

A Blockchain-Inspired Design for a Modern Academic System

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Abstract

When reminded of blockchains, the public's attention tends to turn to finance because of the recent growth of Bitcoin and its impact on the economy; however, these cryptographic data structures also have value in several other disciplines. In this paper, I focus on education and theorize how blockchains can be used to allow non-traditional educators (in other words, non-universities) to enter into and build value in the academic market without being outcompeted by powerful academic institutions. Much of the inspiration for this research comes from the fact that in academia today, it is very difficult for employers to trust any other certificate of achievement other than a university degree. But for many learners, attending a university is not an option because of the financial burden of student loans and inaccessibility to higher education. For people who do not face these issues but still don't prefer to attend college, the reason is usually personal goals; students do not want to be stuck in the same major for four years but rather want a diverse education studying what they want where they want for however long they want. In today's Internet age, there are innumerable resources online for these people to access higher education, whether it be through private tutoring, Khan Academy, Coursera, or Massive Open Online Courses (MOOCs), just to name a few. But earning a certificate from these alternate educators is still not considered as valuable or as trustworthy as a traditional college degree. Further, the manner in which institutions are valued today is often subjective, volatile, and based on too many factors. In short it is rather arbitrary.¹ To give these new educators and the learners using them a chance to build academic value in a fair and non-arbitrary manner, I propose a blockchain-inspired design for a modern academic system.

The new system has two parts: 1) a new decentralized market structure and 2) a set of functions that stakeholders (educators, companies, and individuals) use to build value. The decentralized market structure contains two exchanges, behaving similarly to accreditor companies in today's economy, called the educator and employer exchanges. They are funded by the money that companies spend on recruiting and that educators earn from tuition fees and donations. In exchange, these exchanges grant permissions to educators (such as hiring and querying the network for potential employees), educators (such as granting degrees), and individuals (such as querying the network for the most valuable educators). Calling each of these permissions is a transaction that gives a certain stakeholder value. Each transaction is recorded in the blockchain and is backed by dollars moving between exchanges, stakeholders, and miners. Miners are paid by the exchanges for hashing these transactions into blocks and as a result, the value of educators and individuals is permanently stored and traceable in a tamper-proof manner. This permanence means that value earned by stakeholders will be non-arbitrary and determined by the market operating over this blockchain. Over time, smaller institutions and new learners will accumulate value in the network. This allows employers to trust that the value of a certificate from a non-traditional educator is truthful and backed by a currency (dollars in this case). In effect, it allows employers to trust the value of these alternate sources of education just as much as college degrees.

Introduction

Blockchain technology has received much attention lately, easily earning it a position as one of the most disruptive technologies ever. After the development of the Bitcoin blockchain, people have discovered ways to use blockchain in a wide range of applications from finance to energy to politics. It has recently received acclaim in the field of educational technology as well, since its decentralized nature and inherent trust system allow learners, institutions, and employers to share certificates, portfolios, transcripts, and skills privately and selectively while being assured that these credentials are trustworthy.¹

A blockchain is a data structure that stores timestamped hashes of transactions (or record of any transaction of units of value).² The cryptography is such that it is nearly impossible to tamper with records that have been hashed and stored. This is useful in scenarios where value can be compromised, corrupted, or mishandled. In education, academic certificates are units of value. Blockchains can help keep this value in the hands of those that earned it and can help regulate how this value is shared with other people, companies, and institutions. It can also help people trust that everyone on the network will behave truthfully- otherwise, the cryptography makes it very easy to find a bad actor.

The MIT Media Lab released a platform known as Blockcerts that pioneered the use of blockchain to store academic records. This platform has since evolved to store certificates of all kinds, not just academic. There are also collaborations between universities using a single blockchain to share certificates of achievement between their student and research bodies, particularly the collaboration between Open University, The University of Pisa, and UT Austin. This platform is being designed for university purposes in particular, unlike Blockcerts.

These existing projects are revolutionary, but they still have shortcomings. Blockcerts is built on the Bitcoin blockchain which means it cannot make use of smart contracts, a means of guaranteeing that academic information can be sent back and forth between users of the platform in a trustworthy and autonomous manner. The tri-university platform is built on the Ethereum blockchain, which enables smart contracts, but its current architecture only allows universities to issue credentials. What if a student has accomplishments outside of university that he or she believes should be a part of their greater academic picture? There exists a need for a trustworthy and fluid network that can give these accomplishments value.

The debate over what describes a student's educational background has long been a subject of discussion and has recently become even more confusing with the popularity of Internet learning services. Education boards, employers, and universities have long followed the model of the traditional academic transcript as a means of measuring and verifying a student's academic potential and achievement; a student enrolls in a university, graduates with a degree and a transcript detailing all achievements (courses passed and GPA), and when it comes time to apply to a job, the employer verifies the authenticity of the degree and transcript through the university. It is a time-tested model that has worked in traditional learning environments. But this

model is obsolete in a technologically-driven world where college is just one option; today, students can enroll in MOOCs; learn via Khan Academy, Udemy, Coursera and other online learning platforms; learn professional skills in informal settings; or get a certificate from a private tutor. The torchbearers of the old model have argued that these accomplishments do not hold as much value in a student's academic picture because they cannot be verified as easily as a college transcript. Furthermore, they are not backed by anything; college degrees are backed by hundreds of years of trust and also by dollars that students pay for a degree. For example, how can an employer trust that a video series on YouTube is actually a good teacher? How can the employer trust that the student has in fact learned the necessary skills without a formal assessment and scores recorded on a transcript? And how should this process work for the other learning channels that students use?

A second problem with the current system is that institutions and their programs are valued rather arbitrarily. Rankings for top university programs change all the time, and the parameters judged to create these rankings also change constantly. Furthermore, these parameters can often be biased, qualitative, and even irrelevant. A modern academic system should have a quantitative, market-driven, traceable, and most importantly, non-arbitrary way of deciding which certificates and degrees are more valuable than others.

In this paper, I propose a modification to the traditional academic transcript that uses a blockchain. This modification will allow a student's academic record to be colored with diverse learning channels (not just a college transcript) while still being trustworthy, and will allow these learning channels to gain footing in a competitive market. I will discuss how blockchain technology can address several of these questions and explain how the academic market structure that my research team and I are designing allows learners and educators (universities, MOOCs, online learning tools, certifiers, and private tutors) to do two main tasks: 1) build value through a decentralized transaction model and 2) accumulate value in a non-arbitrary way that is market-driven and quantitative.

Methods

Since this research is based on computational and economic theory, there are no materials (software, hardware, or tools) that were used. There is also not much in terms of methods- in theory research, the process or method is the final product. However, there is still an approach, or rather a thought process, that develops the research. Here are some highlights of that process.

Initially, we realized that the foundational problem that inspired this research is that the centralized structure of academia gives universities an unimaginable amount of authority in determining if an individual has successfully learned something. But in today's Internet age there are so many other modes of higher learning that should be given just as much authority especially since so many people still cannot or choose not to attend a university. These educators' certificates should be just as trusted and just as valuable to employers and individuals as a university degree.

The next stage of the process was realizing what made university degrees so valuable in the academic market in the first place. Reverting to principles from economics, we realized that anything becomes valuable after it is 1) time-tested, as university degrees indeed are, and 2) backed by some metric of value. In this case, the tuition dollars that students pay to earn degrees back their value. Therefore, in order for non-university educators to build value in the market, they needed both of these qualities. Achieving the former is important but not feasible if we want to make it relatively fast for new educators to build value. However, the latter is definitely feasible. Examining how this is done in the actual economy, we realized that there needed to be something similar to accreditors which act as intermediaries converting the dollar value of educators and companies into academic value stored in the blockchain. This is how we developed the idea of educator and employer exchanges that issue permissions to educators and employers which are backed by dollars, discussed in more detail in the results section.

And finally, how did we decide to use a blockchain? We realized that we needed some way to permanently store the value of an educator's certificate and the value of an individual and that we needed some way to trace how that value was accumulated. A blockchain does all of these things. Because it is decentralized, it does not put control in the hands of wealthy universities and companies, thus allowing smaller educators to build value. And since it is public, it forces all stakeholders to be truthful about their value. Ultimately, it proves that all stakeholders have accumulated the value that they deserve and that all value is numerical and determined by the market, not arbitrarily and qualitatively.

Results

The final model satisfies the two main conditions we proposed a modern academic market should have. The first is that the value of all educators and learners should not be arbitrary, but should rather be determined by the market using a currency-backed transactive model. The second is that university degrees should not have an arbitrary hiring advantage over non-university certificates. For example, a computer science degree from Georgia Tech should not necessarily be preferred over a private tutor who teaches the same material with higher quality for less cost.

Our solution to this was the design of educator and employer exchanges that issue permissions to educators and employers which are backed by dollars. Every time an employer, student, or company uses a permission, it changes the value state of a stakeholder in the blockchain. For example, if Google queried a list of all students that graduated from Georgia Tech with a degree in computer science, this query will slightly increase the value of a Georgia Tech computer science degree since it is being subjected to a currency-backed query, or permission, issued to Google by the employer exchange. How does this help new educators trying to build value in a market dominated by university degrees? If any stakeholder uses one of their exchange-issued permissions to query details about the new educator, then this means that that educator's certificate value has gone up because there is demonstrated demand for it on the market. The key here is that the query is *backed by currency*. The query comes from a permission that was essentially purchased by a stakeholder from an exchange, and these stakeholders are all pumping money into the market.

While the details about exactly how much value should be awarded to stakeholders in all possible scenarios has not been worked out, we have at least laid out an economic framework that can make this possible. Perhaps every educator and company develops a unique utility function, or a mathematical representation of their total value. Then this utility function can be shared across the network to let everyone know exactly how value is determined by the stakeholder. Once all stakeholders have done this, everyone on the network knows exactly what credentials contribute to what portion of the demand. And once this demand is clear, the exchanges can then associate a quantifiable value to each currency-backed permission, which can then be transacted and stored as academic value on the blockchain. Essentially, this kind of transparency removes any possibility of arbitrarily assigning value to educators and learners—value is now assigned by a market running on mathematical utility. Blockchain miners will be paid by the exchanges for permanently storing a timestamped record of each educator's and individual's value at any given time. This process ensures that value assignment is not arbitrary and is done purely by demand in the academic market, and also ensures that all educators and learners have a fair opportunity to build value.

Discussion

This model is just that- a model that has only been theorized and not yet tested. In a real-world market, this model may still pose an unfair advantage to large universities who have the money to pay miners and exchanges for more permissions. While it was not in the scope of this project, there are ways to regulate this using various blockchain protocols that use round-robin mining algorithms to ensure that all nodes have an equal chance of acquiring value.

Regardless, this model makes it easier for new educators to find their footing in a very competitive market, and it allows all educators and learners to earn market value in a non-arbitrary fashion using a transactive model. Implementing this protocol will be a challenge. For a blockchain network to work effectively, there must be several nodes moving value back and forth, since this is more incentive for miners and exchanges. This means that several universities, private educators, and students must be educated about the pitfalls of the current academic system and about the benefits that this model could provide.

This model can also bring university prestige down since it will now determine their value based on a process that is non-arbitrary and that is market-driven. This could bring opposition from several large universities that use their prestige to their advantage in recruiting students, getting funding for research, and getting donations. However, in the long-term, this model will reach equilibrium and there will then be a benefit for everyone- for educators, a reduced market risk; for learners, more higher education options; and for companies, a pool of applicants that has a blockchain-backed value from a variety of academic backgrounds.

References

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