Blockchain Technology Development and Its Relevance to Higher Education

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Abstract: Blockchain is an important and innovative technology that has only had targeted use for a few years (Peters and Panayi, 2016). Initially, it was the supporting technology for bitcoin transactions, and very soon thereafter, it became the foundation on which to support business transactions in industries such as banking, trading, insurance, voting, etc. (Atzori, 2015). This paper focuses on providing background information on the development of Blockchain Technology (BT) to those unfamiliar with this concept, as well as noting some of its current and potential future uses to those more well-versed in it.

As with any new technology or tool, educators must decide if there is sufficient demand in the business world for students to be taught that subject matter in college. Considering the great increase in applications of BT by businesses, including the Big Four accounting firms, the likelihood of an increase in the number of colleges and universities in the United States and abroad who are adding the content of BT to their curriculums is anticipated. Findings show this is the case. Higher-level education is embracing Blockchain education more abroad than in the United States; however, interest and education is growing in the U.S. too. Although business education regarding Accounting, Finance and Information Systems are discussed, because of the interest of the authors, accounting applications are the primary focus of education discussions herein. The vehicle for bringing that knowledge to higher-level education ranges from additions as simple as guest speakers on the topic of BT in classes currently taught, to stand-alone Blockchain Technology courses, to comprehensive Blockchain programs.

Keywords: Blockchain; blockchain technology; bitcoin; accounting education; innovative accounting technology

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Introduction

On November 1, 2008, Satoshi Nakamoto (a pseudonym), released the now famous white paper describing how electronic cash could be directly transacted between two parties, seller and receiver, without going through a trusted third party such as a bank. The concept uses a peer-to-peer network to timestamp transactions by combining (hashing) them into an ongoing chain of hash-based proof-of-work to protect transactions from fraud. The resulting chain forms a record that can only be changed by redoing the proof-of-work. The electronic cash is known as Bitcoin (Nakamoto, 2008).

As is known, digital currency, such as bitcoin, is becoming more acceptable in the market. In October 2015, Europe's Court of Justice effectively decided that bitcoin is a currency (Kar, 2015). In 2019, the Cash App used by many on their cell phones to transfer currency, includes bitcoin as an option versus the only other choice…the U.S. dollar (iPhoneX, Cash app).

The technology used to create Bitcoin is called blockchain. Soon after the publication of the white paper, the bitcoin concept and the underlying blockchain technology, changed the market and the way people and companies do business. To explain, a blockchain is essentially a distributed database of records, or a public ledger of all transactions or digital events executed and shared among participating parties (Crosby et. al., 2015). Informally speaking, the blockchain network is one of the forms of a distributed ledger technology, and anyone can transact, access, and read transactions in the system. Compared to a distributed ledger, each chain of blocks under the blockchain network has more security and provides strong distributed consensus, and if changes are made to the ledger, the system will automatically backup and send a copy to all users. Therefore, every user perpetually has a completely updated ledger.

The above describes a Public blockchain, one that is fully decentralized. The main feature of a public blockchain is its transparency, but it also provides anonymity. To address the need of organizations for increased security and less transparent transactions, the Private blockchain was developed.

Private blockchains, those that are centralized, allow organizations to grant permission to select users while blocking access by others (Sharma, 2019). In addition, transactions in private blockchains are processed faster and easier when compared with public blockchains, because of the smaller volume of data processed. A hybrid between the two is called a Permissioned blockchain, and it is partially decentralized (Wolverton, 2020).

A third component of BT is Smart Contracts. These digital contracts are hard coded into BT with triggering events established. When these events are complete, parties to the Smart Contract benefit by the transparent postings, so all parties know the status of the contract at all times (Wolverton, 2020).

Blockchain technology has the potential to upend entire industries with its potential benefits and incredible prospects (Swan, 2015). Some have speculated that blockchain technology might be the first technology genuinely worthy of the label of disruptive data technology (Alcazar, 2017; Sandner and Bekemeier, 2020). According to Don and Alex Tapscott of McKinsey & Company in a 2016 interview, this technology underpinning cryptocurrency could revolutionize the world economy. Sandner and Bekemeier agreed saying, "blockchain is quickly becoming an important economic and social reality with huge potential to disrupt not just our business models, but our daily lives" (2020).
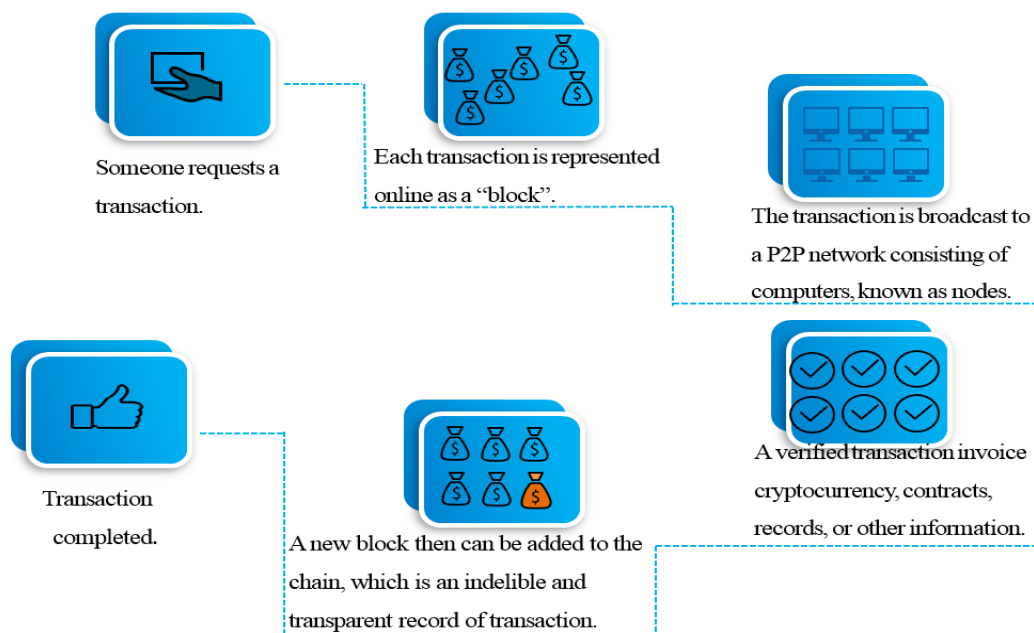
Blockchain technology has been welcomed in the finance industry. The University of Cambridge offers a benchmarking study showing sectors using blockchain technology in 2017 (Coinify Newsroom), of which the banking and finance industry has the most significant use of blockchain technology, and other sectors are catching up. With this movement towards the increasing use blockchain in the business world, it seems important enough for business educators to include this in their curriculum. If no in-depth coverage is initially planned, at least an introduction of the concept to accounting, finance, and information systems is probably in order.

This ever-changing technology has presented an opportunity and a challenge to college and university educators to prepare students to be qualified to make an immediate contribution to their employers, not only with traditional skills, but also with knowledge of cutting-edge technology such as Blockchain. To accomplish this, various approaches to BT education and the related challenges are offered for consideration in this paper. In addition, this paper includes sections on the background of blockchain technology and its current initiatives and applications, as well as potential uses of blockchain.

Background of Blockchain Technology in Business

The development of blockchain versions evolved from 1.0 to 3.0. Blockchain 1.0 focuses on the trading of cryptocurrency; version 2.0 involves similar trading, but it mainly focuses on market and financial applications such as contracts known as Smart Contracts (Wolverton, 2020); and version 3.0 extends blockchain applications beyond currency, finance, and markets to the areas of government, science, literacy, culture, and art as demonstrated by Figure 1 (Swan, 2015).

Figure 1. Blockchain Procedures Workflow adapted from Zignut Technolabs

Someone requests a transaction.

Each transaction is represented online as a "block".

The transaction is broadcast to a P2P network consisting of computers, known as nodes.

A verified transaction invoice cryptocurrency, contracts, records, or other information.

A new block then can be added to the chain, which is an indelible and transparent record of transaction.

Transaction completed.

(Swan, 2015)

At this point in the evolution of blockchain, industries interested in improving transaction flow will most likely find the features of blockchain technology appealing. Figure 1 illustrates the general information flow that many blockchain users have in common, such as:

(1) Distributed ledger. Blockchains are immutable digital ledger systems implemented in a distributed fashion and usually without a central authority. At its most basic level, it enables a community of users to record transactions in a ledger and publish to that community, such that no transaction can be changed once published, and where updates are shared with all members of the community.

(2) Consensus-based. A transaction on blockchain is executed if all parties on the network unanimously approve it, thereby reducing inaccurate or potentially fraudulent transactions out of the network. As noted in the AICPA & CIMA's 2020 White Paper, Blockchain Versus Financial Statement Fraud, if blockchain technology had been in use during the historic financial statement frauds such as Enron and WorldCom, perhaps due to the nature of transparency, those frauds may have been prevented (Wolverton, 2020).

(3) Digital. All the information on blockchain is digitized, eliminating the need for manual documentation.

(4) Chronological and time stamped. Each chain of the block that stores information about a transaction is linked to the previous block in the same chain. These collected blocks form a chronological chain to provide a trail of the underlying transactions.

(5) Cryptographically sealed. Information in blockchain is impossible to delete, edit or copy; therefore, this ensures a high level of robustness and trust (Deloitte Convergence, 2017).

Other Applications of BT

Over the last few years, BT has gained a foothold in areas of business other than cryptocurrencies, although that alone represents billions of U.S. dollars in market capitalizations. Companies such as Facebook, and banks such as Bosch and Daimler, are placing BT at the epicenter of their corporate innovation. In consideration of this increased business focus on BT, of course one should expect the next step to be government regulation of its usage. One such step is the Token & Trusted Technology Service Provider Act, formerly called the Liechtenstein Blockchain Act. It was forged by countries including China, Iran, the United States, France, Germany, and Liechtenstein. It was passed Oct. 3, 2019, to be effective Jan. 1, 2020 (Sandner and Bekemeier, 2020).

How governments regulate blockchain application in different areas of the world could be one of the most significant factors. "Blockchain is a powerful new paradigm for business. People should use it—if it is appropriate." As is cautioned by Yaga and Mell in Blockchain Technology Overview, NISTIR 8202 (January 2018), its use may not be the best option. NIST continues to work with US lawmakers on the scope of blockchain.

Relating to business initiatives by the big four accounting firms, they demonstrate how blockchain technology is changing the accounting profession. For example, Deloitte launched a custom blockchain solution—Rubix Core on April 26, 2016 (Prisco, 2016). Then in 2019, Deloitte's senior manager and co-leader of the U.S. Audit and Assurance Services Blockchain

Practice, Michael Marzelli, indicated that blockchain may very well revolutionize payment and reconciliation processes (Meyer).

On May 19, 2017, Ernst & Young introduced Ops Chain, a set of applications and services aimed at helping organizations commercialize the enterprise-wide use of blockchain technology (EY.com, 2017). KPMG introduced Digital Ledger Services, a comprehensive suite of services designed to help financial services companies realize the potential of blockchain capabilities on September 14, 2016 (KPMG.com). On November 20, 2016, PwC launched Vulcan Digital Asset Services to enable the use of digital assets for everyday banking, commerce, personal currency, and other asset related services (Kastelein, 2016). In addition, from its 2017 annual report, it says that innovation—specifically in blockchain technology, is one of the company strategies. As the big four accounting firms and other business institutions evolve and participate in the BT revolution, school educators and students should become aware and knowledgeable about this technology as well as the changes it is bringing to both education and the accounting profession.

The Impact of BT on Academic Recordkeeping

In Oct 2015, Holberton, an alternative, teacher-less software engineering school in San Francisco, announced it is the world's first school to deliver academic certificates secured and accessible via blockchain. The school believes blockchain technology provides high-quality recognition for Holberton students and eliminates the threat of false resumes and documents. Additionally, having student certifications available in a public blockchain makes it easier for employers to check a student's background before hiring (Holberton, 2015).

In 2016, Learning Machine Company and MIT Media Lab released a digital academic certification toolkit, called Blockcerts Wallet. Blockcerts Wallet is an open standard for building apps that issue and verify blockchain-based official records. These records include academic credentials, professional certifications, workforce developments, and political documents. The principal characteristics of blockcerts are permanence, convenience, shareability, and verifiability. The blockchain replaces the institution's system with permanent and tamper-proof infrastructure. Using the blockcerts wallet app, students can share their diplomas with whomever they choose, including potential employers. Via this app, diplomas or any other official records cannot be altered and thus, are completely secure. Summer graduation 2017, 111 of the June graduates received their diplomas on their smartphones via the app, as well as in traditional paper format (Blows, 2017).

On August 9, 2017, Sony and IBM collaborated to release a new blockchain-based student education record platform to secure and share student records. This platform allows schools to share, exchange, and manage student records and information. Documents and data from several schools can be included, and the platform provides access to their learning history, digital academic transcripts, and so on. Sony Global Education President, Masaaki Isuzu, told the Government Technology Magazine, "We want to keep life-long learning records … securely in the cloud forever. While these records are usually held privately, we want to make it possible for students and educators to share verified, trustworthy information with others securely". (Cavanagh, 2016).

The transformation of records kept by institutions using their proprietary formats and storage systems may be slow to change to BT since those proprietary systems have been in existence since the 1840s, and the accuracy for a well-developed manual process is a 1% error

rate. The problems reside in the labor-intensive, slow turnaround, records management of educational institutions. According to PwC, "As a distributed, tamperproof ledger, a well-designed blockchain doesn't just cut out intermediaries, reduce costs, and increase speed and reach, it also offers greater transparency and traceability." (Donnelly, 2020).

Digital Currency in the Education Sector

In the education sector, researchers posit awarding Edublocks. Marina Gorbis, from the Institute for the Future, says "Learning is earning" presents a vision for a different future for education. The concept outlines an emerging learning economy in which learning, work, and daily life are tightly interconnected, and learning serves as a currency for everything (Gorbis, 2016). Much like a digital currency, Edublocks are awarded for learning outcomes and stored in a virtual wallet. Under this system, users could gain rewards, called Edublocks, through their learning efforts. Workplaces, schools, informal groups, individuals, and apps would grant the Edublocks (Seattle Education online, 2016).

Smart Contracts in Education

The blockchain-based smart contract is a computer program operating on blockchains that autonomously verifies, enforces, and executes the terms in a contract (Kiviat, 2015). It is one of the most promising applications of blockchain technology. It can execute commercial transactions automatically by a specific date between parties in a contract. It also avoids overpayments to vendors. By embedding smart contracts in the education sector, blockchain technology can complete education contracts and certificates, and build a virtual economic, intelligent, education transaction system. In this system, services, such as purchases, use, and payments, are tracked automatically by the system without manual operation. Meanwhile, the purchase records cannot be tampered with, and all the transactions and contract data are saved permanently (Li and Zhang, 2017).

Education—Blockchain Technology

The Moscow School of Programmers is the first school known to teach blockchain. The Osnova news reported, "On February 12, 2018, the Moscow School of Programmers and the Metropolitan IT hub Phystechpark signed an agreement to launch the training course, 'Introduction to Application Development on Ethereum Blockchain.'" The first class was held on March 1, 2018 (Antonovich, 2018).

In addition to schools and education initiatives previously mentioned, in 2017 there were approximately fifteen universities and colleges worldwide teaching courses involving blockchain technology-related subjects (Coinify Newsroom, July 6, 2017). As of spring of 2021, per the Google Search: "how to study blockchain", there are more than 40 universities worldwide offering certificates that include the term blockchain—eight in the U.S.   There are six universities worldwide offering diplomas including blockchain in the title, with zero in the U.S., and there are over 30 universities worldwide with degrees including the term blockchain—four in the U.S.

Clearly, blockchain is gaining momentum in education both worldwide and in the United States. University and college offerings have expanded from teaching a course or two, to providing certificates and even degrees in blockchain technology. These programs are developing using both on-campus and online formats. However, of the more than 70 certificates, diplomas, and degrees offered worldwide, universities in the U.S. represent only twelve of these.

Education in the U.S. has a reputation of moving a bit slowly in response to changes and innovation in the business world, and this seems representative with BT.

Education is being transformed by technologies developed since the adoption of the internet. Classes are conducted online, a process escalated by the pandemic of 2020-21, materials are posted on web pages instead of distributed in class, and homework is completed via the cloud on electronic homework managers. Moving forward, the education sector is investigating potential applications of blockchain technology on a global basis. Considering the investment of time and resources by the Big Four accounting firms in training and application of BT, as well as the interest of the authors, one of the main focuses of education of this paper is on accounting education.

Awareness and Demand
Blockchain technology has been a hot topic in the financial sector in recent years where financial institutions mostly focus on digital currency, cross-border payments, supply chain finance, and securities trading. More than 70 of the world's most prominent financial institutions have joined R3, a distributed database technology company organized in 2015, to study, research, and develop blockchain-related products and services (Kelly, 2016).

Further, according to Kelley (2016), the World Economic Forum (2015) estimates that 10% of global domestic product (GDP), or around $80 trillion, will be stored on blockchain technology by 2027. To address the need to have accountants and financial managers skilled in blockchain technology, the Big Four accounting firms are encouraging educators to move forward with curriculums enhanced with this technology.

Part of the job of educators is to remain current on topics and developments in their area of expertise. The existence and growth of BT in the business world cannot be denied; however, some may think of it as "someone else's problem" or topic to learn more about. It is up to teachers to train students in the cutting-edge technologies, so they are more valuable to employers when they graduate. There needs to be at least one faculty member, a champion, who takes the lead and spreads the word about BT. Mary Lacity, Ph.D., and IS professor at the University of Arkansas is such a person. She said in a recent interview with Cheryl Meyer (2019), "All students need to learn blockchain. Let us go back 20 years; it is like asking, 'Who needs to understand the internet?' Eventually this will be the platform on which all companies transact."

Interest and commitment by the faculty usually leads to awareness and interest on the part of the students. According to Dr. Myles Stern, he taught his first graduate blockchain course at Wayne State University in Detroit in the fall of 2018. Every course since then has been full, and usually half the students are accounting majors (Meyer, 2019).

Educator Training
BT is very new to the education sector, so there may not be many resources available for educators to use to introduce and teach it. One that is available is called Academic Initiative. It is a blockchain-based program created by IBM, and it is one of only a few resources that is open to educators and students. Academic Initiative provides educators and students with a free month of training resources to develop market-ready skills (Gupta, 2017).

Since blockchain is a relatively new concept to most people, educators probably do not have prior, formal training in this area. Therefore, they must study and understand the application of blockchain technology for themselves before teaching it to students. As a sidebar, unless there is an incentive such as a course-load reduction or stipend offered by administration, this additional training must be completed while doing their current full-time job. With limited incentives, educators must consider whether it is even possible to make it happen. On the other hand, there may not be a faculty member on staff who has an interest in learning and/or teaching this new subject matter.

Another scenario could be that an educator, interested in learning about blockchain, chooses to self-educate by listening to Podcasts, reading articles, or talking to others who might be more knowledgeable on the topic. They might partner with other interested faculty to develop a cross-discipline assignment or case study. If the school budget permits, they might attend a conference where the main topics relate to BT, thus providing networking opportunities.

A possible consideration for accounting faculty with an education track focused on public accounting might be to reach out to one of the Big Four public accounting firms, preferably one with an education class on blockchain. This could be a win for the firm and the educator— training an educator who in turns trains the firm's potential employees.

After considering other options, an interested educator might enroll in a BT class at another institution. Many of these are offered through online programs, making the education accessible to those who are willing and able to learn. The expense of this education must also be considered, so if there is a continuing education incentive program or faculty development funds for which to apply at the institution level, certainly that application should be made.

Curriculum and Content

There is an opportunity for the education sector to benefit from adding blockchain technology instruction to their curriculums. Institutions like IBM and some universities are working to explore and leverage the potential entry into education-related areas as previously mentioned. For now, the finance sector has adapted BT into its businesses more than other sectors, but since the natural connection of accounting and finance education has long existed, that may be a strong point in bringing about curriculum change. Perhaps by partnering with another department or an external source such as IBM or one of the Big Four, consensus-building to support curriculum change may begin.

The type of education content may be as basic as inviting an outside speaker to make a class presentation, either in person or virtually, on how BT is used by their company. It could be a bit more involved with the student conducting an active learning project to write a one-page summary of their understanding of what is BT, or there might be assignments to view videos or read articles on BT.

Assignments could be assigned based on the class that is being taught, so if it is an Audit class, maybe assign a case study on Enron or HealthSouth for students to discover ways BT could have been helpful in preventing those frauds. If it is a Financial accounting class, the students could develop a list of Pros and Cons comparing a BT-based distributed ledger with a Traditional ledger.

If more in depth blockchain coverage is desired, perhaps this would involve adding a Blockchain course to the curriculum such as Myles Stern, Ph.D., did at Wayne State University in Detroit. If interest grows among the faculty and/or an outside sponsor presents itself, the momentum may dictate that a Blockchain Center of Excellence (est. 2018) be established such as the one at the University of Arkansas (Meyer, 2019).

Conclusions

This paper provides information describing Blockchain Technology, its brief history, as well as current and potential applications. With companies such as Facebook and banks like Bosch and Daimler placing BT at the epicenter of their corporate innovations, the focus on BT is growing. Add to that the attention of the Big Four accounting firms—both in BT use and developing in-house education for their employees to work with it, and indications are clear that higher education, and schools of business in particular, needs to step up to the plate with course content and curriculum changes to add Blockchain Technology subject matter.

Based on the research for this paper, it was determined that Accounting, Finance, and Information Systems-based businesses are investing greatly in the development and adoption of Blockchain Technology. However, findings also show that only a few universities in the United States teach blockchain technology-related courses. Research shows that BT is a blooming technology. University educators and students in Business should be aware of the existence of this technology in order to make educated decisions about whether to learn it.

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