESCO, 2022). This holistic data illustrates how our educational systems are showing a lack of connectivity, effective stakeholder relationships and continuity between the diverse parts of the learning system such as formal and informal education; public and private education; physical and virtual; kindergarten, primary, secondary and post-secondary stages; school and community; students and school; families and school, teachers and researchers; hard and soft skills; education and learning, among others. In sum, our educational systems worldwide have been shown to be fragmented, drastically reducing our collective capacities to change and evolve as a synergistic whole to enhance learning and wellbeing outcomes.

The UNESCO (2020) publication "Education in a Post-COVID World: Nine Ideas for Public Action'' indicates the need for greater collaboration between schools and other learning stakeholders to enhance innovation and resilience, alongside the challenge of better connection with technological stakeholders in order to facilitate wide availability and access to open source online resources, so as to enhance learning for all. Moreover, the need for connection across multiple sectors that influence learner's wellbeing, health and access is required. According to the Asian Development Bank, "When children's sanitation needs are met, the benefits to human capital encompass not only better health and nutrition but also higher enrolment and lower gender gaps in school participation". Thus the interconnection between fields and stakeholders that are connected to learning becomes essential to facilitate learning and wellbeing in our times.

The UNESCO 2030 Agenda for Sustainable Development is global, holistic and indivisible, with a special focus to "leave no one behind". The commitments made in this agenda offer a crucial opportunity to regenerate and weave our learning and educational systems. Education and the achievement of SDG 4 -to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all- plays a central role in building sustainable, inclusive and resilient societies. As the UNESCO guide for SDG4 states, 'Education in the 2030 Agenda for Sustainable Development' is not restricted to SDG4, but is also linked to almost all of the other SDGs in one way or another. Thus, while SDG4 expresses the educational imperative, learning goals are closely interconnected to other Sustainable Goals identified as education-related targets or indicators that include health and well-being (Target 3.7), gender equality (Target 5.6), decent work (Target 8.6), responsible consumption and growth (Target 12.8), and climate change mitigation (Target 13.3). In sum, education builds human capital, which in turn promotes economic growth, the elimination of extreme poverty, decent work, and overcoming gender and other inequalities (Hanushek & Woessmann, 2012; Bengtsson, Barakat & Muttarak, 2018).

Despite this awareness, the available studies do not emphasize how the implementation of the SDGs in general, and SDG4 specifically, should be organized. Several authors have shown that SDG outcomes are interdependent, with complex coupling between human, technical and natural systems. In this sense, the explicit interconnection of goals and targets demand development of strong relational capacities to respond to complex challenges, as shared in the beginning of this report. Sachs et. al (2019) argues that in order to be effective in the development and achievement of SDG4, transformation will require integrated design and implementation of interventions through close coordination between ministries of education, science and technology, and social affairs, or their equivalents. Some relevant changes mentioned in Sachs et. al (2019) refer to complementary strategies necessary for expanding and transforming educational systems -such as investing in Early Childhood, Primary, Secondary and Tertiary education, as well as Vocational Training, improving teacher training, curriculum development and continuous evaluation of learning outcomes-; and expanding social safety networks and implementinganti-discrimination measures and improved labor standards. Other similarly nested strategies mention the strategic adoption of new technologies that can be accelerated through tertiary education, national science funding mechanisms and science advisory bodies, innovation hubs, and the promotion of entrepreneurship through public–private financing mechanisms and incubators.

Thus, SDG4 becomes a crucial opportunity to evolve design and implementation strategies for our learning ecosystems, but also presents some major challenges that will require deep, structural and organizational changes across all sectors in society. It poses critical questions around the nature of strategies and organization needed to achieve the interconnected SDGs. The present report assumes that learning ecosystems will become a prominent approach for new cross-system organization, and that deepening in its evolutionary nature can support leaders and policymakers to respond to complex challenges as SDG4. **As a departure point in our understanding of this project, we propose that learning ecosystems are not a new and novel approach, comprising a select group of innovative practices found only in certain regions of the world. In contrast, we believe we all already live and learn in contextualized learning ecosystems that offer diverse learning opportunities that can emerge from different places, institutions, people, communities and other areas in our daily lives, but that in many (most) instances these are not fully or effectively activated, visualised, or perceived. Thus, engaging with a learning ecosystems model becomes a new approach to understanding educational systems that allows and facilitates their evolution through the conscious attention paid to specific conditions and dynamics at play within the system, generating expanding access and opportunities for people to learn.** What distinguishes the learning ecosystem approach is a focus on evolutionary process, meaning the progressive development through intentional facilitation of the quality and scope of relational dynamics between the diverse learning stakeholders that influence learning. Through such an approach, collaboration and shared purpose and understanding, becomes an essential driver of new learning opportunities for all.

The recent publication of The Learning Ecosystems Framework by The Economist Impact (2022), sponsored by the Jacobs Foundation, highlights the opportunities offered by a Learning Ecosystem approach, and the progress made by various regions around the globe, concluding that learning ecosystems are crucial to ensure holistic learning and wellbeing for children and young people. It notes that Learning Ecosystems have become much more than emergent isolated practices of intersectoral collaboration, but offer a relevant shift of perspective that challenges the extensive current shared understanding of our global educational systems and approach to learning. Thus, Learning Ecosystems offer an alternative systemic, holistic and evolutionary approach to our existing educational systems around the globe which challenges current individual and collective learning beliefs, organizational cultures, professional mindsets, expectations and practices (NetEdu, 2022). The Economist Impact (2022) goes on to underline some of the barriers to the emergence and uptake of this perspective. Key amongst these challenges are: Firstly, because of the novelty of the approach there is a lack of evidence around the assumption that effective learning ecosystem development will correlate with improved learning outcomes; Secondly, there is an absence/ dearth of approaches, data, and defining metrics allowing us to visualize, prioritize, track, understand, and reflect on how ecosystems evolve and operate to potentially increase our learning goals; and Thirdly, there are high levels of habituation and inertia amongst education decision makers and practitioners in moving away from the traditional, relatively hierarchical, siloed education models which we have inherited.

1.2 Mapping Learning Ecosystems for SDG4

Studies carried out in recent years suggest that creating strong and effective learning ecosystems in our regions, cities, communities, and schools has become one of the most significant global challenges and opportunities for our systems. However, the complex and promisingly fertile idea of Learning Ecosystems for SDG4 - enabling lifelong, lifewide and lifedeep learning and increasing access and equity in education-, is still in a process of development and is evolving into different research and practice paths (Díaz-Gibson et al, 2020). Nevertheless, the evolution of these concepts, practices and research pathways has yielded positive learning and social outcomes, together with an increased awareness of the presence of strong resistances to collaboration, system rigidness and fragmentation, and other forces that inhibit deep change and development (Mehta, 2020).

According to Global Education Futures' report (2020), Learning Ecosystems are emerging worldwide as an interdisciplinary response to the increasing complexity of the 21st century, and at a time when humanity is changing the very trajectory of evolution on Earth, and needing to reckon with our choices to date as a species. In this report, Lucksha et al. (2020) define learning ecosystems as intentional webs of relational learning which are dynamic, evolving, and enable greater diversity in fostering lifelong learning opportunities. The purpose of intentionally activating and evolving learning ecosystems is to offer pathways for learners to actively co-create flourishing futures for people, places and our planet. The WISE Living Lab Playbook: Designing Learning Ecosystems (2022) reflects that a number entities embracing this approach are already in existence, providing education and learning directly to learners, and comprising open and evolving communities of diverse providers that cater to the variety of learner needs in a given context or area. These existing systems are at a variety of different stages in their levels of efficacy, connection and growth, and are usually supported by an innovative credentialing system or technology that replaces or augments the traditional linear system of examinations and graduation.

Additionally, research shows that enhanced school-community and/or district collaboration between interdisciplinary stakeholders is correlated with multiple positive outcomes such as systems innovation, innovative climates in schools and communities, greater achievement in Socio-economically disadvantaged areas, enhanced parent involvement in child learning, greater levels of social capital and trust development, and increased personalized learning and learner participation in school and community governance (Díaz-Gibson et. al, 2020; Azorín and Harris, 2020; ; Luksha et. al, 2020;Henderson et al, 2022, Longás et al, 2019, among others). Furthermore, the global COVID-19 pandemic with the resulting long term lockdowns, and the experience of schools' reopening worldwide has increased the need for stakeholder dialogue and collaboration across multiple sectors and disciplines - such as education, technologies, health, social services, culture, media and so on- and stakeholder groupings -public, private and civil society-, to effectively respond to the complex social challenges that are increasingly impacting on the progress towards SDG4, and which have been highlighted by the pandemic (UNESCO, 2021).

The Learning Ecosystem approach is under construction globally, and is grounded in diverse evidences, experiences and reports, such as United Nation's Transforming Education Summit in September 2022, the work of UNESCO's International Commission on the Futures of Education, and the recent World Innovation Summit in Education special publication Education Reimagined: Leadership for Transformation (presented at the UN in September of 2022), the OECD Handbook for Learning Innovative Environments; World Innovation Summit in Education Learning Ecosystems Playbook; The Learning Ecosystems Framework from the Impact Economist and Jacobs Foundation. It is perceived that learning ecosystems are able to more effectively support the meaningful exchange of ideas and resources, and to facilitate collaboration and shared learning. Thus, local and regional Learning Ecosystem models have been rapidly emerging over the past two decades and have shown remarkable resilience and depth in terms of their ability to deliver on the compelling educational needs for current times. Some examples of such models may be found in Remake Learning, the PAL Network, Dream a Dream, Education Reimagined, RELI, Teach for All, Africa Voices Dialogue, MIET Africa's Care & Support for Teaching and Learning, Fundacion Educacional, among many others.

According to the WISE Living Lab Playbook: Designing Learning Ecosystems (2022), there are already many such existing systems that provide education and learning directly to learners. These systems are made up of open and continually evolving communities of diverse providers that cater to the various needs of learners in a particular context or area. These existing systems may differ in terms of their effectiveness, connection, and development and typically include an innovative credentialing system or technology that supplements or replaces the traditional linear system of exams and graduation. Similarly, the report "A Learning Ecosystem Framework" (Economist Impact, 2022) defines learning ecosystems as 'a diverse, collaborative, and dynamic network of stakeholders that enables greater access to a range of learning opportunities and helps young people attain positive learning and wellbeing outcomes'. In order to transition successfully from the current education system into a more resilient, connected and effective one, we must first create spaces where people can come together and heal harmful divisions within our society, transition from memorization and certification tests to learning within life, through life, and for life, and pivot from the traditional approach to learning, which is based on formal education and ends when one graduates from school, to a lifelong process of learning that begins at birth and lasts throughout a person's life. This approach includes and acknowledges learning that takes place in informal settings, and in multiple lived experiences, as opposed to only those taking place in schools or other educational institutions.

To start initiating this transition and move from complex issues to complex responses, regional leaders and policy makers need to come together to visualize the extensive network of stakeholders and practices that are already in place, beyond the traditional educational system and traditional actors, and start documenting who and what is already impacting SDG4 achievement within a specific context. The process of mapping stakeholders and their connections is a crucial step towards comprehending the complex dynamics of an ecosystem. This understanding can have a significant impact on communication, collaboration, and decision-making, leading to improved outcomes. A visualization tool that allows for the mapping of stakeholders and their connections can provide individuals and organizations with a better understanding of the relationships between various stakeholders in an ecosystem (Bourne and Walker, 2006). This knowledge can be also used to identify potential allies, partners, synergistic areas, overlaps and areas of conflict (Taylor and Logo, 2008).

By mapping stakeholders and their connections, and importantly, through enabling new conversations, leaders can gain new knowledge about their systems and the potential that they hold, identifying key actors in an ecosystem who hold significant power or influence, yet fall outside the traditional formal structures of the current education system. This information can be leveraged to optimize the allocation of efforts or resources towards specific objectives. Furthermore, it can facilitate the identification of communication pathways between distinct entities within an ecosystem, enhancing cooperation and communication between stakeholders, resulting in superior outcomes (Learning Economy Foundation, 2021). Ecosystem mapping can also reveal deficiencies and gaps within the ecosystem, such as absent participants or links. This systemic understanding of the context can assist in identifying pivotal decision-makers within the ecosystem, enabling the facilitation of decision-making and ensuring the involvement of critical stakeholders throughout the process (Bourne and Walker, 2005; Mitchell et al, 1997). Lastly, by evaluating the impact of specific actions or decisions on diverse stakeholders, ecosystem mapping can contribute to informing future decision-making processes.

In addition, ecosystem mapping can be utilized to bridge the gap between employers and educators. By sharing industry requirements and needs with educators, employers can play a role in ensuring that appropriate learning opportunities are generated to meet these needs, and can simultaneously gain a better understanding of the future workforce and adopt a more holistic approach to skills development. This connection can be created through ecosystem mapping, ultimately leading to improved outcomes for all stakeholders involved (Learning Economy Foundation, 2021). Unless we take a more comprehensive approach to data collection and analysis, and improve our capacity to effectively engage and make informed decisions with this, we will continue to measure only what is easily observable—and thereby perpetuating systems that are less than effective (Economist impact, 2022).

2. Research Methods

The objective of this research-action process is to establish a comprehensive framework that links the novel tools and relational processes currently emerging and being tested globally, and to co-design a Learning Ecosystem Online Diagnostic Tool prototype, in order to support government leaders and policymakers in weaving learning and digital Ecosystems, alongside and in partnership with the other actors in the system. The Learning Ecosystem Tool's approach is grounded within a comprehensive research and design process conducted by the NetEdu team between September 2021 and January 2022. This process was divided in two stages, aimed at achieving four main objectives.

The first stage was to design and articulate the conceptual framing for the tool.

- Objective 1 was to develop a directory of existing resources and tools for learning ecosystem evaluation through a documentary and literary analysis.
- Objective 2 was to identify the needs and aspirations of already functioning learning ecosystems from the perspective of international experts.

With this data, the team proceeded to design a conceptual tool, to be used initially as an offline tool and prototyped in Ghana. Stage two focussed on the design of a prototype digital tool.

- Objective 3 was to test the initial prototype and gather data to map the Ghanaian ecosystem and co-construct the tool, together with learning stakeholders in 4 Ghanaian regions and 2 different districts.
- Finally, Objective 4 was to design the prototype of the digital tool. This prototype aims to lay the foundation for the future ecosystem tool implementation and development.

By achieving these four objectives, the NetEdu team was able to design and develop a prototype for a tool to support National Agencies to monitor and facilitate the growth and evolution of learning ecosystems in multiple different contexts around the world. In short, the tool aims to motivate and assist decision makers and leaders at the national level in building purposeful and enduring connections for regional learning ecosystems through purpose-driven network weaving, resulting in a positive and lasting impact on learning experiences and outcomes.

The application of cross-sectional study uses qualitative methodologies, allowing for the emergence of more valuable results for the purposes of a developmental approach and process. This is because it allows for the development of concrete procedures to analyze data as well as explain issues observed, that cannot be achieved by means of quantitative investigation alone (Pérez, 1994; Latorre et al., 2005). In order to best achieve our research goals of iterative design and large-scale implementation of the Learning Ecosystems tool, we utilized a Design-Based Research (DBR) approach. This methodological approach emphasizes ongoing analysis, design, development, and implementation of educational practices in real-world settings. Through our research, we have found that involving users in the design process and prioritizing their concerns is essential for designing sustainable tools and contextualized processes. This approach, known as participatory design, has become increasingly recognized in the field.

As described, the study was developed in two stages:

2.1 Stage 1

In order to ground the Learning Ecosystem Tool's approach, develop the conceptual framework for the tool and accomplish the first aim of developing an offline tool to support a real-world design and development process, the NetEdu team conducted a comprehensive research and design process between September 2021 and January 2022. The first objective was to elaborate a learning ecosystem mapping tool directory. The team identified and assessed a variety of the existing resources and tools available in the public domain for learning ecosystem evaluation through a documentary analysis to elaborate an initial directory.

In parallel, and to respond to the second objective of identifying the needs and aspirations of already functioning learning ecosystems from the perspective of international experts, two global workshops were held, each one consisting of six focus groups, with a total of 59 participants from government, private sector, and civil society learning stakeholders who were actively involved in learning ecosystems at that moment. The purpose of the two workshops and subsequent focus groups was firstly, to explore the necessity and key elements required for a national learning ecosystem approach to improve education access, equity, and learning outcomes, as well as to understand the role of technology and digital ecosystems in this approach. Secondly, participants discussed the key elements and conditions that they perceived as necessary to allow national learning ecosystems to thrive.

These workshops provided a valuable opportunity to gather input, helping to inform the development of the tool. Focus groups were recorded following the presentation guide for qualitative data treatment. Based on the results of the stage 1 learnings, we designed a Learning Ecosystem Mapping and Analysis Tool Playbook as an initial offline prototype to be further discussed and developed in phase 2, in partnership with regional leaders in Ghana, Ghanaian learning stakeholders and our tech development partners.

2.2 Stage 2

In developing our third objective (to test the initial prototype and gather data to map the Ghanaian ecosystem and co-construct the tool), a series of six broadly representative education sector consultations were held in Ghana from March 2022 to June 2022. These consultations were, from the outset, led by local leaders from T-Tel Ghana and members of the NetEdu team, in partnership with UNESCO Ghana and the Ministry of Education in Ghana.

The 6 consultations engaged with a total of 187 stakeholders from four selected regions and two selected districts, and were aimed at initiating the mapping of stakeholders who were contributing in various ways to the education system. The consultation process in each region and district was designed to create a visual representation of the existing and potential involvement of diverse stakeholders from multiple sectors and disciplines beyond the traditional educational system. A mixed methods approach was used to enhance stakeholders' participation and understanding. The methods used included: presentations on the Learning Ecosystem concept and tool prototype; general plenary and discussions among stakeholders; and group work with participants based on their backgrounds, in which they were supported in choosing SDG4 indicators and to brainstorm and work on initiatives to achieve SDG4 in their own contexts.The groups did initial mapping of their regional learning stakeholders, and discussed existing connections and the potential for greater involvement in shared work and synergies. After this, a plenary presentation allowed for participants to share their maps and get feedback from other group members, merging their findings in order to complete a hands-on group mapping exercise. Participants worked with the offline tool prototype to fill in key information from the group mapping activity they participated in. The plenary session and focus group sessions were recorded following the presentation guide for qualitative data treatment. The discussions which followed served to evaluate and improve the offline tool prototype and pilot a process of mapping and analyzing the ecosystem, so as to inform the future digital design of the tool concept.

3. Results

With regard to **objective one**, the investigation of existing resources and tools for mapping learning ecosystems enabled us to differentiate between three types of resources which are currently available for leaders to map and understand learning ecosystems: tools, methods and processes. Consequently, a directory of learning and digital ecosystem mapping resources was designed which covered each of these three types of resources. The directory offers an initial curated selection of learning ecosystem mapping tools with a variety of approaches for improving education and community development outcomes, providing decision-makers with data and knowledge to strengthen policies and institutions, visualizing complex data, and promoting collaborative learning and innovation.

While tools are technically helpful in making our living ecosystems visible, they alone are insufficient in facilitating ongoing engagement, understanding, insight, and the capacity for evolution required for a collective to function effectively over time. To achieve this, any tools used need to be situated within a conscious and intentional process that allows for the development and evolution of our visualization and understanding, alongside the changing dynamics of the ecosystem. For this reason, we have adopted a “Tool as Process” approach, in which the use of the learning ecosystem tool is experienced as facilitating both the “being and becoming” aspects of a system. Not only does it assist users in seeing what is already present, but it suggests opportunities for further development and connection, and facilitates the processes which may enable emergence of the next stage of the learning ecosystem to take place.

Table 1: Summary of the Directory of Learning and Digital Ecosystem Mapping Resources.

(open source or known in the public domain)

Name	Approach	Directionality	Ownership	Outcome	Country / Geographic Context	Inputs from	Scope of mapping
World Bank Education Ecosystem Mapper	SABER is an initiative to produce comparative data and knowledge on education policies and institutions, with the aim of helping countries systematically strengthen their education systems and the ultimate goal of promoting Learning for All. It allows countries to conduct a thorough inventory of their education policies and institutions based on global best practices, as well as provides decision makers and stakeholders at all levels with tools for structured and effective policy dialogue.	Supporting Government decision making	World Bank + Country level	Applied in over 100 countries to assess and benchmark education systems against global best practices, a fundamental step toward meaningful reforms. SABER initially focused on assessing how well a country's education policies and institutions aligned with its education goals, and benchmarked these policies against global evidence of what works to improve learning. Later SABER began developing a framework for measuring and analysing service delivery at the school level, providing a much-needed feedback loop to help countries hone their policies and institutions to better meet their education goals. However, scaling up the use of these instruments is difficult and costly.	Global	Governments, country policymakers and stakeholders	Early Childhood Development, Education Management, Information Systems, Education Resilience, Engaging the Private Sector, Equity and Inclusion, Information and Communication Technologies, School Autonomy and Accountability, School Finance, School Health and School Feeding, Student Assessment, Teachers, Tertiary Education, Workforce Development
Centre for Global Equity	Inclusive Innovation, which is inclusive in purpose and approach. They mobilise frontier science and technology to enhance the wellbeing and economic development of the poorer half of the world's population, without harming the environment or the interests of future generations. All potential solutions are co-created with the people they are intended to benefit.	Low-resource communities in developing and emerging economies.	Board of Trustees	Deeper understanding of the root causes, impacts, and solutions to global disparities in areas like health, education, and economic opportunity.	Global	NGOs, international development organizations, policymakers, and researchers focused on global equity issues. Activists, social workers, and educators	Inclusive Innovation approach to solving challenges relating to food, water, health, work and the environment.
Rural Senses	Uses a blend of AI-powered data collection and machine learning-backed geospatial analysis to provide detailed, bottom-up community profiles. This method integrates both quantitative and qualitative data to reflect community needs accurately, especially in high-demand areas like refugee settlements. Led by locals, the process not only aids in crafting targeted interventions but also supports community income. By mapping data geospatially, it reveals regional trends and uncovers	Generally seems to be unidirectional - ie to provide data upwards for decision making	Centre for Global Equity plus organisational partners	In betaphase development	3 geographies (not clear which)	Communities via trained local data collectors	Data related to rural communities, their needs, resources, and challenges. This may include mapping geographical features, infrastructure, agricultural practices, socio-economic conditions, and environmental factors.

	the intersections of community needs, values, and services, considering economic and geographical factors for comprehensive project feasibility assessments.						
Visible Network Labs	Visible Network Labs is a network data science and strategy company working to tackle the problem of adverse social connectedness in the way we collaborate and provide care. The PARTNER Platform is a robust network analysis platform that uses network science to help visualize your partnerships, demonstrate collective impact, track and adapt your strategy to do more, together.	Seems to be centralising	Visible Network Labs and their partners	Network maps	Variable	Utilized by researchers, policymakers, non-profit organizations, and healthcare professionals.	As requested and determined by partners
Service Design Tools	The ecosystem map is a synthetic representation capturing all the key roles that have an influence on the user, organisation and service environment. The ecosystem map is built by first displaying all the entities, and then connecting them based on the type of value they exchange.	Service design orientation	Resource and training platform	Individualisation of maps as per users	Global	Utilized by service designers, business strategists, UX/UI designers, and potentially students in relevant fields.	Applicable across a wide range of industries and sectors wherever service design is relevant, including healthcare, education, retail, and technology.
School Weavers Tool	The School Weavers Tool is aThe SchoolWeavers is a collaborative and international research-action project that supports school leaders around the globe to analyze, rethink and weave their school-community ecosystem to enhance caring relationships, sense of belonging, personalized learning and wellbeing opportunities. The SchoolWeavers is run by an online tool that facilitates school leaders to regenerate their focus beyond academic results and achievement, and intentionally engage with seeding the conditions and opportunities for deep and wide learning within and across school borders.	Bi/multi directiona	NetEdu Project	The tool provides an assessment framework for supporting schools to strengthen their relational strategies around 7 key ecosystemic domains of the model: empathy, trust, purpose, collaboration, innovation, personalised learning and equity.	Global	Teachers, leaders, students, staff, community collaborators and families.	Apans across various educational levels from primary to secondary education.

LE Trilogy III. SDG4 Ecosystems Tool

Local Weavers Tool	The LocalWeavers Tool is designed for leaders fostering educational networks to enhance learning within communities. It gathers data via questionnaires, assessing the network's performance across six key areas: co-responsibility, transversality, horizontality, collaboration, innovation, and trust. The feedback provided by the tool is aimed at reinforcing the learning ecosystem's effectiveness. Validated both theoretically and empirically, it offers strategic insights to improve educational outcomes.	Bi/multi directional	NetEdu Project	In beta phase development	Catalunya		Assesses domains of Co-responsibility, Transversality, Horizontality, Collaboration, Innovation and Trust
Kumu Network Visualisation Tool	Kumu emphasizes a user-friendly interface, allowing users from various backgrounds, not just data scientists, to create complex network visualizations.	One-way and two-way relationships. Can also represent feedback loops, essential in systems thinking and complex network analyisis.	Kumu is developed and maintained by Kumu.io, a company that specializes in data visualizatio n and systems mapping.	The primary outcome of using Kumu is gaining insights into complex networks and systems, which can aid in decision-making, strategy development, and understanding interdependencies.	Kumu.io, the company behind the Kumu Network Visualization Tool, is based in the United States.	The primary source of data for Kumu maps is the users themselves.	It's used in a wide range of fields, including business, education, non-profit, and research.
Flourish	Bringing data to life for the purpose of storytelling and developing a shared understanding and purpose. A tool to allow non-coders to create high-end visualisations and stories without the cost and delays of commissioning bespoke projects..	Flourish allows for various forms of data representation, including directional data in network graphs, flow charts, and more.	Flourish Studio was initially developed by Kiln, a data visualizatio n and interactive storytelling studio. In April 2020, Flourish was acquired by Canva, an Australian graphic design platform.	Transformation of complex data into comprehensible and visually appealing formats, enhancing understanding and communication.Flourish is often used for storytelling with data, making it a powerful tool for journalists, educators, and businesses to engage their audience.	Flourish was created by Kiln, a company based in the United Kingdom. Since its acquisition by Canva, an Australian company, Flourish has become part of a global platform with users from various countries worldwide, benefiting from Canva's extensive global user base.	Similar to other visualization tools, Flourish primarily relies on data provided by its users.	Flourish is used across various fields like journalism, marketing, education, and corporate reporting, owing to its ease of use and versatility.
inHive	Data mapping to support collaborative decision making.	Bi-directional?					
DebateGraph	Tool for visualising and connecting areas of thought and debate - visualising and sharing networks of thought – and opening reasoning and action to collaborative learning and iterative improvement.	It allows for the visualization of the interconnectio ns and various perspectives within a debate.		Provides a platform for deeper insights into complex discussions, fostering better understanding and decision-making.stop	Global	User-generated content, where individuals contribute different viewpoints and sources.	Used in education, policy-making, and public debates, adaptable to various complex topics.

LE Trilogy III. SDG4 Ecosystems Tool

The Greenlight Movement	Tool to gather and visualise community level feedback on their living circumstances. Collaborative of 80+ organisations that participate.		Greenlight Office	Aimed at creating environmental awareness, policy influence, or community action.	South Africa & extending	Community involvement, partnerships, and possibly research data.	Environmental issues, sustainability education, and activism.
A Better Africa	Connecting and providing a space for community evolution for multiple players in an education system. Designed to become self-managing. Also serves as a Knowledge Management System for the individual organisations and the collective development of the ecosystem.	Platform - multi-direction ality		Targeted at improving conditions in Africa, whether through education, health, or economic development.	Focused on African countries, with potential partnerships globally.		Wide-ranging, depending on the specific focus areas like education, health, or economic empowerment.
LinkedTo	LinkedIn approach - self-directing. Connecting needs to resources and identification of pathways of delivery to the end user. Focussed on "last mile" connections in the social support arena.				South Africa		Connecting social resources to "last mile"distribution networks. Facilitation of the flow of crisis resourcing.
EdVision	Likely a technology-driven approach, focusing on innovative education methods, digital learning tools, or curriculum enhancement.	Favouring funders of education initiatives. Poor ability for schools to locate resources	Rand Merchant Bank	Aims to improve educational experiences, equip students with modern skills, and potentially transform teaching methods.	South Africa	Targeted at educators, students, school administrators; could involve collaboration with educational content creators and tech developers.	Range from K-12 to higher education, including lifelong learning and professional development.
Data Driven Districts	The DDD Dashboard provides data and information down to an individual learner level; giving School Management Teams as well as district and provincial officials essential information to give learners the support they need. The DDD Programme is active in 8 provinces, with accredited DDD trainers building capability through training and support to education officials to ensure data collection and use.	Aimed at enhancing educational outcomes through data-driven insights and interventions in school districts.		Improved educational planning, resource allocation, and policy development based on comprehensive data analysis.	South Africa	Utilized by school district administrators, policy makers, educational researchers, and potentially teachers.	Focused on primary and secondary education, specifically at the district level, possibly influencing national education policies.

Dark Matter Labs	Strategic discovery, design and development lab working to transition society in response to technological revolution and climate breakdown. Dark Matter Labs is focussed on the great transitions our societies need to respond to the technological revolution and climate breakdown we face. Our aim is to discover, design and develop the institutional 'dark matter' that supports a more democratic, distributed and sustainable future.	Likely to explore new methodologies, technologies, or theoretical models to address social, environmental, or economic issues.		Generating new insights, prototypes, or models that can be applied to solve real-world problems.	United Kingdom. Potentially global in scope, addressing issues that transcend national boundaries.	Involves researchers, scientists, policy makers, and possibly public participation for broader societal impact.	Wide-ranging, covering urban development, environmental sustainability, social justice, or technological innovation.

In order for mapping tools to be accessed, populated, utilised and interpreted, it is necessary to have methods that facilitate engagement with the tools and what they show us, and both the tools and these methods must be able to evolve with the changing ecosystem. Thus effective ecosystem mapping as a process is iterative and alive, held by the collective purpose and intent to grow our understanding of ourselves as individuals in relation to the collective and how the collective itself is manifesting. To realize this vision, a process needs to be designed that progressively visualizes, reflects upon, and evolves our understanding of the connections that humanize us. The act of attending to and thinking about these connections supports their growth in depth and strength. Thus, in measuring these aspects of the learning ecosystem, we directly influence them, and become able to better notice, activate and strengthen the connections that result in improved relationships, effective communication, deeper trust and a greater potential for the flow of information and resources. The process should allow for progressive and iterative reflection cycles amongst participants in the process, continually evolving to include more of the framing ecosystem in which they are embedded.

The progressive nature of these reflective cycles allows our initial understanding to form the basis of the next cycle of growth, development and reflection, but also to dissolve fixed ideas which we may have about the system, as new insights and understanding emerge. The goal is to provide a continuing process for the evolution of understanding. The structure of the process must allow for the collection and visualization of reflections to become collectively visible, shared, and co-reflected without becoming static and fixed. The structure should surrender to the process of evolving understanding, restructuring, and evolution. Visibility and understanding can only come when one is a participant in the broader process, so all actors within the system who want to understand it, and view it as a whole must participate and co-reflect upon the system that they are a participant in to move towards a shared understanding. Thus, in the instance of what the NetEdu team is developing, the design and delivery of our approach is intended to develop a lived, co-reflected understanding of the learning ecosystem being examined, which develops within the process of deepening relationships, rather than providing simply a unidirectional static picture of the system.

In respect of **objective two**, and for the design of the tool concept, the findings developed through the 12 focus groups of existing learning ecosystem practitioners were analyzed and coded (see table 2). This allowed us to develop a system of the categories and dimensions identified for tools, methods and processes to effectively support Learning ecosystem development, as interpreted from the focus groups' discussions. This strategy allowed us to follow the deep discussions and identify the most frequently repeated ideas across groups to better identify a common narrative. The two tables below summarize the key ideas discussed and analyzed. Table 1 describes the pattern of evolution and the impact on learning outcomes and wellbeing that existing learning ecosystems are already evidencing in participants' experience. Table 2 describes the value that a digital mapping tool can bring to education, as articulated by participants.

Table 2: Analysis of learning ecosystem impact and evolution

Impact	Ideas shared	Discussion
Detecting and mobilizing learning resources that already exist	- Helps connection between and within micro, meso and macro levels. - Minimizes the gap between policy makers and practitioners - Capacity to activate the whole system at all levels - Coordination between initiatives allows giving value to each other. - Recognises where learning and the most innovative activity occurs - Support an understanding of 'what my part of the ecosystem is'. - Support an understanding of present connections and possible future connections. - Allows a diagnosis of duplication, overlaps, underuse of resources and poor or lost connections.	The VUCA and post pandemic world forces countries and regions to detect and mobilize existing resources within and beyond their traditional educational systems, amplifying and leveraging access to new learning opportunities for children and young students, as well as professionals and leaders in areas such as crucial knowledge, expertise, funding, innovation, collective learning, and so on.
Unlocking and connecting the learning potential in the ecosystem	- Establishes more communication channels for people to connect. - Helps to find what transformations need to happen on a relational level. - Enables growth. - Develops a mindset of collaboration instead of competition. - Allows us to continue building community. - Enables change initiatives to reach many people. - Creates a lifelong learning perspective in which diverse actors and inputs are involved.	To reduce costs, better leverage resources and effectively achieve educational goals, it is necessary to reduce silos across sectors, avoid duplication of efforts and weave connections between people, organizations, policies, sectors and existing resources. This involves unlocking cross-sectoral potential and weaving learning policies across multiple sectors, such as the digital, health, wellbeing, culture, sustainability, sports, entrepreneurship sectors, and so on.
Supporting the conditions for learning, innovation & experimentation	- Build collective capacity and skills. - Facilitate knowledge and resources. - Facilitating thinking and learning partnerships. - Address the mismatch of skills - Resource people more effectively. - Infrastructure provision. - Facilitate relevant investment from institutions. - Support startups. - Reward the actors.	Uniting diverse people, organizations, places and networks within the wider learning ecosystem facilitates better access to learning opportunities for everyone and sparks new ideas and perspectives. These kinds of innovative conditions allow the ecosystem to seed and pilot shared, intersectorial and collaborative strategies for system change and development of improved learning conditions.
Connecting the digital and the wider learning ecosystem	- We require not only a diagnostic tool but a methodological approach, facilitation process and shared learning. - Needs relevant and comprehensive content, use friendly, technology and accessibility. - Human-centered approach is required. - Don't expect tech to do what ministers should do. Tech enables, but human beings do and act. - Variations in communication channels and digital infrastructure have to be considered when extracting quality, contextual data. - The complexity of the learning environment requires a level of collaboration between the tech team and the community organizing and using the tech.	It is crucial to embrace the digital and technological components of national learning ecosystems in order l to effectively harness the potential that ICT offers to support the attainment of national and global learning goals (SDG4) . Weaving tech industry stakeholders in partnership with academia, research institutions and other relevant stakeholders in the learning ecosystem supports such integration.
Developing our human collective capacities and culture so that we can thrive together	The ideal learning ecosystem tool should enable: - Bridging between peers in a multi-directional and fluid way. - Nurture relationships between individuals. - Support people to realize they belong to an ecosystem that everyone can join. - Seek to build and facilitate trust among actors. - Create a shared culture building collective intelligence. - Need for an infrastructure that deepens the relationships and connections. - Helps to develop a unified and more equitable level of development. - Minimizes the gap of resources and capacities between and within countries.	The learning ecosystems' development enables a diverse network of people and organizations from different levels of the system to define a shared purpose and collectively respond to their strategic education goals. In order to engage with the emerging collaborative cultures that enhance our system capacities to thrive together, we need to consciously evolve from traditional educational systems towards learning ecosystem approaches

Table 3: The value that digital learning ecosystem mapping tools can bring to education

Value	**Ideas shared**
Tool conceptualization	- Share a conceptual comprehension of what a learning ecosystem is. - Generate an active learning environment. - Should be a learning and reflecting tool rather than just a visualization tool. - Support us to map out what a healthy network is in a way that speaks to to participant's meaning and own understanding - Identify and reflect the key pillars of the local educational system in each region. - Develop a common understanding of the real purpose of a tool to enable learning ecosystems, beyond simply sharing best practices. - Need for a pluralistic view.
Visualizing nodes	- Awareness of who the actors (both formal and informal) in the systems are. - Understand the role of each actor and how they evolve over time. - Governmental awareness of other stakeholders - Enhance Government ability to engage with, communicate and learn from other nodes. - Facilitate engagement across and between nodes.
Diagnosis and direction	- Measure expectations and needs from stakeholders. - Ability for stakeholders to see, reflect and understand their own data. - Having a diagnostic tool which centralizes data for decision making. - Grow shared understanding and empowerment. - Balance between top down decisions and bottom up information and capacity. - Multi-directional feedback loops and data co-owned by all system stakeholders. - Formulating policies in collaboration with the network. - Support governments to supervise their policies. - Bring the representatives of the key target beneficiaries into the project community.
Communication and diffusion	- Use of marketing and publicity. - Visibility, communication and transparency. - Embrace the concept of “porous borders” and shifting dynamics. - Grow an understanding of systems, living dynamic ecosystems and an ability to work within complexity.
Data use	- Data visualization and availability. Create data sets that are later open and comparable. - Build interoperability in mind. - Practice the habit of reflecting, learning and engaging with data. - Building capacity to absorb, analyze and share data. - Think on insights such as visual and data mapping can and should bring.

To clarify the **third objective, a list** of stakeholders was created to enable the visualization of existing and potential relationships between stakeholders within the ecosystem. Participants experienced a knowledge sharing exercise, which resulted in significant feedback and responses. Most notably, participants showed significant enthusiasm in the discussion and actively contributed to filling the tool prototype. The workshops were deemed largely successful due to several factors. Firstly, participants gained an enhanced knowledge and understanding of the learning ecosystem. Secondly, they realized the importance of engaging and including other sectors and sub-sectors that work directly or indirectly with education to achieve the Sustainable Development Goal 4 (SDG 4). Thirdly, participants were given details on how the ecosystem will shape the development of education plans and other critical national documents such as policies across the country. Fourthly, they appreciated the critical role of the mapping tool in terms of its value for national development. Furthermore, participants were informed about the need for buy-in from Government and stakeholders to effectively use the tool.

Selected comments and questions from participants reflect the appreciation and optimism for the development of the learning ecosystem and the mapping tool. Participants expressed gratitude for the exercise and the potential of the system in achieving education goals. One district participant from the Volta Region expressed appreciation for the exercise, recognizing its potential to set the pace for a brighter educational future for the country. They added *"we have long waited for such an initiative that will bring all education stakeholders together to work towards a common goal. This exercise has provided us with an opportunity to have a holistic view of the education system in Ghana and identify potential areas for improvement".* Regional participants from the Northern Region in Accra echoed this sentiment, emphasizing the opportunity to locate and connect with all those directly and indirectly involved in supporting education. They expressed their appreciation, stating *"this is an excellent opportunity to map out all actors working towards the same objective. It will help to identify gaps and overlaps in the education sector, which will ultimately help in improving education quality in Ghana."*

Participants from the Northern Region in Tamale described the exercise as interactive and interesting, giving them hope for the future of education in Ghana. They also expressed a desire to put into practice what they had learned, building a well-connected system that would allow them to focus on the positives of what they can do to support education and alleviate concerns of not meeting SDG 4. One participant noted, *"this exercise has given us a comprehensive understanding of the education system in Ghana, and we can now identify specific areas that need intervention. It is a great initiative, and I am hopeful that it will help in achieving SDG 4 in Ghana".*

In addition to positive feedback, participants had questions about the initiative's structure, sustainability, and inclusivity. Some questioned how new stakeholders would be absorbed into the system in the future, while others wondered if the Ministry of Education had the capacity to pioneer the initiative or tool. Participants also expressed concerns about ensuring buy-in from all stakeholders and maintaining continuity and sustainability over time. Furthermore, participants inquired about how the tool would be implemented at the local and community levels, and how it could be sustained beyond the initial mapping phase. They also expressed the need to strengthen capacities for emerging groups and ensure that the engagement with the initiative continued beyond the gathering. One participant suggested *"the Ministry of Education should consider integrating this initiative into the education curriculum at all levels to ensure its continuity and sustainability. It will help to create awareness among learners about the importance of education and the roles different actors play in the education ecosystem".*

Several recommendations and a way forward were also highlighted during the consultations. One of the recommendations was to develop criteria and processes for the inclusion of new organizations in the ecosystem. Secondly, it was recommended to develop and disseminate the timelines for building and developing the mapping toolkit. Thirdly, if there is to be a separate core team to develop and work on the tool, then there is a need to consider other groups that can join the core team to develop the mapping toolkit. Fourthly, it was recommended to review the "Discipline" (ie field of work) column for multiple options, as some stakeholders do multiple things, and this should be noted and captured. Fifthly, it was suggested to review the "Geography" column to include international, Africa, etc. as the current design appears ambiguous for the participants, and they do not understand what geography means.

Additionally, it was recommended to operationalize some of the terms as the meaning may differ from context to context, for instance, civil society, private civil society, etc. These can be confusing if not explained well. It was also noted that the departments under the ministry at the national level become organizations when they are operating at the district level. Therefore, it is important to note this in the tool. Participants expressed a need for more time to understand the mapping tool before they can complete it effectively. Finally, it was discovered that most participants appear not to know the SDG 4 indicators and priority areas, and a session was introduced to introduce participants to SDG 4 priority areas and indicators.

Finally, along with the consultation process and co-reflection, the concept tool was progressively designed. From February 2022 to October 2022 DXtera in collaboration with the NetEdu team developed an initial concept of the UNESCO-NetEdu Learning Ecosystems tool using WordPress existing plugins to code the initial concept tool previously designed. The development was connected to the consultation process and prototyping occurring in the 4 regions and 2 districts in Ghana, weaved by the T-TEL and NetEdu teams, and using real data to gather stakeholder's inputs and create visualizations of stakeholder and relational maps of the Learning Ecosystem in Ghana.

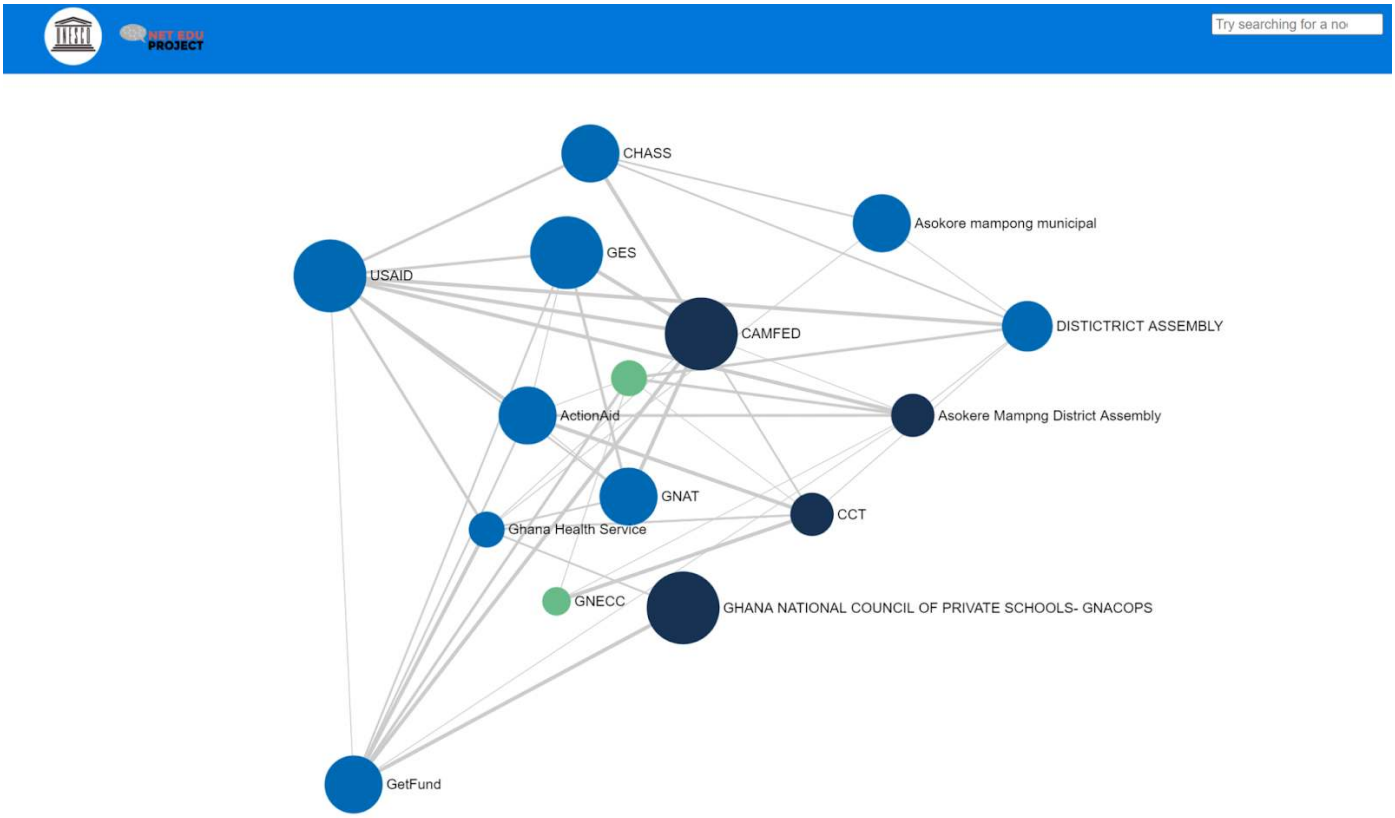
Initial development was focused on bringing the ecosystem vision to life through a website that would begin to visualize the results of education delivery and the relationships between parties in a certain Region or District in Ghana. The goal was to design a concept tool that could be presented, discussed and further developed for its full deployment in the near future. The concept tool development resulted in the following capabilities:

- Content site developed (Figure 1), describing the need for Learning Ecosystems for SDG4 and how mapping stakeholders and relationships contributes to better understanding and leverage potential resources.
- User login management for core participants and stakeholders.
- Stakeholder survey data available for use with mapping visualizations and provide the ability to navigate and view stakeholders in the country (Figure 2).
- By region
- Filter by various aspects of the stakeholder survey data (Sector, discipline, scope, focus, among others).
- Profile pages for learning stakeholders and managers.
- Demonstration visualization of relationship survey utilizing simulated data (Figure 3).

Figure 1: Learning Ecosystem tool Home Page Image

Figure 2: Image of Stakeholder Survey Data

Figure 3: Relationship Data Image



The initial development of the tool prototype allowed the NetEdu team, DXtera and project stakeholders -UNESCO Ghana, the Ministry of Education of Ghana and Jacobs Foundation- to discuss and reflect around the tool capabilities and further improvements. A relevant part of the discussion was around the need of including complementary data beyond the stakeholder visualization and relationships. It was shared that a diverse type of data was already being collected by different public and private agencies in the country, such as from diverse agencies in the Ministry of Education, Jacobs Foundation, UNESCO, UNICEF, T-TEL, among others, but all this data was not directly used to comprehensively inform and monitor educational system outcomes. It was highlighted that data bases coming from diverse data sources were siloed, not even shared nor interconnected.

Thus, the learning ecosystem was firstly hindered by the fragmentation of learning stakeholders, and in turn was also hindered by the separation of these data and evidence that was miss informing the development of the evolution and educational system. In this sense, learning stakeholders consulted in the research process shared a professional fatigue around new ongoing projects, tools and researches that had irrelevant impact in the improvement of educational outcomes in the Ghanaian educational system. It was shared that the final tool needed to address this issue by serving as a data hub that could holistically visualize and monitor the wide development of learning outcomes in the ecosystem, in order to inform evidence based decisions. Finally, the team co-designed the final version of the concept tool for Ghana, with the purpose of progressively scaling it to other countries.

3.1 Design of the Learning Ecosystem Concept tool: The NetEdu Hub in Ghana

After initial research, prototyping the tool in the territory, and discussing real needs with stakeholders and policymakers, the 'NetEduHub in Ghana' is the first iteration of the conceptual tool to be developed in the next few years ahead. The NetEdu Hub is more than simply a mapping tool - rather, it offers a holistic platform capable of gathering and aggregating education data over time at national, regional and local levels. **The NetEdu Hub aims to support the newly established GEED Lab team in Ghana to progressively gather, visualize and analyze data relating to the Ghanaian education landscape, informing new evidence-based decisions and policies for further development of the learning ecosystem, greater SDG4 achievement and attainment of learning goals in the Ghanaian Education Strategic Plan (2018-2030).** The NetEdu Hub will actively seek wider learning stakeholder engagement across the national ecosystem, supporting all participants in the process to better engage and collaborate with aligned stakeholders, and also serving as a channel for continued feedback with the GEED Lab unit. The digital Hub will be co-developed with the Ghana GEED Lab, NetEdu and DXtera, in collaboration with the PBME Directorate of the Ministry of Education, and supported by UNESCO.

To better understand the development of the NetEdu Hub we describe here 3 essential processes that articulate how the Hub is designed, led and developed: 1. The Public Map as the global presentation of the Hub; 2. The Stakeholder Profile as a relational empowerer for all learning stakeholders in the country; and 3. The NetEdu Hub Profile as the managing site for government units.

1. The NetEdu Hub will provide a public Learning Ecosystem Map -starting with Ghana but ready to be extended for scaling across other countries-, from which all users will be able to access and essentially interact in two different and complementary ways:

1. Search for country learning stakeholders with specific interest, zooming in and out in a 'google map' from national to local. Users will be able to filter and customize their intentional search for learning stakeholders by geography, name, role, sector, scope, discipline and focus.
2. Register as a new Stakeholder as an active contributor of achieving SDG4 in their school, community, district,city and/or nation. Stakeholders will be able to create a Public Profile, with descriptive information that will be shared through the map-, and a Private Profile -restricted to the stakeholder leads. All new profiles will need to be accepted and validated by the NetEdu Hub managing unit (GEED Lab) to complete their processes.

2. The NetEdu Hub will allow learning Stakeholders to create their own individual Profile and empower their sense of belonging, collaborative capacities and voice in the learning ecosystem development. Beyond accessing the public stakeholder map, the Stakeholder Profile will facilitate four key actions:

1. Once the Stakeholder representative is registered on the platform by sharing personal data as Name, Email and Password, users will be able to create a Stakeholder profile: Here, users will be asked to respond to a Stakeholder Form with descriptive data (provided below). This form has been already tested in the context of this research to initially map learning stakeholders in 4 Ghanaian regions and 2 districts. Once the form is completed, this data will be validated by the Hub managers, who will activate the profile and this will then be shared on the public map and will be visible to others as active contributors to SDG4. In this space, the respondent will add the following Stakeholder descriptive information:

Stakeholder Public Profile

- Name of Stakeholder
Open question
- Logo
Image
- Geography
Address
- Type of Stakeholder
Organization / Project-Initiative / Policy / Ministry / Network
- Sector
Public / Private / Civil Society / Public-Private / Public-Civil Society / Private- Civil Society / Public-Private-Civil Society
- Scope
National (Macro) / Regional (Meso) / District (Meso) / Community-School (Micro)
- Discipline
Early Childhood Development / Primary education / Secondary education / Tertiary education / Non formal education / Technology / Health / Social services / Culture / Environmental Sustainability / Unions / Research / Policy making / Economics / Employment Publishers / Youth organizations / Media and communications / Arts / Religion / Architecture / Learning material and furniture Design / Funder / Police / Justice / Housing / Transport / Traditional Leaders / Community Leaders / Community Educators / Entrepreneurship hubs / Small and Medium Enterprises / Business Chambers Elders
- (If public) Public Administration Level
National / Regional / District
- (If tech) Technology roles
Startup / Companies / Incubators / Accelerators / Funders
- Focus and Interests
Achievement / Holistic learning / Student's Wellbeing / Teachers Wellbeing / Teacher training / SDG4 (to be decided)

2. Once the profile is validated, stakeholders will be able to access the Ecosystem Tool to track, visualize, analyze and enhance their own Network of Relationships Map, and partner with shared purposes along with other stakeholders in the ecosystem. By responding to a brief social network survey, they will progressively map their social and collaborative relationships with other stakeholders involved in SDG4, and will be able to visualize connections, gaps and potential synergies for better leveraging resources.

3. Through their Profile, Stakeholders will be able to additionally access other sets of specific tools to support their performance within the ecosystem and the achievement of desired learning outcomes, such as The SchoolWeavers Tool, the Nexial Map and the Community Evolution Scale (Jacobs Foundation), among others. We have evidenced that these tools have already been effectively used and tested in Ghana to allow stakeholders to achieve connected goals.

4. The Stakeholder Profile will serve as a direct communication and feedback platform between the stakeholders and the NetEdu Hub managers (GEED Lab). This feedback will be catalyzed through ongoing surveys, online meetings, workshops and other events, where stakeholders will be called to express their vision and perceptions of the learning ecosystem development. Specifically, 3 initial surveys will seek feedback around the 7 domains of Thriving learning ecosystem development model (Report III NetEdu, 2022), and others could be added over time. Once the surveys are responded, the Profile will capture the individual response and data from which stakeholders can use to create new dialogues and carry on new evidence based decisions. Stakeholders will receive some notifications to complement their profiles, for example when a New Stakeholder in the region is registered, or a new survey is required, or just tips to better navigate the platform.

3. Finally and most importantly, NetEdu Hub will progressively enable and equip the GEED Lab team to manage the Hub Profile, thus being able to gather relevant evidence overtime on national learning ecosystem development, mapping progress towards achievement of SDG4 and Ghanaian Education Strategic Plan (2018-2030), and informing new evidence-based policies for further development and improvement. All the sources of data gathered and aggregated by the NeEdu Hub will be automatically segregated by geography, supporting the GEED Lab to zoom in and out the level of the analysis throughout National data / Regional Data / District Data / Local Data / School Data.

The NetEdu Hub Profile will facilitate four key actions:

1. The NetEduHub will automatically gather data provided by Stakeholder Profiles by responses to the Descriptive form, Learning Ecosystem tool -relational survey-, and 2 Perceptive surveys on the development of the learning ecosystem.

2. The Managing Profile will allow the team to intentionally aggregate data from diverse sources, such as the data provided by existing tools (SchoolWeavers or Community Evolution Scale) and also other databases related to education and learning outcomes such as achievement, attainment, higher education enrolment, amongst other items of interest to the team.

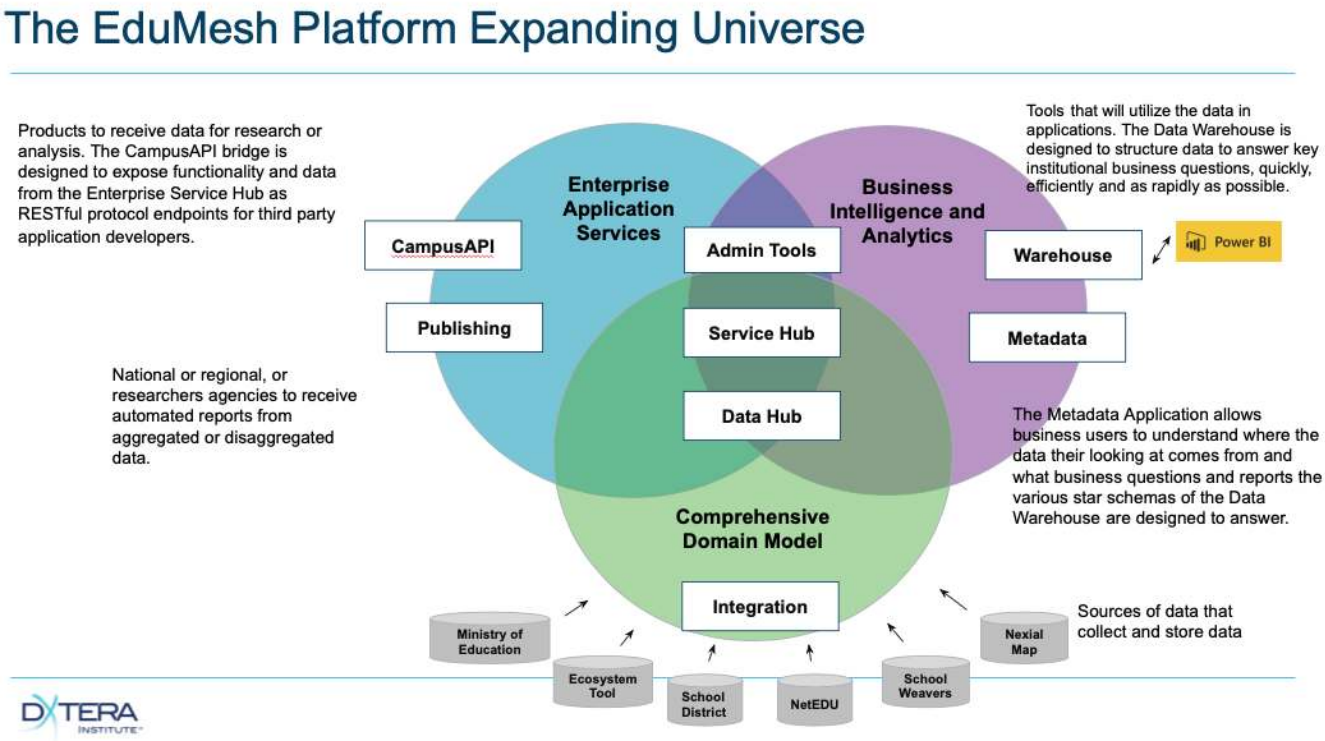
3. The Managing Profile will allow the team to visualize the data in an attractive and understandable way. 1- Descriptive data from the Stakeholder Descriptive form will be shown by the public map but will also be accompanied by % figures of existing roles, sectors, scopes, disciplines and focus -in each of the levels of analysis-. 2- The Relational Survey responses will be added to the previous map by including a Network Analysis Visualization, with possibility of including filters to visualize the existing relational dynamics in each of the levels -reciprocity, shared purpose, trust, collaboration, innovation-. 3- The Perceptive surveys will be a 10 point Likert scale and will show scores in % on 7 dimensions (Thriving learning Ecosystems, NetEdu), that in turn will automatically determine 4 levels of maturity of the ecosystem for each community- city- district- region- nation-. In addition, other aggregated tools such as the SchoolWeavers or the Community Evolution Scale will be visualized absorbing and utilizing their own visualizations. Finally, aggregate data from other databases will be visualized utilizing other accessible tools for data visualization.

The NetEdu Hub development will support the integration of diverse data sources beyond the mapping that will provide an integrated EduMesh platform (Figure 4) that can be utilized as a Hub of learning ecosystem data. This platform would initially integrate data from diverse data sources and utilize the tools that are being developed in Ghana (previously mentioned), but capable of absorbing other types of learning outcomes data from the Ministry of Education and beyond. This holistic platform would support any region and entities to deeply advance on the evidence generation and visualize and understand correlations between ecosystem and process data with learning outcomes and results.

DXtera will be deploying their open technologies to enable the needed infrastructure of the Hub (Figure 4). EduMesh™ is the next generation of data management solutions for education institutions, regional agencies and governmental entities. It supports the comprehensive EduSchema™ educational domain models to streamline data integration, transformation and orchestration across disparate systems within an education institution.

Aligned with the principles of Data Mesh, the EduMesh platform is designed to enhance business analytics across the entire ecosystem of educational enterprise software, including Student Information Systems, Learning Management Systems, Degree Audit, Human Resource Manage Systems, Financial Systems and more. We provide a turn-key solution for education institutions or regional agencies to capture and manage academic, educational, personnel, and financial information via established connectors to systems of record. Unlike alternatives in the market, we enable holistic decision-making by institutions through an enterprise-wide and technology-agnostic solution that is deployed in the local environment.

Figure 4: EduMesh Platform



The following components would be provided to enable the EduMesh platform to become an innovative solution for use in low-resourced environments. This platform provides a scalable and sustainable solution for institutional and education data management. DXtera designed features include:

- Integration Framework - Schema-first transformation of enterprise and legacy data. Keep all your data aligned and integrated with the applications that need it.
- Enterprise Data Hub - A comprehensive operational data store to manage all your data, aligned and normalized for efficient reporting, analytics and application support, while tracking changes over time.
- Data Warehouse - An SQL based data warehouse solution for aligning institutional data to meet the reporting and decision driven analytics needs of your organization
- Lakehouse Framework - In-lake schema transformation utilizing DXtera's Lakehouse Transformation Architecture to provide campuses with a best of both worlds data lake solution for maximum data flexibility and staging plus an EduMesh aligned LakeHouse for efficiency and scalability.
- CampusAPI™ - Streamline your campus' application integration and development using the EduMesh-based comprehensive RESTful protocol suite. CampusAPI service endpoints can be configured to interface directly with source systems, or through the Enterprise Data Hub or Lakehouse Framework for enhanced performance.

4. Conclusions

The NetEdu Learning Ecosystem Tool offers a "tool-as-process" solution to enable national education leaders, as well as the stakeholders participant in national learning ecosystems, to identify, articulate, define and connect the multiple learning resources available within a country that can support that country's objectives with regards its SDG 4 goals. The tool provides support from the micro -school level-, meso -district and regional level- and macro -national and potentially continental- levels to enable learning system stakeholders to identify and connect with key partners and enablers of learning. Furthermore, the tool and its associated supporting processes aim not only to visualise the broader learning ecosystem, but also to connect and to enable communication, facilitate the exchange or flow of resources and information, and support collaboration and co-creative potential to be developed across and between multiple differently located and affiliated stakeholders. In this way, the Learning Ecosystem tool seeks to dissolve the boundaries and communication barriers between the silo's within a country's learning landscape, in order to enable improved access to learning resources and developmental opportunities, foster coherence and the correct sequencing of learning interventions, address barriers and gaps in delivery and service, and foster an increasingly strong sense of shared purpose and co-creative capability within the system.

In essence, the NetEdu Learning Ecosystem Tool has been shown to provide a holistic and interoperable vehicle for collating, comparing, and connecting data emerging from across the learning landscape, enabling national education ministries and the associated bodies charged with the development of effective education environments to more fully visualise, understand, and be able to utilise all of the resources available for learning within their own particular context effectively, and synergistically. Furthermore, the tool facilitates a sense of shared ownership, participation and involvement in decision making across multiple different stakeholder groups, reducing the dissonances and misunderstandings within the system, and enabling a greater level of co-operation, co-ordination and shared ownership of both system development and outcomes. The tool is intended to support communication between the different layers of the system, and between different stakeholders, giving them common data and insights on which they can base debate, discussion, and generative dialogue. It supports an iterative process of information generation, triangulation, mirroring and reflection, allowing for progressively deeper cycles of shared insight and understanding to be generated.

The NetEdu Learning Ecosystem tool has been developed, and is offered, as a novel, flexible and integrative approach for supporting a learning landscape that moves beyond the constraints of a hierarchical and outdated traditional education system, and can increasingly embrace and facilitate the functional emergence of a progressively maturing learning ecosystems.

A mature learning ecosystem is not one in which has reached an "optimal structure" - rather, it is one within which the actors have become proficient and comfortable with embracing and adjusting to "change as the only constant". The learning ecosystem tool and approach prototyped here is offered as an early example of a tool, method and process that could facilitate these "systems-navigating" skill sets for education stakeholders - and that could support them with an expanding pool of partners, resources, skills and experience to allow them to achieve the SDG 4 goals that they have for their country,

It has been noted through the development and beta-phase trialing process delineated in this paper that:

- There is an appetite and need for tools such as these, which is experienced at all levels of the learning system.
- The tool is effective in cross-connecting data silos, such that these can better inform each other and the system as a whole
- The tool allows for the generation of interconnecting maps that weave together and facilitate knowledge and resource transfer between the micro, meso and macro levels of a learning ecosystem
- It also facilitates an effective process to build human relationships, collaborative cultures, transcend silos, and start new dialogues.
- Use of the tool enables a deepening of shared purpose, greater connection, and more profoundly co-creative capabilities for stakeholders within the system, and for the system itself.
- Effective and high-quality relationships that can be created and enabled with support from to the tool, offer the greatest opportunity for transformation for the participants and their respective communities.
- The process enabled by the tool expands stakeholders' concept and insight of what is already present and available to them within their ecosystems, growing their sense of capacity, agency and courage. When we start to see what we already have, it gives us courage for what we need to do!

This research demonstrates that collective mapping of stakeholders in the education system has proved to be an effective way of visualizing the existing and potential involvement of diverse stakeholders from multiple sectors and disciplines beyond the traditional educational system. The consultations undertaken provided participants with an enhanced understanding of their own learning ecosystem and the importance of collaboration to achieve the SDG 4. The mapping tool, and other similar tools for supporting the evolution of a healthy national learning ecosystem, was widely recognized as being a critical component for national development and the achievement of high quality national learning outcomes.

Recommendations and a way forward have been offered to ensure that the mapping tool is used effectively and that the momentum of the workshops is maintained. The Learning Ecosystem Tool initiative has generated significant interest and curiosity from education stakeholders in Ghana. As the initiative moves forward, addressing queries and concerns from partners within the system will be essential in ensuring the tool's success and impact in Ghana's educational landscape. Participants in the process expressed their willingness to support and collaborate the ongoing implementation of the initiative, which is a positive sign for the future a learning ecosystem approach to education in Ghana, and for the effective development of this tool. The PBME Directorate - Planning, Budgeting, Monitoring and Evaluation- has shown interest in fully deploying the learning ecosystem tool as it has been designed. Further funding is being sought to enable the tool's ongoing use and development, since Ghana has been negatively impacted over the past financial year by budget cuts affecting both public and private finance. Once developed and deployed, the learning ecosystem tool will support and enable the Ministry to map out all critical stakeholders who contribute to the education system in Ghana as well as the relationships that exist between them. Through this exercise, the Ministry will be able to delineate and categorize stakeholders based on the support they provide or the roles they play within the educational system, and engage in dialogue in order to activate the national plans for achieving SDG 4.

Stakeholders who were mapped during the tool development phase will be engaged in the development of the Education Sector Medium Term Development Plan for 2022-2025. This is a critical step towards ensuring that the stakeholders' voices are heard and their contributions are taken into consideration when developing the plan. This important step has been facilitated as a result of the existing implementation of the learning ecosystem tool in Ghana, as this process has enabled these stakeholders to become visible to the ministry, and resulted in their inclusion in planning and strategic implementation approaches. It is important to note that other ministries and departments, aside from the Ministry of Education, need to be engaged in order to further develop the tool for wider coverage. This will enable the Ministry to fully understand the complexities of the education ecosystem and ensure that all relevant stakeholders are included in the mapping process. Further development of the learning ecosystem tool and its aligned processes will ensure that those ministries (eg Health, Social Services, Infrastructure, Youth Development etc) whose work is both directly and indirectly linked to generating supportive learning environments are progressively included in the work of developing an extended living learning ecosystem map.

The Learning Ecosystem tool offers a route into both 'being and becoming' for national learning ecosystems. Being - in that the tool allows for a shared appreciation of what it is that already exists within the system - and becoming - in that it allows for stakeholders to see the potential, the needs, and the leverage points within the system that they can then connect around in order to facilitate the further maturing and evolution of the learning ecosystem. This approach advocates for, and offers the opportunity to realise, an expanding set of interconnections between disparate parts and players within the system. It offers a means for progressively incorporating other tools, complementary data, sites of action and innovation, and related initiatives in other sectors that have the potential to further the country's learning objectives. The tool has been designed in such a way that it itself can continue to evolve so that, in addition to, and beyond just mapping the data emerging from the learning ecosystem, it can increasingly integrate and cross-reference this data - thus allowing the individuals immersed within these data sets to engage with, learn from, and collaborate with each other.

We hope to continue to work in partnership with our many colleagues and friends within the community of Learning Ecosystem practitioners to advance these objectives. Our hope is to offer practical, accessible and affordable tools to enable schools, districts, communities, regions and nations to embrace a learning ecosystem approach to human development and growth, in symbiosis and sympathy with our living planet's own design.

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