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POSITION PAPER

EdTech Horizon Scan

Blockchain technology in education

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Reviewers

Bjoern Hassler

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1. Introduction

EdTech Hub horizon scans are publications designed to provoke thinking on a range of topics related to the design, implementation, oversight, and monitoring and evaluation of educational technology (EdTech) tools, products, services, and related ideas.

The scans DO contain a range of sources that have been identified by the authors as interesting and insightful. These have been synthesised to foster ongoing conversation as the EdTech field rapidly evolves. These scans ARE NOT designed to be comprehensive, and should not be confused with systematic literature reviews or academic literature. They are quick guides that are part of the Hub's commitment to sharing knowledge fast and learning out loud. Should you have any questions or feedback on this horizon scan we would love for you to [contact us here](#).

This EdTech Horizon Scan examines the use of blockchain technology in education — what the possibilities are, what has been done so far and what can be done in the future. Given that blockchains are an emerging technology, the purpose of this scan is to provide readers with insights into blockchains more broadly and their potential use within education systems.

2. What is blockchain technology?

Blockchain technology uses [cryptography](#) to store and share information securely ([†Det Norske Veritas, 2017](#)). A blockchain is a decentralised database that stores information in a digital format that cannot be changed. It can be described as a digital ledger of transactions that is shared across a network of computer systems. Everyone who is part of the network has access to this ledger and the record of transactions. Although the ledger is shared with the different members of the network, all transactions are only recorded once and are permanent ([†International Business Machines, 2022](#)). These transactions cannot be changed, deleted, or destroyed. A blockchain database differs from a normal database in the way that the information is stored ([†Hayes, 2022](#)). In a blockchain, the data is stored in groups (a block) and linked together to form a chain, whereas a typical database stores data in tables. There are three steps to how a blockchain works ([†Gadgets 360 Newsdesk, 2021](#); [†International Business Machines, 2022](#); [†Miles, 2017](#)):

1. Each transaction is recorded as a 'block' of data on the database, recording any necessary information about the transaction. As each block is secured by cryptography, it contains a unique key that acts as a personal digital signature and a private key works as a password. The private key is verified using a public key. The unique key becomes invalid if the data is changed in any way.
2. Whenever a new block is added to the chain, it is securely connected to the one before, preventing the block from being altered. A new block cannot be inserted between two existing blocks, it is always added to the end of the chain; thus, they are always stored in chronological order.
3. Transactions are added as additional blocks to create an irreversible chain called a blockchain. The blockchain cannot be tampered with. Blockchains do not have a single point of control and are therefore difficult to hack or corrupt. As they are decentralised and distributed, this increases security.

Blockchains are most commonly known for their use in cryptocurrency systems, such as Bitcoin, where they maintain a secure record of transactions ([†PwC, 2019](#)).

Recently, as blockchain technology has emerged, actors in many sectors have been exploring how it can be leveraged to strengthen the security and validation of databases. The education sector is no exception to this.

3. How can blockchain technology be used in education?

This section explores how blockchain technology can be adapted for use in education. Initial explorations and research into how blockchain technology can be integrated into the education field have focused on five main topics ([↑Cognizant, 2019](#); [↑SotaTek, 2021](#)):

1. Micro-credentialing and ownership of learning credentials
2. Transfer of credits and smart contracts
3. Storing student credentials
4. Identity verification
5. Intellectual property protection

This section outlines how blockchain technology can be used in these ways to transform education.

3.1. Micro-credentialing and ownership of learning credentials

The blockchain approach could support the digital storage of students' credentials. These credentials could range from secondary school education, tertiary education and other post-graduate education, and ongoing professional development. The benefits of this would include:

- Student evidence of formal and informal education, as well as their personal data, can be managed directly by the student. This would allow them to choose who has access to this information and have a “self-updating CV” ([↑Cognizant, 2019](#)) that can be shared with employers and other educational institutions.
- Employers could be sure that the CV of a candidate has already been verified.
- The system is more reliable as credentials on a blockchain cannot be modified.
- Learners would no longer need to go through their educational institution as a trusted source when sharing their academic and skills-based achievements.

3.2. Transfer of credits and smart contracts

Transferring to a new institution can be a challenge for students, as they need to ensure that the courses they have already completed and the credits they obtained at their previous institution are recognised by the new institution they wish to attend. This challenge is exacerbated for marginalised populations that are forced to move locations, such as internally displaced people, refugees, and rural migratory populations, as they may not be able to keep a physical record of their qualifications. They may also have had breaks in their education. By having blockchain support smart contracts between institutions, credits would automatically be transferred provided that the conditions set out in the contract are satisfied. The benefits of this would include:

- Students would not need to repeat courses to get into a new institution.
- Credits obtained at a student's former institution would be recognised at the new institution.
- Different institutions recognise credits differently and language barriers between institutions would no longer be a problem.
- Smart contracts can be set up between educators and students for the completion of set tasks. Once the task is completed according to the contract, a student is able to move on to the next stage of the course. This would provide a more personalised approach and allow students to take more ownership of their learning.

3.3. Storing student credentials

Blockchains can be used to store students' credentials including their student record / transcript, personal information, and degree certificate. The benefits of this would include:

- Administrators would only need to establish a student record once.
- A blockchain system could be shared among different educational institutions, rather than each institution having a private system that is only accessible to the institution's staff.
- Were an institution to close down, all the certificates and credentials issued prior to the closure would remain in the blockchain as the records are stored permanently.

- The validity of a certificate could be easily verified without contacting the issuing body by sharing the link or digital address to a student's profile.
- The prevention of forged diplomas and transcripts.

3.4. Identity verification

Educational institutions need to verify students' identities for a variety of reasons including admitting students, allocating courses, and providing credentials. By using a digital process through a blockchain network, the verification process only needs to be done once, rather than multiple times for different parts of an organisation. The network stores information about the student's identity rather than the student identity document itself. The benefits of this would include:

- Fewer people would have access to students' personal data.
- Institutions would no longer have to manage the personal data of all their students or try to keep it secure and avoid data tampering.
- Only the people verifying the information in the blockchain will have access to the data, reducing privacy concerns.
- Students, and those applying for jobs, could easily identify themselves online and maintain control over the management of their personal data.
- Institutions would only need to ensure the device or network is secure when the initial verification process occurs.

3.5. Intellectual property protection

Currently, aside from going through extensive research journals, it is difficult to find out if a professor is beginning research that is similar to an academic study that is already being conducted elsewhere. Using a blockchain, professors and educators can publish content and keep track of the use of their content by others. The benefits of this would include:

- Authors looking to undertake research and publish papers on different topics would be able to avoid the high access fees of research journals by being able to find papers that have been uploaded to the blockchain.
- Professors and lecturers can upload ongoing research.

- University professors / school teachers could upload materials for lectures / lessons for students to use in their own time.
- The use of uploaded materials by learners could be tracked through the blockchain to understand how students are using the different materials and which materials are best for future teaching.
- Educators could be rewarded for the use of their materials through the use of crypto-coins according to how their materials are re-used by students.
- Academic materials would be more easily accessible, more secure, and safe from tampering.
- The platform can be used for sharing and communicating. For example, departments within institutions would be able to submit information about events and lectures.

4. Summary

Blockchain technology is becoming more widely used as we continue to understand more about how it works and how it can be adapted to innovate different sectors. There are a number of excellent use cases and each day we are learning more about how the technology can be applied.

As with all EdTech solutions, particularly emergent ones, the technology brings both benefits and challenges. The main challenges associated with adopting blockchain technology into education systems are integrating it with current systems, the technical scalability of the blockchain network, and the limited number of blockchain developers ([↑SotaTek, 2021](#)). It is also important to note the environmental costs of the need for significant energy and computing power to verify and process transactions and secure the network. Furthermore, some may feel that the digitalisation of students' records in this manner would make students feel constantly monitored, to the point where any mistakes made during their study may impact their future employment.

For blockchain solutions to begin making more of an impact on education, there needs to be more collaboration across a number of stakeholders. For example, the European Commission pledged to invest €300 million in the European blockchain space as part of the EU's strategy to "harness the many opportunities of blockchain and avoid a fragmented approach" ([↑Cognizant, 2019](#)). This approach will allow more collaborative learning across different sectors. It is necessary for the governments of each country to not only create regulating practices but also to build the required infrastructure to allow blockchain solutions to become more prevalent and better understood by all.

5. Examples of blockchain technology in education

5.1. University of Melbourne

Title:

[University of Melbourne to issue recipient-owned blockchain records¹](#)

Publication date: October 2017

Resource type: Article

Focus country: Australia

This article looks at the adoption of blockchain technology to issue digital credentials for students at the University of Melbourne — the first university in the Asia-Pacific region to issue credentials in this manner. Starting with the Melbourne Teaching Certificate, this certification is undertaken through the Learning Machine issuing system, which uses the Blockcerts open standard. Provided that the learner has the Blockcerts Wallet (an open-source app) on their mobile phone, they are able to share their credentials with the necessary people and their information is verified instantly and free of charge.

5.2. Indian Institutes of Technology (IIT)

Title: [Blockchain in schools and colleges²](#)

Publication date: December 2021

Resource type: Article

Focus country: India

This article looks at the use of blockchain technology by the Indian Institutes of Technology. The Indian Institutes of Technology are a group of public technical institutes across India owned by the Indian Ministry of Education. In December 2021, graduates were given their qualifications in a

¹ Retrieved on 20 July 2022

<https://www.unimelb.edu.au/newsroom/news/2017/october/university-of-melbourne-to-issue-recipient-owned-blockchain-records>

² Retrieved on 20 July 2022

<https://indianexpress.com/article/opinion/blockchain-technology-education-nep-7696791/>

blockchain-based digital form. As a result of the pandemic, institutions are looking at ways for learners to have a more flexible learning environment by investing in digital learning and using innovative technologies to move forward. The government of India has begun creating a robust digital education ecosystem by using blockchain innovation to manage degrees and diplomas. Moving forward, this can then be used for other aspects of the ecosystem such as teaching, grading, and recording attendance and achievements.

5.3. Maryville University

Title: [Maryville begins issuing student-owned digital diplomas](#)³

Publication date: November 2019

Resource type: Article

Focus country: USA

Through a blockchain initiative, Maryville is one of the first universities in the USA to issue digital diplomas. These diplomas are for both students and alumni, whereby they are able to manage their digital diploma through an app on a smartphone. The use of blockchain technology means that the diploma is easily verifiable and cannot be tampered with. It can be shared and verified instantly through a link and bypasses the need to contact student services for verification. Students and alumni can receive both a digital and physical copy of their diplomas. The digital diploma is sent as an email attachment that can be added to the student's mobile wallet app.

5.4. UNICEF

Title: [UNICEF Innovation fund graduate: OS City](#)⁴

Publication date: March 2020

Resource Type: Article

Focus Countries: Mexico, Argentina, Chile, Brazil, Columbia

³ Retrieved on 20 July 2022

https://www.maryville.edu/mpress/digital-diplomas/?_gl=1*10m805a*_ga*MTg4ODM1ODM3NC4xNjQ4MTMzODQ2*_gid*OTE1MjQ4NjU4LjE2NDgxMzM4NDY.*_fplc*TIlwS2NFVmdGenR6aEZuNU51bWkzSVlFOHdyc0RITkZSRFZyciUyQlRkQUg3cm1VTVRCTVZ3bVICN2xUQnU5d0NZNIJZczdHJTJGVUw0UVInY3Y0RU1aNW9HcmYxM1BUc3NWcnBXbU1YTXlyUW9SV2NWQnNpYkdjNjNuc0t6ak80dyUzRCUzRA

⁴ Retrieved on 20 July 2022 <https://www.unicef.org/innovation/fundgraduate/OSCity>

In 2020, the UNICEF Innovation fund was providing up to USD 100K in equity-free investments (in USD and / or cryptocurrency) in early-stage financing and mentoring to for-profit technology startups that have the potential to benefit humanity. One of the portfolio members of the innovation fund in 2020 was OS City — a company that built an open-source platform allowing anyone to create their own blockchain. Users are able to create certificate templates and issue their own digital certificates. The platform gives users a choice of five different blockchains: Bitcoin, Ethereum, Ethereum Classic, Rootstock Platform (RSK), and Blockchain Federal Argentina (BFA). In one of the completed pilots, digital university diplomas were issued through the blockchain platform. A further example is a day school in Argentina using the platform to give out digital certificates. More about OS City's work can be found [here](#).⁵

In 2022, the UNICEF Venture Fund collaborated with [Giga](#)⁶ for a similar call for blockchain-based software solutions that would build capacity and empower communities. As in 2020, the investments are up to USD 100K and equity-free, but paid in cryptocurrency only. The Innovation fund was looking to invest in companies that are developing blockchain-based software solutions using solutions such as cryptocurrencies, smart contracts, and different types of tokens, as well as learning and training initiatives that will build capacity. The deadline for submissions was in March 2022 .

⁵ Retrieved on 20 July 2022

<https://drive.google.com/file/d/1YtULAjMyUXGrCAr5GdbY549sBlp9MryU/view>

⁶ Retrieved on 26 July 2022 <https://www.unicef.org/innovation/giga>

6. Additional Resources

Towards a blockchain-based smart certification system for higher education: an empirical study⁷

This empirical study was undertaken in 2016 and published in 2022. It provides an analysis of blockchain adoption in the field of education, with a particular focus on producing and sharing higher education certification using a blockchain process.

Published: 2022

Blockchain and Higher Education Diplomas⁸

This research paper looks at the benefits of using blockchain technology for higher education certificates and diplomas. It notes that using this innovation would allow students applying for international degree programmes to be able to easily share their qualifications and have them instantly verified. It would also allow refugees to have coherent academic documentation where their physical documentation and belongings may have been lost due to conflict situations.

Published: 19 Feb 2021

Blockchain in education management: present and future applications⁹

This systematic literature review on the use of blockchain technology in education conducts a bibliometric analysis of publications, journals, authors, and citations with the three main research questions:

1. How has blockchain technology been defined in educational settings?

⁷ Retrieved on 20 July 2022

http://sro.sussex.ac.uk/id/eprint/103536/1/IJCDS-Towards%20a%20BlockChain-based%20smart%20certification%20system%20for%20Higher%20Education%20SA_Latex.pdf

⁸ Retrieved on 20 July 2022 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8314335/>

⁹ Retrieved on 20 July 2022

<https://www.emerald.com/insight/content/doi/10.1108/ITSE-07-2020-0102/full/html?skipTracking=true>

2. How was the technology examined (i.e., the methodology)?
3. What were the results of using this technology in an education system?

The review looks at the benefits, challenges, and current applications of blockchain technology in education, with the aim of providing a foundation for education institutions, policymakers, and researchers to begin understanding how blockchain technology can be used in education.

Published: 19 May 2021

Office of Educational Technology, United States — Blockchain in Education Section

The Office of Education Technology in the United States launched the [Education Blockchain Initiative](#)¹⁰ (EBI) in February 2020. The initiative looks at how blockchain technology can address problems in education. As part of this initiative, the US Department of Education alongside the American Council on Education (ACE), launched the [Blockchain Innovation Challenge](#)¹¹ with the aim of looking at how blockchain technology can empower individuals through economic opportunities and social mobility. The final report on the EBI can be found [here](#).¹²

[Go here for more information on blockchain in education at the Office of Education Technology.](#)¹³

¹⁰ Retrieved on 20 July 2022

<https://www.acenet.edu/Documents/ACE-Education-Blockchain-Initiative-Connected-Impact-June2020.pdf>

¹¹ Retrieved on 20 July 2022

<https://www.acenet.edu/Research-Insights/Pages/Education-Blockchain-Initiative.aspx>

¹² Retrieved on 20 July 2022

<https://www.acenet.edu/Documents/Education-Blockchain-Initiative-Final-Report.pdf>

¹³ Retrieved on 20 July 2022 <https://tech.ed.gov/blockchain/>

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