Towards a digitally enabled learning ecosystem

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Contents

This paper is a collaboration between CSE and Google for Education for the Asia Pacific Leadership Symposia. The Symposia bring together education system leaders from across Asia Pacific to share powerful leadership practices that have high impact in education transformation. The Leadership Papers combine insight into new capabilities for system leadership, analyse innovative strategy, and demonstrate the power of digital to transform learning. They provoke, share and support new thinking and innovation in education.

Disclaimer

This work was produced by Tom Barrett and Chris Harte in their personal capacity. The views expressed in this paper are the authors' own and do not necessarily reflect the views of their employers.

Introduction

Our world is complex. Just look at a single tree. Within its branches, leaves and roots lives an entire ecosystem of organisms – a teeming, interconnected and interdependent world. The complexity of natural and human-made ecosystems can be so overwhelming we compartmentalise them to be more manageable. As we see in the natural world, however, if we inadvertently disrupt the flow of an ecosystem, it has unintended and often disastrous consequences. Disregarding the connected nature of our world has led to the climate crisis and deep social issues.

Similarly, education is an intricate ecosystem. If we disconnect the school experience from the broader learning ecosystem, learners, educators, administrators and families become siloed. They risk being so focused on schooling that opportunities for ecosystemic learning are missed.

Moreover, rigid education systems degrade and break down when they come under significant pressure (eg, pandemic, climate-driven school closures, war and poverty). For instance, during the COVID-19 pandemic, 1.5 billion children were abruptly displaced from their schools, while in Pakistan, over 25 million children are out of school due to systemic issues.

These examples underline the brittleness of rigid, disconnected education systems. We need to spend time designing and nurturing stronger antifragile learning ecosystems that are digitally enabled.

> *Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better.*
>
> (Taleb, 2013)

Although educational inequities persist, technology can bring the sum of all knowledge to learners' fingertips, connect them safely with experts around the world and allow them to collaborate on real-world challenges. This starts to describe the potential of a Digitally Enabled Learning Ecosystem (DELE), while putting the current dominant model of education systems into stark and unflattering contrast.

As technology advances to fulfil its promise of genuinely personalising learning, custodians of the education system have the opportunity to reimagine school systems into personalised learning ecosystems. Our challenge is to recast education, build equity, embrace agency and support our learners to thrive.

The story of us

As authors of this paper and teachers who entered the profession in the early 2000s, we witnessed the transition of technology in UK classrooms was transitioning from overhead projectors to interactive whiteboards, from disconnected computer labs running offline programs to the burgeoning world of online learning and laptops for teachers.

> ... connecting young people to a meaningful learning experience has always been the goal.

Much has changed since then, but we both maintain a 'purposeful-learning-first' mindset. Technology is incredible, but unless grounded in purpose and thoughtful learning design, it can become a distraction from learning.

Another common attribute we share is a passion for making the walls of the traditional classroom porous to the broader world. Whether through project-based learning, school exchanges or digital pen-pals, connecting young people to a meaningful learning experience has always been the goal.

It is important to ground this paper in this context because we both continue to work in technology, Tom as a practitioner and curator in Artificial Intelligence (AI) for education and Chris as an education strategist at Google for Education – and we never lose sight of the purpose of education.

Building on the OECD's Future of Education and Skills 2030 project and framework, we think that the purpose of education is

... to help learners develop the knowledge, mindset, skillset and toolset necessary to thrive in a transforming world and actively co-construct a flourishing, diverse and equitable society.

With this purpose we value knowledge, both general and subject-specific, but also bring to the fore the criticality of

- mindset (disposition and how learners think),

- skillset (domain-specific, cognitive and affective skills like critical thinking and empathy), and

- toolset (mastery of the various tools available to support learning).

Most importantly, we acknowledge agency through co-construction, which we believe is truly at the heart of what it means to thrive: to have purpose and agency.

In this paper, we explore how system leaders and guardians of the next generation of humans can nurture DELEs to meet this purpose and rise to the challenges that we face as a species.

The story of now

Expert colleagues have covered the shifting contexts and challenges impacting our education ecosystems, so we will not linger there. However, it is important to touch briefly on factors that remove learners from education systems, illuminating why more personal, agile ecosystems may be needed.

- The climate crisis interrupts access to schooling, through disasters like bushfires, floods, storms and typhoons.

- Natural disasters like earthquakes and tsunamis devastate school infrastructure.

- War and conflict further damage infrastructure and displace millions of children.

- Inequity and poverty exclude students on a massive scale.

- Pandemics evict students en masse, as COVID-19 did by shuttering classrooms for 1.5 billion children.

These conditions disconnect learners (often the most vulnerable youth) from their schools and exemplify the brittleness of our traditional education systems.

With their rigid schedules, standardised curricula and one-size-fits-all assessments, our schools are ill-equipped to adapt and grow from challenging new contexts.

Given that context matters, the education system becomes stronger, more adaptable and resilient to disruption, when it recognises and works

within the greater learning ecosystem and aims to help young people leverage the opportunities to personalise their learning experience.

Technology now shows its potential to enable more responsive, learner-centred ecosystems. While tech-equity gaps remain, advances in affordable devices, connectivity infrastructure and AI make personalised learning achievable, not just an ideal. Technology is the connective tissue holding personalised ecosystems together and we shall examine this in more detail.

School, education and learning – the future is here, but unevenly distributed

When you think of the words 'school', 'education', and 'learning', what images stir in your imagination? What other words do you think of? Undoubtedly, there is overlap – they belong to the same semantic field – but have our cultural references evolved? We would like to gently provoke your thinking around the grammar of schooling, education and learning.

School

We have all heard a keynote presentation where the provocateur shows us a picture of a 19th-century classroom and challenges us to see how today's classrooms are closely related. Or, if you search for stock photos of 'teachers,' you will see teachers writing on chalkboards while children sit passively in rows of desks. The icon for teachers is often an academic hat. Even AI image generators tap into these ingrained cultural stereotypes, picturing

> While tech-equity gaps remain, advances in affordable devices, connectivity infrastructure and AI make personalised learning achievable, not just an ideal.

future classrooms with robots replacing teachers at the front of the room. These examples reveal the stagnant hegemonic mental models embedded in our collective consciousness, reinforced through media, pop culture and AI systems' training data.

Our experience is that these depictions do not stand up in many of the best schools we have experienced. We witness more dynamic, personalised learning, with teachers as experts and designers of profound learning experiences, and students as partners in their learning.

Look at the work of the XP Schools Trust in the UK[1] who reimagined the curriculum through the lens of expeditions, with their key design principle stating

> *At XP we build our community through activism, leadership and equity sharing our stories as we go.*

This is not a pithy statement for a website; it is the principle from which all learning design flows. XP Schools are fundamentally part of a learning ecosystem that connects them to, and makes them leaders for change in, their local communities.

During one visit to XP Gateshead, it was a joy to see learners using technology to

- capture the voices of recent migrants to the local community,

- collaboratively project manage their expedition work, and

- engage in deep dialogue around the question 'should I stay or should I go?'.

The learning outcomes include a student film weaving together a narrative on whether immigration has been worth the risk for local people in this port city.

However, it is true in many contexts that the concept of 'school' has not changed. We still talk of buildings, classrooms, timetables, semesters and terms, assessments, students, teachers and principals. School remains a physical hub of academia and a central place of support for emotional learning. School is critical, but how it functions as a node in a more significant, interconnected learning ecosystem must be better explored. Otherwise, the 'school' will remain an output-focused extension of 19th-century, factory-style education.

Education

The same stagnancy is true of the concept of 'education'. We often think of something done to us, an abstract noun with qualities: 'I had a good education'. More specifically, when we look at education through a systems lens, we talk about policies, governance, curricula, just-in-case content, budgets and exams. Again, while all of this seems vital, many education systems have not evolved with the complex and contemporary needs of young people who deserve a learning experience that sets them up to thrive.

Nowhere is this disconnect more apparent than in our inadequate large-scale assessment systems. These standardised processes fail to represent what young people know, what they can do and who they authentically are. For the most part, education systems remain fixed despite the evolving world. However, some bright spots like Indonesia offer exceptions to the norm.

In Indonesia, the world's fourth largest education system, President Joko Widodo nominated in 2019 a new Education Minister, who did not come from a traditional education background. Nadiem Anwar Makarim was a former McKinsey & Co consultant and technology entrepreneur. He founded Gojek, South

For the most part, education systems remain fixed despite the evolving world.

East Asia's most successful on-demand platform for transportation, food delivery and logistics. Minister Makarim brings a familiarity and impetus for positive disruption, which he had engineered in the tech world, into the education system. Within three months of taking office he dispensed with the high-stakes end of schooling assessment. He quickly launched an umbrella policy known as Merdeka Belajar, or Emancipated Learning. Implementation of these policies relies upon a significant roll-out of digital identities and the development of a teacher 'super app'. Deep partnerships with industry support digital transformation, through content provision, human resources and work experience for young people.

Learning

So, what about the concept of 'learning'? We would argue that learning has dramatically changed in the last decade, not for every child, unfortunately, but for children with access to internet-connected technology. Paradoxically, the first principles of learning – exploration of knowledge, repetition, formative assessment and feedback, reflexivity, relationships and collaboration – remain unchanged, but the acceleration in the power of technology to make these more accessible, faster and more personalised has been astounding. Consider the shift from offline word processors to AI tutors that adapt to individuals, curate portfolios and understand how each student learns best. This acceleration is driven by technology's potential to deeply personalise learning and connect students to the broader world.

> The promise of personalisation through technology is finally coming to fruition.

AI, particularly generative AI, plays a pivotal role within the landscape of a digitally-enabled learning ecosystem.

Originating over six decades ago as a groundbreaking new discipline, AI has made remarkable strides. Some of its most notable achievements include IBM's supercomputer, Watson, triumphing on the game show Jeopardy, Google DeepMind's AlphaGo outperforming human players in the complex game of Go, and AlphaFold's pioneering discovery of protein structures. This vast combinatorial problem, known as the 'protein folding problem,' has been one of the most significant challenges in the field of molecular biology.

The advent of generative AI chatbots such as ChatGPT and Bard has captivated educational systems globally. These AI technologies are not only seen as powerful tools to enhance educational support, but they also have the potential to profoundly disrupt traditional educational practices, including standardised assessments.

The promise of personalisation through technology is finally coming to fruition. If governments can build DELEs – where every child, irrespective of geography and socio economic status, has access to adaptive learning and AI that safely and securely adds value to the learning experience – then we will make a huge difference in closing the learning gap. The scope of this paper does not allow for a deep dive into AI, but with the right AI Principles,[2] transparency and guardrails, a DELE powered by AI will have the power to transform learning at scale.

When we start to consider ecosystemic learning opportunities from a learner-centred perspective, then we see technology not as an add-on to the process of learning, but more the connective tissue of a learning ecosystem with individual children at its heart. What do we mean by a DELE?

Healthy, digitally enabled learning ecosystems

In this paper, we invite education system leaders to consider the complexity of a learning ecosystem where we safely connect learners to both formal and informal learning opportunities through technology. This includes the traditional concept of schools and education systems, but also considers the role of self-serve learning content, AI, community and public-private partnerships. Importantly, we might start to reconsider the role of Ministries, Bureaus and Departments of Education, not only as the policy bodies in an education system, but also as the overall guardians of DELEs, who ensure that every learner is able to participate fully in learning through the ecosystem.

By centring any transformation on learners, we start to consider the actors within the learning ecosystem. Let's take a moment to explore a map of who the actors in a DELE are. As you read through the following list, start to consider the complex interrelationships that exist between the different actors and also the role of technology in connecting these actors to one another.

> One impact of building a digitally connected learning ecosystem is that it can bring learning home.

Traditional actors within the learning ecosystem

Learners – at the heart of the system, most often learning in school, but also considering learners who are not part of the traditional school system and how we connect them to learning through technology.

If we contrast the 19th-century factory metaphor of schooling with the ecosystem metaphor of schooling, learners are no longer a time-stamped, standardised commodity rolling off a production line, but rather one of millions of different flowers in a garden that need to be tended to and nurtured so they can fully thrive.

Home – the meaning of home, and the level of support in learning it provides, varies greatly from child to child. This includes parents, carers and the wider community. While many children have a home situation that absolutely allows them to flourish, many do not. This pernicious problem is a real challenge, especially in places where education is not traditionally valued.

One impact of building a digitally connected learning ecosystem is that it can bring learning home. This became evident in the 2020 impact report[3] into ReadAlong, an AI-enabled reading fluency app aimed at improving the literacy level of young readers. The app was piloted in several different ways, including a direct-to-home model. While the impact on the literacy levels of the children themselves was impressive, one of the unintended consequences was that the parents of the children who, themselves, often had low literacy levels, started using the app to improve their own learning.

Schools – Schools will always be a key part of the learning ecosystem; safe places to learn and develop character, grow social connections and receive the support necessary to thrive. Arguably though, schools are not able to fulfil the unique needs of every child. Often this is a question of resourcing. If I cannot get everything I need as a learner from my school, how else might I access learning? Or, worse still, if I do not have access to school, how do I access learning at all?

In some cases, School is no longer only a physical building. For example, 5.7 million Ukrainian school-aged children have had their access to school cut off during the war. UNESCO[4] and UNICEF, in partnership with Google for Education and others, provided hardware and software to enable continuity of learning through a hybrid approach. This, coupled with teacher upskilling, psycho-social support and a focus on digital infrastructure and data analytics, has created a more resilient learning ecosystem, despite the horrific conditions of continuing war. The power of technology to connect has enabled the Ukrainian learning ecosystem to transcend borders. Young people in Ukraine can connect with those who have fled to other countries and can still learn online with volunteer educators from places like Monash University in Australia.[5]

Teachers and the education workforce – the life blood of the ecosystem that needs to be well respected, highly trained and supported as life-long learners themselves. The teaching profession is currently under immense pressure. UNESCO's estimates indicate the need globally for an additional 24.4 million teachers in primary education and some 44.4 million teachers for secondary education, in order to achieve universal basic education by 2030.[6] While this is a big problem in less economically developed countries in sub-Saharan Africa and South Asia, the problem exists everywhere.

One Australian Federal Government prediction is that there will be a shortfall of 4000 teachers in Australia by 2025. While this paper does not have the scope for us to explore this issue in detail, improved working conditions including

salary, training, support and recognition of the complexity of the profession would go a long way to remedy some of these challenges. Without teachers and educators (including learning mentors, specially trained classroom support workers and a whole range of allied professionals) the learning ecosystem will crumble.

Governing organisation – includes those people and institutions responsible for policy making that ensures a safe, effective and appropriately resourced learning ecosystem. This may be at a national, state and local level. One of the complexities and values of a broad learning ecosystem is that it is decentralised, or at least re-centralised around the learner rather than an education system. This means there are many more stakeholders whose work impacts the learning outcomes of young people. This does not require less policy, strategy and resourcing from governing organisations, but more. The more stakeholders in the ecosystem, the more important it is to have intelligent and empathic policy making and effective data and information sharing between the different levels of governance. It requires a mindset of 'stewardship'; designing policy, strategy and resourcing that takes into account the whole ecosystem and focuses on the thriving of every learner.

This shift in mindset is not modern, but in fact can be found in First Nation systems of learning around the world. In Australia, Hayley McQuire explains indigenous stewardship as a way of being and learning for Aboriginal and Torres Strait Islander People, who have 'cared for our continent for thousands of years'. In her 2018 article 'Education was not "introduced" it already existed'[7] Hayley lays out the imperative for meaningful connection and the reclamation of the millennia-old system of learning.

A system which fosters the connection and understanding of the interdependencies that exist in the world. One which is founded on an Indigenous learning and knowledge system where the purpose is to connect so we can take care of Country and community, a striking contrast to the current education system driven by the economic purpose of competition for jobs in a capitalist society.

The required shift to ecosystemic governance can be seen currently in the powerful work being done in South Australia at a Department for Education[8] level, which focuses on an authentic transformation of the education system into a learning ecosystem that has young people, schools, families and communities, higher education institutions and employers as partners in learning.

Curriculum and accreditation bodies – those bodies that define curriculum outcomes and certify formal learning through examinations. What we teach and how we assess has shaped our education systems for decades. In a learning ecosystem, we have the opportunity to reimagine both the curriculum, what we assess and how we assess it. While a strong focus on literacy and numeracy is essential to allow young people to access learning, a limited approach to curriculum that does not embrace mindsets and skillsets, as well as knowledge, risks providing its learners with knowledge that dates very rapidly and quickly becomes useless. A focus on other literacies, including critical and creative thinking, digital literacy including AI literacy, and more complex competencies like empathy and intercultural understanding, is essential to build the capabilities of young people faced with a diverse complex world. To paraphrase Alvin Toffler (1970), the paramount skill is to learn, unlearn and relearn.

In a learning ecosystem, we have the opportunity to reimagine both the curriculum, what we assess and how we assess it.

In a learning ecosystem, we also have the opportunity to think not only about what we assess but, as importantly, how we assess. Using the technology in a DELE to capture data on the growth of complex competencies, or AI adaptive learning to give in-the-moment feedback, is a compelling argument. Moreover, when we consider the learner-centred nature of a DELE, we can ask how we might personalise assessment so that each child gets the assessment task they need. This can require the broadening of our understanding of accreditation bodies. There are so many impressive examples of micro credentials now being issued by organisations other than schools that are recognised as part of an holistic overview of what a young person knows and can do.

All of the above actors are familiar to those leading education. In the following section we explore some of the less traditional actors in an ecosystem and briefly outline their roles in young people's learning.

Less traditional actors in an ecosystem

Micro credentials, community and informal learning opportunities – recognising the experiential and character-building learning opportunities that are uniquely part of learning outside of the classroom. As we break down the traditional walls between school and the wider community, we can really see the power of informal learning opportunities. To return to XP Schools Trust: community and informal learning is key to developing the character traits they value so much; above all compassion. By valuing and accrediting informal learning, XP Schools Trust further validates the contribution of young people to their community.

Education partners – learning through cultural education partners, like museums and libraries, but also partnering with private enterprise around education through online courses and internships.

Governing organisations and schools cannot provide an education worth having on their own. Partnerships are vital in creating a robust and healthy learning ecosystem. The Indonesian Government has unbundled higher education by allowing university students to earn university credits through off-campus, real-world experience. Almost 500,000 university students have embarked on project-based learning in world-class companies or industries: conducting research in world-class social sectors; teaching in schools in remote areas; learning technology skills from thousands of technology-based national and multinational companies; studying abroad in world-class universities; or studying in a different campus in a different region in Indonesia so they learn more about their country (Syahril, 2023).

> Data, like water, is at its best when it flows, and a DELE allows data to flow ...

Self-serve learning content – using technology to access freely available content and curated, curriculum-linked content. In a DELE, young people can access the incredible wealth of resources available on the internet, at the time they need to. Whether this is paywalled accredited content by some of the world's biggest education institutions or free Khan Academy videos, there is no shortage of quality content available. There is so much content, finding exactly what you need can be a challenge, but advances in AI and adaptive learning are making it even easier to source the right content at the right moment for learners.

AI-powered adaptive learning – advances in AI technology are finally delivering on the promise of personalised learning. Realtime feedback and AI-powered literacy tutoring are already integrated into many education platforms. The emergence of powerful Large Language Models (LLMs) means that interacting with complex information through a generative chatbot is genuinely helping learners in a way that was previously impossible. The concept that a learner in a DELE can have a natural language learning guide available to them whenever they need is revolutionary. It does mean that the modality of some assessments may need to change, to ensure that learners do not just copy and paste a Bard-generated answer to a question, but in many ways this problem has been around for many years; we have often talked of creative ways to make assessment unGoogleable and generative AI is forcing this conversation further.

The key element of this model is the role of technology as the connective tissue between the different parts of the ecosystem. By empowering students and educators with technology, it is possible to unleash the true power of an ecosystem that connects educators and learners to learning opportunities that were previously unavailable.

The agile nature of the ecosystem also means it is less likely to be disrupted by challenges such as pandemics; learning can continue anywhere that technology is available. Finally, the ecosystem opens up the power of data. Data, like water, is at its best when it flows, and a DELE allows data to flow, making individual and cohort learning growth visible, measuring the impact of investment and resourcing and enabling the stakeholders in the ecosystem to identify areas that are successful and areas that need further support to flourish.

Enabling factors of a healthy DELE

We have so far explored the concept of governments as the guardians of the DELE, but we now need to focus on what that means practically. What are the enabling factors that are necessary to keep a digitally connected ecosystem healthy? In the next section we draw on our experience of working globally in supporting DELEs. We will share insights and advice that system leaders may want to consider as they work through their own digital transformation planning.

Here, we explore the following six enabling factors for a digital learning ecosystem.

- Strategy, policy and resourcing
- Connectivity
- Devices
- Platform
- Teacher skills and content
- Learner skills and accreditation

Strategy, policy and resourcing

Although, strictly speaking, there are three enabling factors here, the reality is that they are deeply bound together as the main work of Government, in the space of creating a DELE. We started this paper talking about the key importance of having a shared vision for education that focuses on learning and the holistic growth of young people. We know that successful digital transformations are led by governments that take a 'pragmatopian' approach to this, by defining and being driven by a 'utopian' vision of what they want to achieve and translating that into a 'pragmatic' roadmap that will help them reach the vision.

It may sound obvious, but ensuring that there is a strategy with related policies and resourcing, milestones and measures of success is key to developing a healthy learning ecosystem. As importantly, using the data that can be gathered in a digitally enabled ecosystem (device data, platform data, learning data), governments can continually review and build on strategy, policy and resourcing, based on near-realtime information. Below, we explore some of the health indicators that education leaders might want to look at in relation to their own ecosystems, including some of the metrics that might be measurable through data.

Connectivity

Focus on connecting learning devices to the internet. The quality of the learning experience when a learner is safely connected to the internet far outstrips that of a disconnected device. Even devices that are intermittently connected to the internet provide a better learning experience than offline devices. This is especially powerful in terms of equity. Putting connectivity and devices into lower-resourced schools and communities allows them to leapfrog into higher-quality, connected learning experiences.

Where connectivity is an issue, system leaders may want to aim their resources at combining connectivity and devices – better to have a lower ratio of connected devices to students than to have lots of less-useful offline technology. If the learning experience that an offline device gives children can be replicated in an analogue manner, then use paper; it is more cost effective.

Connecting learners to freely accessible online learning content and tools opens them to a world of learning, collaboration and creativity. Moreover, in terms of equity, access and anywhere learning, connectivity is key to ensuring that every child,

irrespective of their location or circumstance, can access the learning they need when we support them with connected technology. However, as we will explore in the following section, Governments must put in place the policies, platforms and devices to safely manage connectivity so as not to expose our young people to any bad actors or inappropriate material.

We have seen many wonderful examples of safely managed devices, platforms and connectivity that have not only opened up great learning opportunities for young people, but that have also allowed for data to flow through the system. By leveraging the Cloud-based nature of modern learning platforms, Governments have been able to use dashboards filled with vitally important information, to improve processes and practices at all levels; from cohort-level assessment data analytics, to individual device usage data, from understanding the trends around digital tool usage, to ensuring that the investment in digital tools is being used wisely. Data flow allows visibility into the connected learning ecosystem in a way that was previously inconceivable.

In the Diocese of Parramatta, Dr Raju Varanasi and his team have led some amazing data analytics work that allows the leaders of that particular DELE not only to deeply understand resourcing and academic growth but also to trace the social and emotional learning journey of young people. The Centre for Strategic Education and Google for Education have published a paper (Varanasi and Pianta, 2023) that details this work.

Devices

Being able to access learning through any device is incredibly useful and a core tenet of cloud-based learning platforms. One thing that we see as a really important part of national-level and state-level digital transformation plans is equitable and resource-efficient distribution of devices. The advantage of being able to purchase devices at economies of scale, and to manage those devices, allows national and state governments to better manage resources and to track the return-on-investment of their resourcing.

By having managed devices, not only can administration policies be applied across all devices remotely, but data can be gathered on how and when the devices are being used to better understand the most efficient patterns of usage.

In terms of the ratio of device to student, we sometimes talk about the 1:1 ratio as a goal. While this is an ideal scenario, we appreciate that it is a journey to get to this point. We have seen many countries starting with school sets of shareable devices, then moving to a class set of laptops over time, with some schools aiming to get to a 1:1 model.

From a learning perspective, system leaders need to consider which device is most appropriate for learners and set budget expectations appropriately. This means that learners who are expected to write a 1000-word essay are not doing it on a tablet screen, and that every device has built-in accessibility features that allow all learners to learn.

Platform

While connectivity and devices are key, the connective tissue that really holds the learning ecosystem together is the platform. The following information is not a sales pitch, despite one of the authors working for Google. Both of us have used the Google Workspace platform for well

over a decade and are most familiar with it. What follows is a description of the Google Workspace platform, but there are other platforms available.

In 'best-in-class' digital learning platforms, we find

- Cloud-based storage,

- a teaching, learning and assessment platform,

- collaborative software,

- administrative software,

- AI-driven personalisation,

- a Single Sign On identity, and

- world-class security and privacy.

While this paper does not have the scope to delve deeply into the pedagogical impact of each of the tools, we will share some highlights from the platform we are most comfortable with; Google Workspace for Education.

Google Drive is the repository of all online content. It is a fully searchable and organisable Cloud-based 'filing cabinet' that allows teachers and students to create, share and collaborate with different types of learning.

Google Classroom acts as the central hub for digital learning through Workspace. This is the digital space where students and teachers can communicate, share resources, submit assignments, capture grades and provide formative feedback. In the paid edition of Workspace Plus, students and teachers can access tools like Practice Sets, which includes an AI-driven 'worksheet' where students can, for example, work on maths problems and receive immediate feedback from the AI on any errors, as well as highlighting of possible resources to remediate the errors. Having this type of AI tutoring supports the teachers, by giving them more time

to focus on the more cognitively challenging tasks while supplying data on student progress in a dashboard.

Google Docs allows for collaborative text creation, while integrating the power of Google search and AI to make researching and referencing sources incredibly simple. Moreover, teachers can see the development of a text and leave formative assessment feedback for each individual student through the commenting feature.

Google Forms allows for the creation of assessments with multiple question types that can provide automated feedback, collect and analyse data, then live-feed that data into a Google Sheet for further analysis.

From an administrative perspective, the Single Sign On (SSO) capability of Workspace means that teachers and students can also access Mail, Calendar and Meet which support the smooth running of administration in schools. Using Mail to communicate with parents, Calendar to build and share schedules and appointments, and Meet to create inclusive communities where students anywhere can join a lesson over video, are just some of the powerful use cases of the platform.

The most important thing to consider when considering the Workspace platform is that it is secured by world-leading technologies, keeps user data private and in the hands of the users and allows the system at a domain level (whether that is national, state or school), to manage the user experience for different groups of users simply and at scale. If a system were to decide to activate Mail and Calendar for all teachers, but not students, it is simply a case of switching it off for selected organisational units (ie, teachers or all students or even specific groups of students) using the admin console.

Teacher skills and content

As Governments move towards building a digitally enabled ecosystem, one of the key factors in ensuring its success for all learners is to plan carefully for the necessary pedagogical shift in teacher practice. Moving to a digitally enabled ecosystem allows for much more learner-centred, active pedagogies, such as project-based learning, design thinking, individual and group student research and inquiry, and the creation of beautiful and meaningful outputs of learning.

Teachers will need support in exploring the opportunities of hybrid pedagogy. In the CSE paper *Renegotiating learning in a hybrid world* (Harte and Howarth, July 2022), the authors explored the pedagogical impacts of digitally enabled ecosystems on pedagogy, with a particular focus on place, space, time, people and power.

The opportunities to combine digital and analogue learning spaces, to learn and teach from anywhere with connectivity, to learn synchronously and asynchronously with experts from around the world, and to truly enable learner agency, are some of the exciting and impactful opportunities that come with a DELE.

> Teachers will need support in exploring the opportunities of hybrid pedagogy.

In their 2022 paper, Harte and Howarth dived more deeply into the opportunities to embrace multiple pedagogical approaches through a DELE, but whether an educator is using explicit instruction to share subject-specific knowledge or designing a Project Based Learning experience to build complex competencies, we can enrich the experience through the judicious use of technology.

Without going over old ground, it is also very worthwhile to consider the role of published and community created content in a DELE. As we share more learning content into a DELE, we create more opportunity but also a greater need to curate that content.

Learner skills and accreditation

In the same way that we need to work with teachers and learning designers to help them think deeply through the challenges and possibilities of a DELE, we also need to scaffold this process for learners. Whether that be developing online safety skills through programs like Be Internet Awesome, learning algorithmic thinking through freely available curriculum,[9] or building AI literacy through Teachable Machine,[10] supporting learner growth in digital skills is key to students successfully navigating a DELE.

As previously discussed, there are powerful ways to recognise learning within a DELE, including microcredentials, so exploring how to include portable, trusted and meaningful accreditations is some of the key work of education leaders. There has been some fascinating work happening in the New Metrics Project,[11] at The University of Melbourne, tackling this very issue.

As education leaders start to move their thinking from system to ecosystem, these enablers become key and are deeply interconnected. Building a healthy, DELE is an ongoing endeavour, so it is key for leaders to be able to identify sources of data and information that can be used to provide insights into the health of the learning ecosystem. In the next section we explore this in a little more detail.

Indicators of a healthy learning ecosystem

While constructing models and maps of learning ecosystems is crucial for comprehending our context, this is just a means to an end. As stewards of learning ecosystems, our goal is to sustain and enhance its health, thereby enabling individuals to thrive.

To maintain optimum health we need to understand the indicators that signal the wellbeing of a healthy learning ecosystem. If we understand these indicators, we can assess the health of our learning ecosystem and make informed decisions to improve it. Under each of the indicators we have tried to capture what an unhealthy DELE and a healthy DELE might look like.

A holistic focus on human thriving

In a healthy learning ecosystem, human thriving is at the centre of all initiatives. This means that the ecosystem is designed to support the growth, wellbeing and success of all individuals involved.

Unhealthy	The system focuses on the system and makes decisions that focus on incremental ways to keep the status quo.
Healthy	The system focuses on people and evolves to reflect the evolving needs and shifting contexts of the people.

Future-focused vision for education

A healthy learning ecosystem has a future-focused vision for education. Leaders across the ecosystem share a picture of the future that is challenging and inspiring. Guiding principles and a strong direction align to everyday actions.

Unhealthy	Education has a solely custodial and economic vision (school is somewhere for young people to be and learn how to become workers).
Healthy	The education vision is shared, understood by all and seen as a key driver in societal thriving, now and into the future.

A capacity to reflect, adapt and evolve

In response to uncertainty, disruption and change, healthy learning ecosystems have the capacity to reflect, adapt and evolve. This is more than continuous improvement. It means the ecosystem strengthens in response to changes in the educational landscape, including technology, social trends and the needs of learners.

Ecosystem resilience is the inherent ability to absorb various disturbances and reorganise while undergoing state changes to maintain critical functions.

(Sasaki et al, 2015)

Unhealthy	The 5-year plan is the 5-year plan and we will execute it as it was written.
Healthy	There is a flow of data that informs how well the ecosystem is doing and micro adjustments can be made.

Equitable and accessible learning opportunities

A healthy learning ecosystem provides equitable access to high-quality learning opportunities for all individuals, regardless of background or circumstances. Resources are allocated to address systemic barriers faced by disadvantaged groups. Initiatives actively promote inclusion and support diverse learning needs.

Unhealthy	Your capacity to thrive through education depends on your socio-economic situation, geographical location, gender and ethnicity.
Healthy	Education is designed with equity at its heart so that all learners can thrive in lifelong, lifewide learning.

A diverse, expert and flourishing workforce

A thriving ecosystem has a diverse workforce, where professionals from all backgrounds are empowered to grow and excel. There are opportunities for ongoing development of expertise, aligned to personal and organisational goals. Wellness and balance are prioritised alongside professional success.

Unhealthy	Workforce is undervalued and underpaid, diverse skillsets are not valued and non-essential processes take time from the fundamental work of supporting every learner to grow.
Healthy	The system invests in the workforce, helping to build diverse skillsets (remote teacher, resource builder, 1:1 coach). The system ensures that supporting learners remains fundamental, by reducing or reimagining administrative processes.

Flexible, safe and data-rich digital systems

A healthy learning ecosystem utilises adaptive digital platforms, which enable personalised, self-directed learning while protecting student privacy and data security. Technology expands equitable access to high-quality resources, networks, expertise and insights, locally and globally. Data and analytics responsively inform decisions and guide continuous improvement, while upholding ethics and security.

Unhealthy	Digital systems are inflexible to the needs of educators and learners and create unsafe 'shadow IT' practices, which put users and their data at risk.
Healthy	Digital systems are flexible and responsive to user needs, while risk is mitigated by centralised management and support.

Quality and sustainable physical infrastructure

A healthy learning ecosystem invests in high-quality digital and physical infrastructure, to enable a better educational experience. The infrastructure utilises sustainable materials and practices, with a view to long-term environmental stewardship. Facilities provide accessible, inspiring learning environments that support growth and model sustainability.

Unhealthy	The physical learning spaces are not conducive to learning, with little access to devices and connectivity.
Healthy	Physical learning spaces are flexible, impact positively on learning and are shared with the community. Device ratios are approaching 1:1, but remain adaptable and sustainable.

Standards informed and flexible learning pathways and curriculum

Learning pathways combine clear standards and skills with customised experiences based on diverse needs, interests and strengths. An indicator of health is the flexibility and responsiveness of the learning pathway, without compromising the alignment and integration of standards. A healthy learning ecosystem balances rigour and flexibility.

Unhealthy	Curriculum and the designed learning experiences are one-size-fits all, most students learn the same things in the same way.
Healthy	Fundamental literacies (literacy, numeracy, digital, SEL) standards are clear and progressive. There is flexibility in other areas of the curriculum that respond to the learner's needs and local opportunities.

Multiple, trusted forms of accreditation

A healthy learning ecosystem communicates learning success, internally and externally, in a variety of trusted ways. Accreditation is holistic, diverse and equitable. Young people are empowered to make connections across the ecosystem with trusted credentials, which communicate their progress and growth.

Unhealthy	Accreditations are high-stakes, summative, narrow and academically focused, They are seen as the only metric of success.
Healthy	The education system curates and validates multiple forms of accreditation that, when combined, tell an holistic story of a student's knowledge, skills and competencies.

The indicators of a healthy learning ecosystem are interconnected and mutually reinforcing. Human thriving is enabled by equitable access, diverse professionals, adaptive systems, inspiring spaces, personalised learning and trusted credentials.

These elements help ecosystems absorb change, reorganise and continue serving all individuals. They build resilience to uncertainty. By assessing and strengthening specific indicators, we holistically reinforce systemic health.

A thriving ecosystem has redundancy across indicators, so strengths in others buffer setbacks in one area. There is no perfect state, only a dynamic balance, but this equips the ecosystem to flourish over time.

Conclusion

Our aim with this paper is to help leaders shift from systems thinking to ecosystemic thinking. We hope that some of the provocations, around how digitally enabled learning ecosystems can be nurtured to become antifragile, resonated with the reader. There is a huge amount of work to be done in this emerging, transformative space and it takes leaders with courage, empathy and an unwavering focus on human thriving to be stewards of these DELEs and ensure that every young person can thrive. It is often said that it takes a village ... well, we believe it takes an ecosystem.

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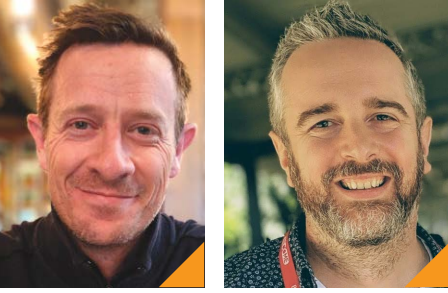
L-R: TOM BARRETT & CHRIS HARTE

About the author

Tom Barrett founder of Dialogic Learning Pty Ltd, has over two decades of experience as a classroom teacher, school leader and consultant. He started integrating technology to enhance the learning experience while teaching in England and remains curious and passionate about the potential of great innovation. Based in Melbourne, Tom works with schools across Australia in long-term partnerships and supports leaders as a coach. Drawing upon his expertise in design thinking, coaching and facilitation, he helps clients achieve their goals and address their challenges. Recently he led a remote professional learning project for secondary teachers from Papua New Guinea.

Chris Harte has worked in education since 2000, as an award-winning languages teacher, a senior leader in one of the UK's most innovative schools, Director of the online school, Emerging Sciences Victoria, an independent consultant and now as Government and Academic Engagement Lead at Google for Education. In his role at Google, Chris works with multiple jurisdictions across the Asia region as a 'thought partner' in developing vibrant, healthy learning ecosystems that use Google technology to develop educational equity and 'anywhere learning' and to provide data insights into learning growth.

About the paper

The authors argue that as technology advances to fulfil its promise of genuinely personalising learning, custodians of the education system have the opportunity to reimagine policy and practice, transforming school systems into personalised learning ecosystems. The challenge, they believe, is to recast education, build equity, embrace agency and purposefully support all learners to thrive. They discuss the roles of traditional and less traditional key actors in the learning ecosystem and explore how system leaders and guardians of the next generation of humans can enable and nurture Digitally Enabled Learning Ecosystems (DELEs), embracing technologies as the connective tissue holding personalised ecosystems together.