The Role of Web 3.0 and Blockchain in the Future of Education

Conference or Workshop Item

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Abstract

The emergence of Web 3.0 and the Blockchain holds the potential to shape the future of education in various ways. Web 3.0 and the Blockchain offer a decentralised peer-to-peer infrastructure, where privacy, secure archiving, consensual ownership, transparency, accountability, identity management and trust are built-in, both at the software and infrastructure levels. This decentralised peer-to-peer infrastructure offers opportunities to decentralise education by transforming the ways that we find educational content and tutoring services online, how we register and pay for them, as well as how we get accredited for what we have learned and how this accreditation affects our career trajectory. This paper discusses some of the ways that the future of education can be impacted by decentralisation. In particular, a pilot case study of the research project QualiChain is presented, in the context of which the use of decentralisation technologies has been investigated towards providing lifelong learners with transparent and immutable educational accreditation.

Keywords: Web 3.0, Blockchain, Decentralisation, Lifelong Learning, Accreditation.

Introduction

Education today is still controlled mostly by educational institutions, which offer quality, credibility, governance, and administrative functions. This model is not flexible enough and poses difficulties in recognising the achievements of a lifelong learner in informal and non-formal types of education. As a result, a lifelong learner's transition from formal to informal education and vice versa can be hindered, as the achievements acquired in one type of education are not easily transferable to another (Harris & Wihak, 2017; Lundvall & Rasmussen, 2016; Mayombe, 2017; Müller et al., 2015). Generally, lifelong learners have limited control and ownership over their learning process and the data associated with their learning.

This indicates the need for a decentralised model across all types of education, offering learners with a framework for fully controlling how they are learning, how they acquire qualifications and how they share their qualifications and other learning data with third parties, such as educational institutions or employers (Mikroyannidis et al., 2018; Mikroyannidis et al., 2019). In this paper, we investigate how Web 3.0 and Blockchain technologies can help realise this vision via a pilot case study of the QualiChain project. This pilot case study is aimed at offering support to lifelong learners in various stages of their learning journeys and of their career trajectories.

The remainder of this paper is organised as follows. First, we introduce the concepts of Web 3.0 and Blockchain. We then present the overall framework of the QualiChain project and the pilot case study for supporting lifelong learning with decentralisation technologies. Some of the lessons learned from the deployment and evaluation of this pilot case study are then discussed. Finally, the paper is concluded, and the next steps of this work are outlined.

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Web 3.0 and Blockchain

Web 3.0 was first proposed by Berners-Lee et al. (2001) as the Semantic Web, an evolution of the previous versions of the web. Web 1.0 was the first version of the web in the 90s, consisting of mostly static web pages interlinked with each other. Web 2.0, also known as the Social Web, emerged in the early 00s and enabled web users not only to consume web content, but also to easily produce and publish content on the web. Web 2.0 marked the emergence of blogging and social media, allowing web users to connect with each other and share data among them, which has led to the explosion of the data published daily on the web. However, this data is mostly controlled by a handful of companies that offer social media services and provide online platforms for publishing and curating data.

Web 3.0 has recently evolved from the concept of the Semantic Web to the concept of the Decentralised Web. This concept was first proposed by Wood (2018) and promises to use decentralisation in order to 'democratise' the web by offering web users more control over their data. Web 3.0 aims to move data away from the control of a few companies and instead establish web applications and services based on Blockchain technology, so that data control is distributed among web users. The main characteristics of Web 3.0 are the following:

- **Decentralised:** instead of content controlled and owned by centralised entities, ownership gets distributed among web users.
- **Permissionless:** everyone has equal access to participate.
- **Native payments:** cryptocurrency is used for financial transactions instead of relying on the infrastructure of banks and payment processors.
- **Trustless:** financial incentives and Blockchain mechanisms are used instead of relying on trusted third parties.

The Blockchain is the underpinning technology for the realisation of Web 3.0. The first Blockchain was conceived by Nakamoto (2008) as the basis for Bitcoin, the most well-known Blockchain-based cryptocurrency. The Blockchain is a publicly shared immutable ledger, which uses crypto-currency techniques to minimise any security risk. Blockchain technology can act as a provenance protocol for sharing data across disparate semi-trusting organisations, without the need for any central control.

The value of Blockchain technology at documenting, verifying, and sharing data across diverse stakeholders can be a particularly valuable asset in today's fast-pacing economy, which is largely driven by continuous learning and credentialing (Crosby et al., 2016). Ethereum (Buterin, 2013) is currently the most well-known and well-established Blockchain platform. Rather than serving solely as a platform for a crypto currency, the underlying aim for Ethereum is to be an open Blockchain platform to support the development and use of decentralised applications.

As shown in Figure 1, the Blockchain records transactions in blocks that are linked together through a series of hash pointers. Each block aggregates a timestamped batch of transactions and is identified by a cryptographic signature. These blocks are all back-linked so that the chain can be traced all the way back to the very first block created. Any tampering of a block can be detected since the hash pointer to it would no longer be valid. In this way, the Blockchain contains an immutable record of all transactions.

A key feature of the Blockchain is that every user has their own copy of all transactions recorded on the Blockchain, as there is no central or master copy, simply the multiple copies held by the volunteers in the user community. Volunteers are rewarded for their effort through algorithmic processes with small payments that can be attached to individual transactions. Consensus on what types of blocks and transactions can be part of the Blockchain is automatically reached according to whether the majority of Blockchain holders

accept newly proposed blocks.

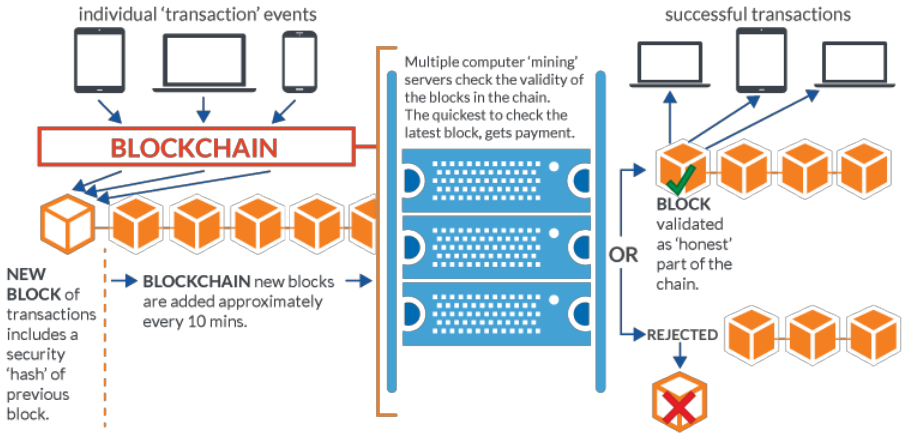

Figure 1. The core functions of the Blockchain.

The QualiChain Project

The QualiChain research and innovation project has been focused on the assessment of the technical, political, socio-economic, legal and cultural impact of decentralisation solutions on education. As shown in Figure 2, QualiChain has been targeting four key areas for exploring the impact of decentralisation: (i) lifelong learning; (ii) smart curriculum design; (iii) staffing the public sector; (iv) providing HR consultancy and competency management services.

QualiChain has investigated the creation, piloting and evaluation of decentralisation solutions for storing, sharing and verifying education and employment qualifications and focuses on the assessment of the potential of Blockchain technology, algorithmic techniques and computational intelligence for disrupting the domain of public education, as well as its interfaces with private education, the labour market, public sector administrative procedures and the wider socio-economic developments (Kontzinos et al., 2020a, 2020b).

Within the QualiChain project, we have conducted a pilot case study for facilitating the learning journeys and career trajectories of lifelong learners. In the context of this pilot case study, we have investigated how the use of decentralisation technologies can support lifelong learners in navigating their learning journey and in advancing their career. In particular, the objectives of this pilot case study have been the following:

- Awarding lifelong learners with **transparent and immutable educational accreditation.**
- Offering lifelong learners **personalised recommendations** based on their learning achievements.
- Supporting lifelong learners in reaching **their personal and professional learning goals.**

According to the use case of this pilot case study, lifelong learners have their personal ePortfolios within the QualiChain platform. Lifelong learners are awarded Smart Badges by

educational institutions, upon reaching certain milestones in their studies, e.g., completing part of a course or an entire course. Smart Badges are stored on the Blockchain, thus ensuring the validity of the awarded accreditation and eliminating the risk of fabricated qualifications. Smart Badges include data about the key skills that learners have acquired upon obtaining these badges.

Figure 2. The key areas targeted by the QualiChain project.

As learners continue to earn Smart Badges, they start receiving personalised recommendations about the latest job offers that match their skills. They also receive recommendations on what to study next, based on the skills they need for the job market. These recommendations assist lifelong learners in taking decisions about their personal and professional progression. This use case is illustrated in Figure 3.

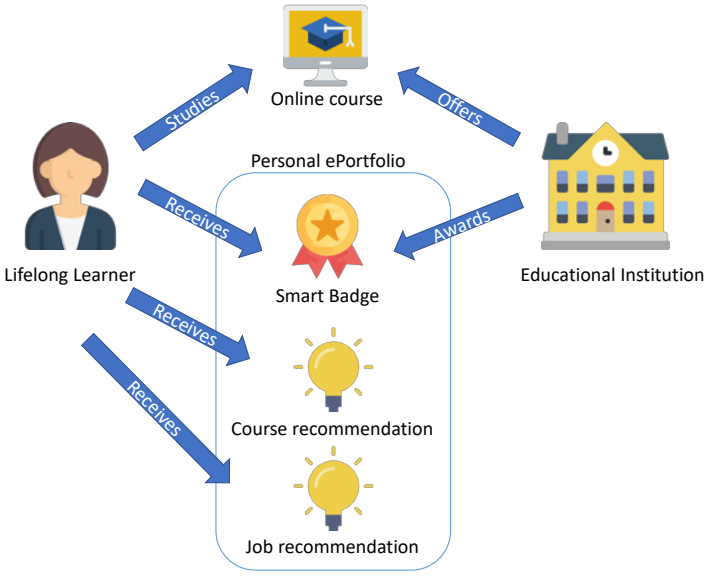

Figure 3. Supporting lifelong learning with decentralisation technologies.

Lessons Learned

In this section, we present some of the lessons learned from the deployment and evaluation of the lifelong learning pilot case study with members of the education community. The lessons learned that are presented below have been derived from our continuous engagement with the education community throughout the 3-year duration of the QualiChain project.

Lifelong learners require support in several aspects of their learning journey

During the first year of the QualiChain project, we conducted a series of consultation workshops with stakeholders from the education community, the outcomes of which have been presented in (Mikroyannidis et al., 2020). During this consultation, the following lifelong learning challenges associated with accreditation and employability emerged:

- **Immutable formal and informal qualifications:** Stakeholders pointed out the need for ePortfolios to aggregate immutable formal and informal qualifications that will be easily validated by employers and educational institutions.
- **Lifelong learning pathways and micro-credentials:** Stakeholders highlighted the need to be guided on how to build lifelong learning pathways in order to achieve their learning goals. Acquiring micro-credentials can help lifelong learners achieve these goals by studying short online courses and earning professional or academic credentials.
- **Career counselling:** Stakeholders also indicated that they need a comprehensive overview of the job market and the latest market trends, so that they can make informed decisions about the next steps in their careers.
- **Data ownership and privacy:** These requirements were deemed quite important by stakeholders. It was highlighted that lifelong learners should own their digital identity and the data in their ePortfolio. Additionally, they should be able to control who accesses their identity and their ePortfolio, which data are accessed and for how long.

Some of these challenges have been addressed by the QualiChain project via decentralised management and verification of qualifications, personalised job and course recommendations offered to lifelong learners, as well as decentralised mechanisms for data ownership and privacy. Beyond QualiChain, these challenges should serve as drivers for the development of relevant policies at a local, national, or international level, aiming to provide the necessary support to lifelong learners.

The education community requires guidance and training on the use of decentralisation technologies

There is currently a hype around Blockchain technologies, mostly due to the emergence of Bitcoin and other cryptocurrencies. However, very few members of the education community are aware of the potential of decentralisation for transforming education. During our consultation activities with a wide range of stakeholders from the education community, it became quite clear that there is a need to provide guidance and training to the education community regarding the use of Blockchain in education and specifically in lifelong learning.

Towards addressing this need, we have produced the Badged Open Course (BOC): "Decentralising Education Using Blockchain Technology",[1] which introduces Blockchain technology and its potential for decentralising and transforming education. The course also

[1] https://www.open.edu/openlearncreate/course/view.php?id=7981

presents the work carried out by the QualiChain project for the decentralised management and verification of education and employment qualifications in a lifelong learning context. Finally, the course offers an opportunity to learners to try the online platform developed by QualiChain and earn a Smart Badge.

The course is available on the Open University's OpenLearn Create platform and is licensed under Creative Commons BY-NC-SA 4.0,[2] which allows the reuse and adaptation of the course materials for non-commercial purposes. Upon completion of the course, learners earn a free statement of participation. Figure 4 shows the entry page of the course, featuring short introductory text and video materials about the course, which explain what the course offers to learners.

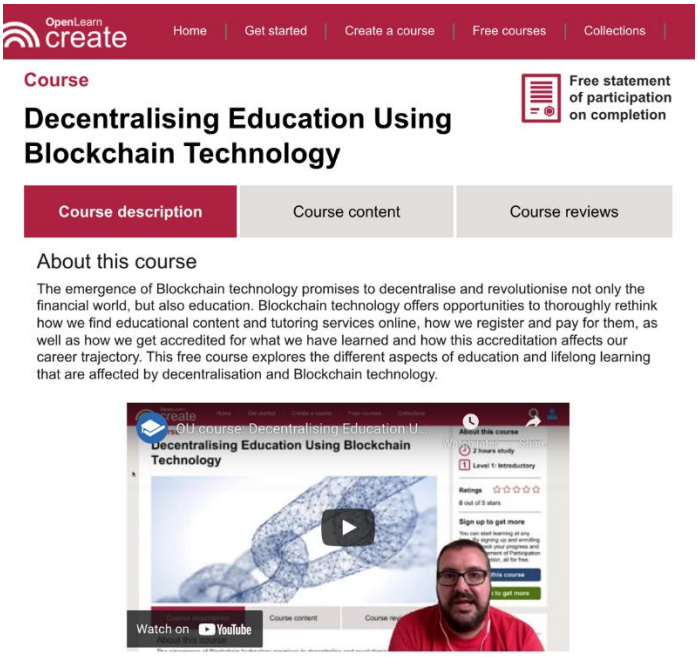

Figure 4. The introductory page of the QualiChain Badged Open Course (BOC).

Conclusions

This paper has discussed the potential impact that decentralisation technologies, such as Web 3.0 and Blockchain, can have on the future of education. In particular, we have presented a pilot case study for supporting lifelong learning with the use of Smart Badges and personalised recommendations. This pilot case study has employed decentralisation technologies for providing lifelong learners with transparent and immutable educational accreditation. It has also used personalised recommendations for helping lifelong learners reach their personal and professional learning goals. This pilot case study has been conducted as part of the QualiChain initiative, which has explored the decentralisation of education and employment qualifications in a variety of contexts.

[2] https://creativecommons.org/licenses/by-nc-sa/4.0/

Engaging the communities of stakeholders within this pilot case study has provided us with valuable insights into the challenges that lifelong learners face regarding their accreditation and employability. We have also identified the need to raise awareness within the education community about decentralisation technologies and their practical applications in education. The next steps of this work will be therefore directed towards addressing the identified lifelong learning challenges, as well as towards raising awareness about the educational uses of decentralisation technologies.

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