Education

Blockchain Goes to School

Education leaders need further proof that secure distributed ledger technology is ready for prime time. But with a wealth of compelling potential applications at its disposal, the industry stands to reap significant benefits in terms of cost reduction and the student experience as blockchain accelerates into the mainstream.

Executive Summary

The education industry is changing before our eyes. No longer solely the province of a centralized learning environment in either the physical or virtual worlds, education now occurs via peer-to-peer interactions, online and from anywhere on the planet. Educational providers, particularly in higher-ed, are struggling to harness digital technology as a tool for transformation.

Blockchain technologies present enormous opportunities to help higher education providers:

- Reduce costs and eliminate fraud by avoiding manual verification of transcripts and other documents.
- Increase innovation by providing a platform for collaboration between business and educational institutions, as well as other possibilities.
- Boost efficiencies via "smart contracts" that execute automatically when certain conditions are met.

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Potential applications of blockchain in education include:

- Storage of permanent records.
- Learner identity verification and information security.
- Student ownership of lifelong learning credentials.
- Automatic credit transfers.
- Intellectual property protection for educational content.

These are very early days for the use of blockchain in education, and few institutions are ready to invest heavily in the technology. However, the potential benefits are convincing for a resource-constrained industry concerned about competition from nontraditional players. As a result, educational institutions are working to better understand the technology and are conducting pilot projects to target the best use cases and most likely benefits.

Once the industry begins to move, with more alliances being formed and standards being defined, adoption could be rapid. Blockchain platforms are characterized by a strong network effect, meaning that the value of the platform grows with each additional user and/or company participant. Educational providers should get involved now to be ready when blockchain reaches the mainstream.

The Education Sector: Grappling with Disruption

As an industry, higher education has enjoyed a long period of stability and steady profits. That idyll came to a crashing end with the advent of digital technologies, such as social, mobile, analytics, the cloud, artificial intelligence and the Internet of Things. Higher education is buffeted by disruptive forces, and chief among them is online learning.

Economic necessity has been a major driver for students becoming more open to and trusting of new ways of accessing learning. Increased participation in the sharing economy has also served to engender consumer trust in the peer-to-peer model. The degree of peer-to-peer collaboration in education is evolving at a rapid rate, creating new sharing models and business opportunities.[1] The rise of massive open online courses (MOOCs) presents the very real prospect that more students will elect no-cost education options.[2]

At the same time, the education sector must also cope with a heavy regulatory burden. Seemingly straightforward tasks like sharing a school transcript currently requires an inordinate amount of time and money compared with similar transactions in the digital world. This creates an expectation gap, as consumers are accustomed to having their needs met quickly and with personalized attention. Institutions of higher learning are struggling to keep pace with all these changes.

Further, most educational institutions follow a model in which each maintains control of its student records and credentials. Since each organization controls its own data, it can be altered or deleted, and there is no fail-safe or redress should the data become corrupted. Institutions can prevent or set conditions on data access at their whim, or data can be used and shared in an unauthorized manner.

This model also places data at risk of being altered or destroyed during global events such as war, or due to natural catastrophes such as floods or earthquakes. The war in Syria, for example, destroyed credential records across the country, further adding to the widespread chaos.[3]

The need to share data in a secure and frictionless manner will only increase as students increasingly pursue more mobile learning styles and studying abroad.[4] Institutions that hope to attract students from across the globe need to bring their systems and processes in line with modern student expectations.

Blockchain's distributed ledger technology can play an important role in meeting all of these challenges. Its decentralized architecture offers the benefits of enhanced privacy and security through public key infrastructure (PKI) encryption, anonymity, longevity, integrity, transparency and immutability.

Already, the technology has progressed steadily in industries such as financial services and insurance. IDC estimates that global blockchain spending will reach $2.1 billion in 2018.[5] Leading adopters in these industries are moving from proofs of concept to full blockchain deployments.

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The Blockchain Opportunity

Given that blockchain is an emerging technology, education leaders, similar to executives in other industries, are seeking additional proof of blockchain's mainstream application (beyond cryptocurrency).[6] Many are wary of investing precious resources on a still maturing technology. But there are risks to sitting on the sidelines too long. Organizations that start now to understand the technology and the value it can deliver via precise use cases (see next section) will be properly positioned to reap its operational benefits.

As history has shown, "first-mover" status is advantageous, with the lines between giant technology players such as Amazon, Google and Facebook and their more traditional rivals increasingly disappearing. Already, Google has launched Google Apps for Education (GAFE), a free, cloud-based productivity suite with tools comparable to the Microsoft Office suite. This offering is enticing for schools as it results in significant cost savings in both licensing and server maintenance expenses. GAFE has grown to over 30 million users worldwide, according to the company, and has become an industry standard for collaborative cloud applications, disrupting the position of traditional vendors offering learning management systems (LMS).[7]

Amazon is another case in point. Its textbook rental model is presumably cutting into traditional textbook publishers' revenues. And though still in beta format, its AmazonInspire marketplace for self-publishing, curation and delivery of educational content will compete with MOOCs and traditional publishers.

Rather than waiting to see how technology giants will shake things up, institutions of higher education can benefit from advancements in educational technology, including blockchain.

Quick Take

Blockchain: How It Works

Blockchain serves as a platform for achieving and maintaining integrity in distributed peer-to-peer systems, obviating the need for a central authority or clearinghouse. Here's how it works at a high level:

- **Each user maintains his or her own information**, including transactions, contracts, certifications, credentials, assets and identities, as well as anything else that can be recorded in digital form.
- **Because entries are permanent**, transparent and secure, community members can view transaction histories in their entirety.
- **Each update is a new "block"** added to the end of a "chain." A blockchain protocol manages how new entries are initiated, validated, recorded and distributed.
- **Cryptology replaces third-party intermediaries** as the keeper of trust, with all blockchain participants running consensus algorithms to certify the integrity of the whole.

(To learn more, read our ebook "Demystifying Blockchain."[8])

Blockchain Use Cases in Education

There are many potential use cases for blockchain in education:

- **Storing student credentials.** Most higher education institutions keep students' completed course records in proprietary formats. These databases are structured for exclusive access by an institution's staff and in dedicated online systems, with little or no interoperability. Further, the majority of institutions have their own specialized system for keeping students' completed course records, which preserves the proprietary data structure of the database.

  In contrast, blockchain records are stored permanently, so documents such as degrees and course certificates can be secured and verified, regardless of whether or not a user has access to an institution's record-keeping system (see Figure 1). Even if the institution that issued the certificates were to close, or if the entire education system collapsed, those certificates would still be verifiable against the records stored in a blockchain. In addition, once institutions issue a certificate, no further efforts are required to confirm the validity of that certificate to third parties, since the certificate can verify itself directly on the blockchain.

  For example, the MIT Digital Certificates project offers an open-source ecosystem for creating, sharing and verifying blockchain-based educational certificates. Digital certificates

Student Credentialing through Blockchain

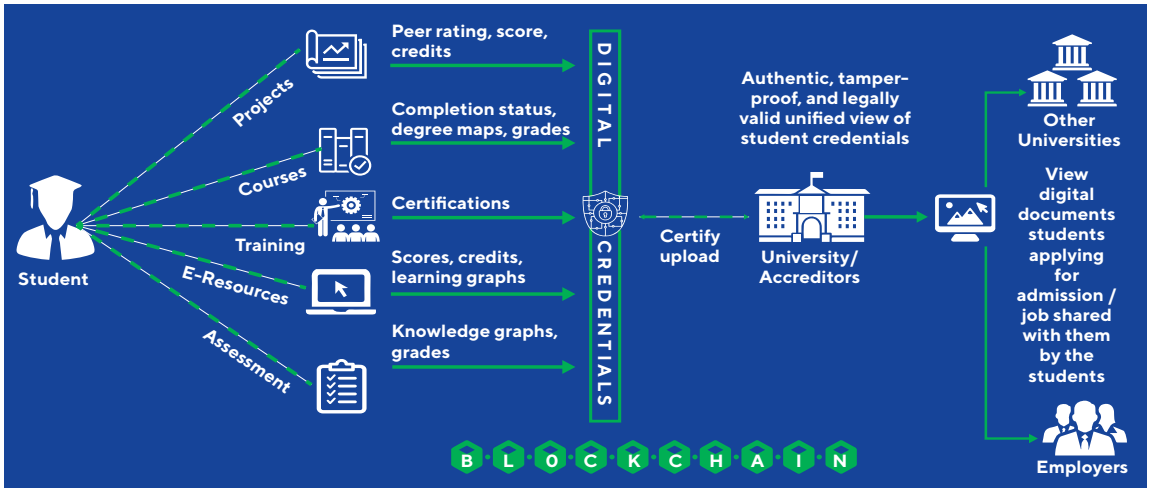

Figure 1

Blockchain records are stored permanently, so documents such as degrees and course certificates can be secured and verified, regardless of whether or not a user has access to an institution's record-keeping system.

are registered on the Bitcoin blockchain, cryptographically signed and tamper-proof.[9]

- **Identity verification** is another perennial problem for educational institutions, requiring much manual intervention and presenting many opportunities for data tampering. With a digital process, validation of a student's identity happens once. Rather than storing the student identity document, the blockchain network stores information about that document. Using blockchain, students and job candidates can identify themselves online while maintaining control over the storage and management of their personal data.

Within larger institutions, students need to regularly identify themselves to different parts of the organization. In such cases, either each part of the institution collects the student data for itself, or the organization uses single sign-on, whereby one shared copy of the student data is used by all parties within the organization.

Under both of these models, tens if not hundreds of people might have access to a student's personal information. Keeping that data safe requires managing access rights for all those people, and ensuring their devices are also secured – a mammoth, if not impossible, undertaking.

With blockchain, only a select few – namely the parties responsible for verifying a student's identity – have access to the data (see Figure 2). Other than that, it's in the student's hands. This means that the organization no longer needs to manage

Ensuring Digital Identity through Blockchain

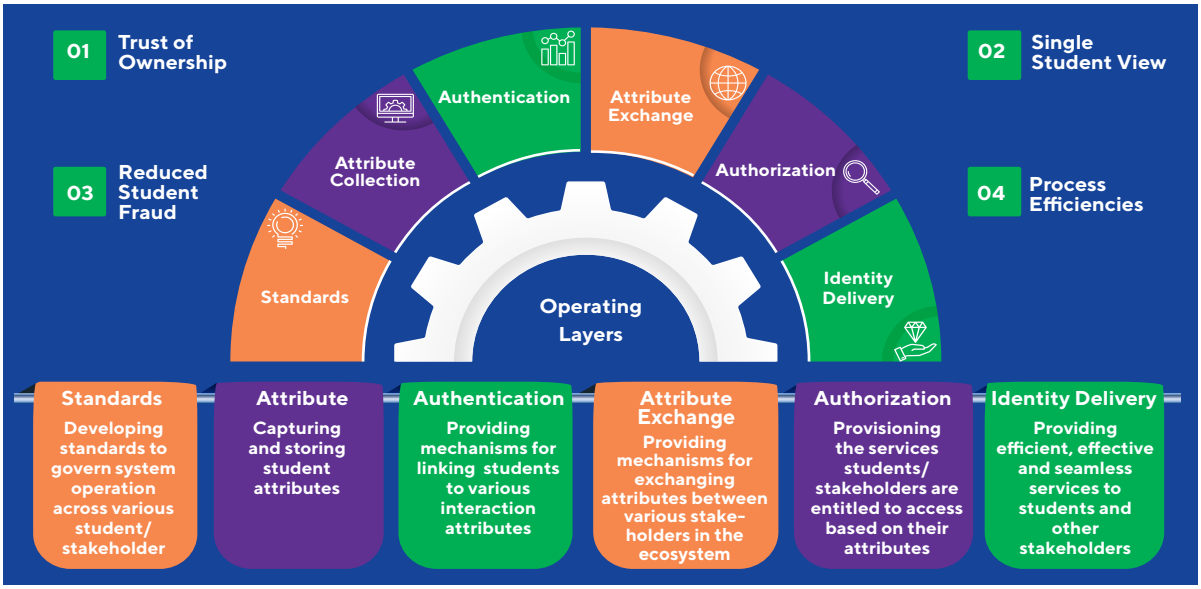

Figure 2

Rather than storing the student identity document, the blockchain network stores information about that document.

the complex systems for access rights, and only needs to secure the device or network where the initial verification takes place. This removes the need for significant investment in hardening the network against data breaches, staff training on data protection and managing access rights.

- **Intellectual property protection.** Professors regularly publish research and papers as part of their work. Under the traditional system, there is little way to know if a similar academic study is under way when a professor begins his or her research. In addition, there is much piracy of the research itself. The use of blockchain helps address these problems.

  Blockchain could allow educators to publish content openly while keeping track of reuse, without putting limitations on the source material (see Figure 3). Such a system would allow teachers to be rewarded based on the level of actual use and reuse of their teaching materials, similar to how they are rewarded based on the number of citations to their research papers.

Students and institutions could then make metrics-based decisions on which teaching materials to use. Teachers could announce the publication of their resources and link to them, as well as the other resources they used in creating the material. Crypto-coins could be awarded to educators according to the level of reuse of their respective resources. In an open scenario, coins would not be spendable but would rather be used to determine the author's prominence. In a closed scenario, coins would have monetary value and would result in monetary compensation.

A more advanced implementation might automatically scan resources to identify the percentage of other resources that were reused and automatically issue awards. For example, a "smart" (or self-executing) contract could distribute payment to authors based on how often their material is cited or used. Authors would no longer have to go through intermediaries such as research journals, which often limit use by charging high access fees.

Protecting IP through Blockchain

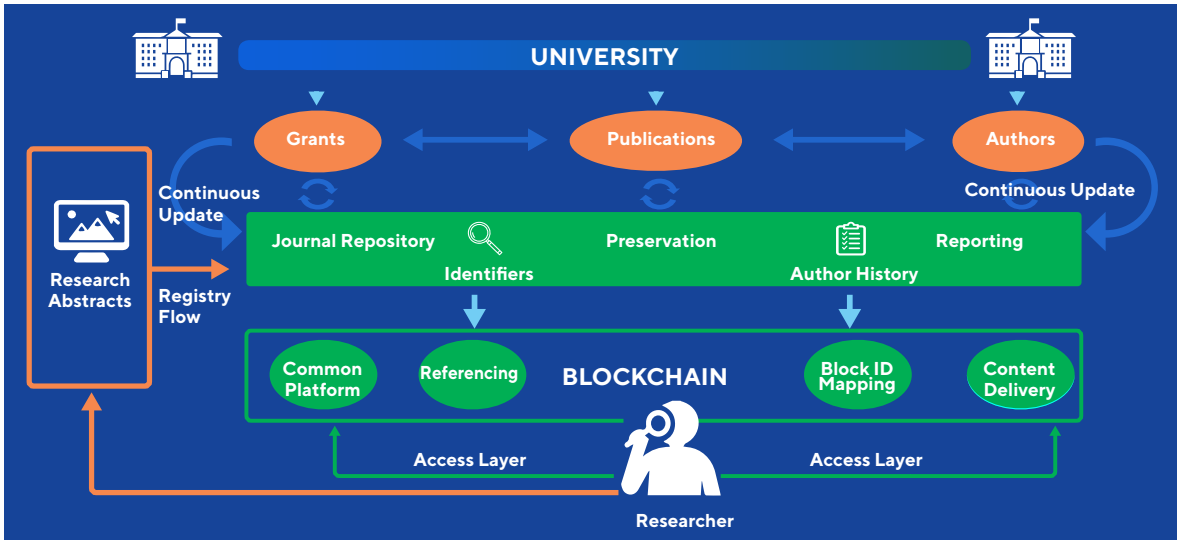

Figure 3

- **Micro-credentialing and ownership of learning credentials.** Blockchain could provide a more durable and flexible system for storing student credentials as they move from course to course throughout their professional careers, as well as their secondary education (see Figure 4). Via blockchain, credentials cannot be modified, providing a more reliable system of storing credentials for a lifetime of learning.

  Blockchain allows personal data to stay personal to the learner. Students gain control and ownership of all their education data, including accreditation and portfolios of work, in a secure place that is accessible to anyone who needs to verify it. Public blockchains facilitate self-sovereignty by making individuals the final arbiter of who can access and use their data and personal information.

  Within an educational context, the term is on its way to becoming synonymous with the empowerment of individual learners to own, manage and share details of their credentials, without the need to call upon the educational institution as a trusted intermediary. This will be increasingly important as the industry continues its move toward skills-based education.

  With blockchain, learners could store their own evidence of formal or informal learning, share it with a desired audience, and ensure instant verification. This means students could have a self-updating curriculum vitae that can easily be shared with employers. Employers, meanwhile, could reduce their workload since they would not have to verify CVs and could simply search to see whether candidates have the skills required.

- **Transfer of credits** has been another perennial challenge for institutions, often leaving students at a disadvantage when they find, for example, that they must repeat courses to fulfill a new institution's requirements. Students also experience difficulties transferring to another higher education institution, while still preserving and proving courses completed at a previous institution. This problem is even more vivid in cases when a student wants to transfer to an institution in another country, where language and disparate processes are likely to pose additional barriers. Moreover, standards for record storage vary, which can make inter-institutional record exchange difficult.

Ensuring Durability, Flexibility with Micro-Credentialing

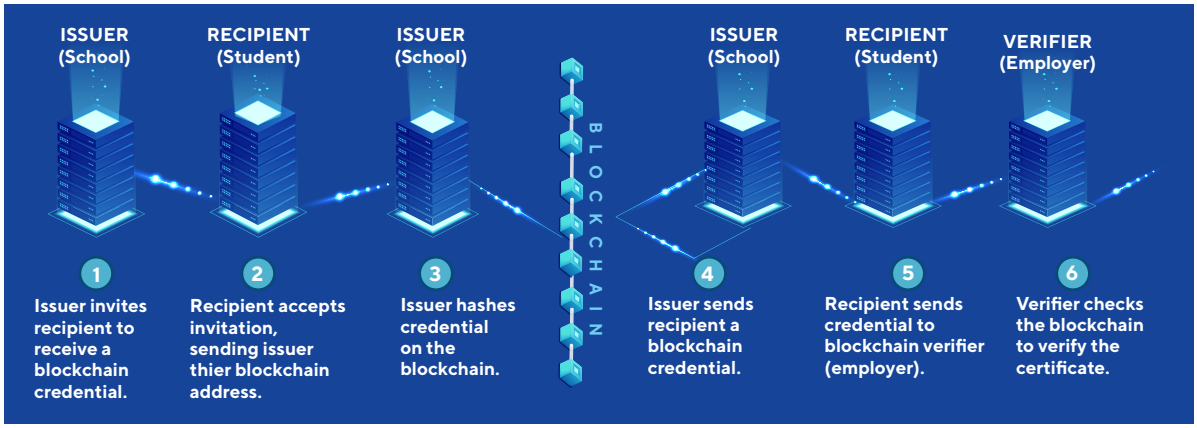

Figure 4

Currently, credit transfers depend on institutions negotiating agreements to recognize each other's credits subject to certain conditions, but students report these agreements are often not recognized. With a blockchain approach, these agreements could be written as blockchain-based smart contracts, whereby the credits would automatically be transferred upon fulfillment of the conditions of the contract.

Challenges to Blockchain Adoption in Education

As a nascent technology, blockchain adoption presents numerous challenges. Blockchain requires wide-ranging business process change, with the technological component being only a small part of its implementation. For blockchain to make a significant impact on the education space, grassroots-level change is required, as well as collaboration from all the stakeholders across borders. (To learn how this is being tackled in other industries, visit the Blockchain Primary Research section of our website.)

Governmental bodies will play a critical role in creating and overseeing blockchain regulations, as well as building the infrastructure needed to propagate blockchain use. This activity has already begun. Recently, the European Commission set aside €300 million to be invested in the European blockchain space as part of the E.U.'s strategy to "harness the many opportunities of blockchain and avoid a fragmented approach."[10] Such public investments in blockchain infrastructure are necessary to spur and ease its adoption. Moreover, regions outside North America and Europe are leading the way in sweeping away regulatory hurdles surrounding blockchain – particularly Australia, Singapore and others in the Asia/Pacific region. [11]

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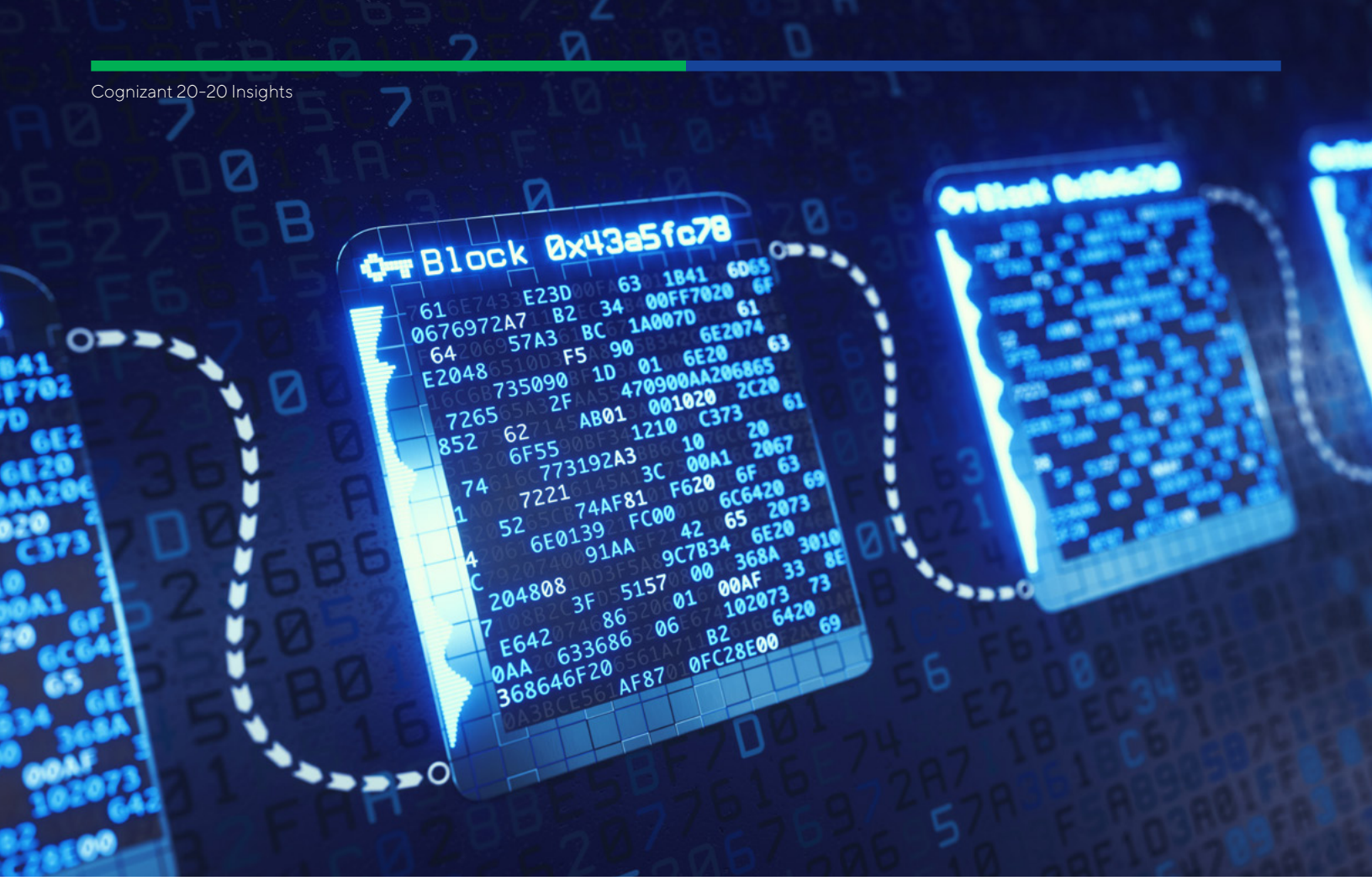


There are, however, a host of distinct issues that await resolution, including the development of data standards, the high cost of storage and processing, the location of data storage, and how to filter, analyze and securely share data.

Standards are a particularly thorny issue for blockchain in education. Each institution has its own way to store and manage student data. As blockchain adoption increases, new standards are being defined every day, with the potential for chaos. Standards bodies such as IMS Global, W3C and IEEE are potential catalysts for such activity. Standards to be developed include an education-industry taxonomy, metadata, data privacy, accessibility, geo-specific data storage policies (as applicable in Europe), data-exchange frameworks for credits, qualifications, skills, what data can be made transparent to others vs. what needs to be hidden, data-access governance and rules, etc.

Another notable issue is the transition of data storage. While the new records will be available on blockchain, what happens to the existing data? How do institutions bring all of their legacy data onto newer systems or make it accessible through new networks (and ensure compliance with standards as they take hold)? Another open question is whether and to what degree institutions will recognize and accept the need to release control of the data.

Organizational change management and governance also loom large. Overcoming governance challenges will require a concerted effort to ensure that the standards for digital credentialing systems are open and that they take into account the needs of all involved — learners, educational institutions, employers and governments.

Get Ready for Blockchain

Blockchain's learning curve is steep. Implementation raises significant technological, operating and business model issues, as well as the need to ensure collaboration and the availability of knowledge and resources to experiment with and deploy distributed ledger technology.

However, with such compelling use cases, it's inevitable that current adoption rates will only increase. Here are three actions educational institutions can take in the short term to begin preparing for blockchain:

- **Promote understanding.** There's a pressing need to communicate blockchain's complexities in a clear and comprehensible manner that resonates with target stakeholders. Domain experts, specialist researchers, academics and industry leaders have an important role to play here.
- **Experiment.** Blockchain applications for education are picking up steam. However, educational organizations need evidence to prove that blockchain offers significant value, either to themselves or to their students. Understanding the potential of blockchain without these examples is just theory. There's currently a big push in the industry to conduct pilots to obtain a fine-grained understanding of where the true potential lies.
- **Be part of the movement.** Blockchain cannot be ignored. It's set to overturn the education sector and will have a profound impact on current players in this market, so it's important to be part of this innovation process. This is a time of great opportunity for those who act decisively and assertively. The development of the technology needs to be considered a shared competence in the education market, to ensure an appropriate balance of private sector innovation, along with safeguarding the public interest.

Looking Ahead

Blockchain is positioned to reinvent the education sector. It is vital for leading lights to begin now to understand and experiment with the technology, both individually and as part of a consortium. While few institutions are ready to invest heavily in blockchain, kicking off the discussion internally and with colleagues across academia will enable them to be prepared once opportunities emerge, with the scale and significance to deliver both game-changing business value and learning experiences.

Quick Take

Checklist: When to Use a Blockchain

A key success driver for successful blockchain adoption is identifying a relevant use case. The following elements must be present before moving ahead with blockchain experimentation:

- **A database formatted as a ledger** (i.e., a list of time-stamped transactions listing what was transacted, from whom and to whom).
- **Multiple writers** (i.e., different individuals, usually in different physical locations, need to write to the database).
- **Transacting in the absence of trust** (i.e., each of the writers to the database would not be willing to allow anyone else to edit their entries).
- **Disintermediation** (i.e., the various writers don't wish to grant control of the database to a centralized authority for management).
- **Transaction interaction** (i.e., there is some interdependency between the transactions).
- **A clear set of rules** (i.e., transactions are only allowed if they meet precise conditions, which can be independently and automatically verified).
- **A store of value** (i.e., entries on a blockchain should represent assets or records that have real-world value).

Blockchain Decision Path

1. Need for a shared common database?

2. Multiple parties involved?

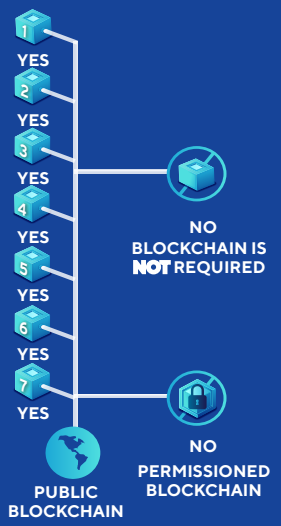
3. Parties involved have conflicting incentives and/or are not trusted?

4. Rules governing participants are not uniform?

5. Need for an objective, mutable log?

6. Rules of transactions do not change frequently?

7. Are transactions public?



Source: https://twitter.com/ctricot/status/947784521117814784

Endnotes

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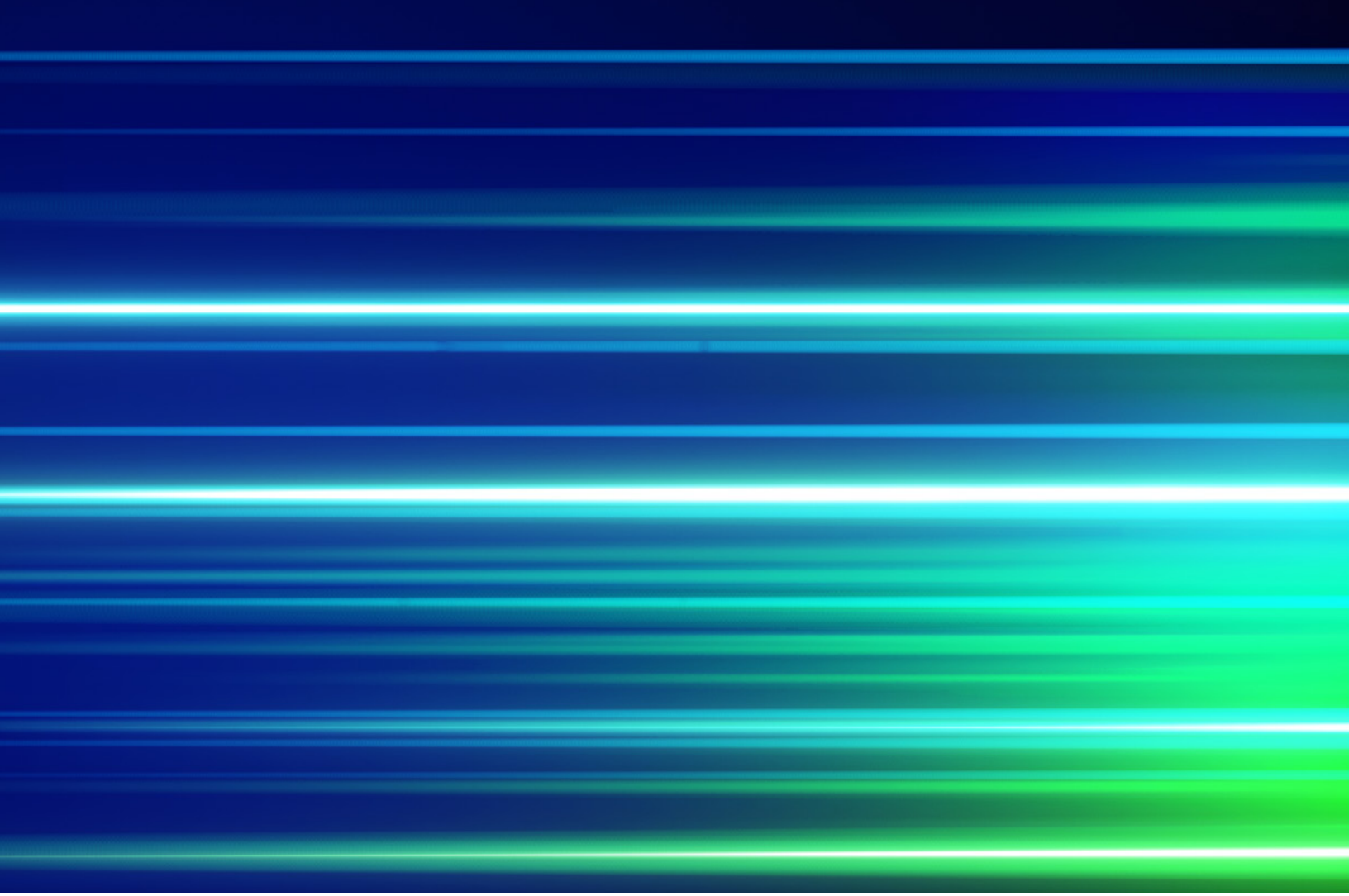

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