Issues in Information Systems
Volume 23, Issue 3, pp. 174-186, 2022

DOI: https://doi.org/10.48009/3_iis_2022_114

Recommendations for Course/Program Objectives in Blockchain Technology

Azad Ali, Indiana *University of Pennsylvania, azad.ali@iup.edu*
Pankaj Chaudhary, *North Carolina A&T State University, pchaudhary@ncat.edu*

Abstract

This paper introduces a list of program/course objectives for the emergent field of study of Blockchain. Since its emergence, Blockchain technology has been increasing in use at a rapid rate. It has emerged as a viable technology alternative that contributes to many organizations and sectors, especially in financial applications and record keeping. When surveyed, it was found that there are few programs and courses that teach this emerging topic. Many of these courses do not use Bloom's Taxonomy to list course objectives. This paper aims to fulfll the gap of coming up with a list of courses for a Blockchain program where specific objectives are stated using the Bloom's Taxonomy. The paper employs a formal literature review to come up with a set of topics and concepts. Courses are recommended to target coverage of these topics and concepts. Program/course objecitves are complied based on Bloom's taxonomy and the coverage provided by the courses.

Keywords: Blockchain, Blockchain objectives, Digital Ledger Transaction, Bloom's taxonomy, Academic programming.

Introduction

This study builds upon two previously published studies in the area of Blockchain and the development of the course and program objectives. In the first study by Ali and Smith (2018), Bloom's taxonomy was used to develop program objectives for big data analytics as a field of study. It reviewed literature on big data analytics and followed a methodology (same as used in this manuscript) to list program objectives for big data analytics. In the second paper, Ali and Smith (2019) discussed Blockchain as a new field of study, its characteristics, and its application in the area of mortgage lending. This current study follows the methodology laid out in first paper along with understanding of the blockchain technology as demonstrated in the second study to arrive at a set of courses and learning objectives for a blockchain curricula. The learning objecitves are stated as per Bloom's taxonomy for a program in a traditional university setting.

Blockchain has emerged as a technology that is experiencing significant growth. It has been proliferating at a significant pace (Amoah & Oh, 2021; Pilkington, 2016). Yet, academia somewhat lags in its coverage of Blockchain technology as a formal and distinct field of study and/or as a stand-alone course. While courses do exist, the proliferation of courses in the curriculum lags the notoriety and hype that has been generated in the IT and finance industry. An initial search for blockchain courses and programs, as part of this research, resulted in a scant basket of short courses or certificates offered. There is not a significant number of courses and programs that lead to a four-year degree, a major, or a minor field of study in Blockchain. So, the effort in this paper is directed towards arriving at course/program objectives that can

serve as a basis for developing courses and/or a program in Blockchain and also aid in further development and refinement of these objectives as the field evovles.

Research Methodology

This section describes the methodology that was followed to achieve the goals and objectives of this research. The methodology comprises of a number of steps with each step producing a defined output that feeds into the next step. A literature survey of the Blockchain area was undertaken. "Open Coding" framework (Khandkar, 2009) was used to identify keywords related to Blockchain from this literature survey. After collecting a sufficient number of keywords, "Thematic Coding and Categorizing" (Gibbs, 2007) were used to develop categories. Lastly, course/program objectives were developed using "Bloom's Taxonomy" guidelines (Krathwohl, 2002). Figure 1 below shows the steps followed in reaching the end goal of this paper. More details on each of the steps are provided in the following sections.

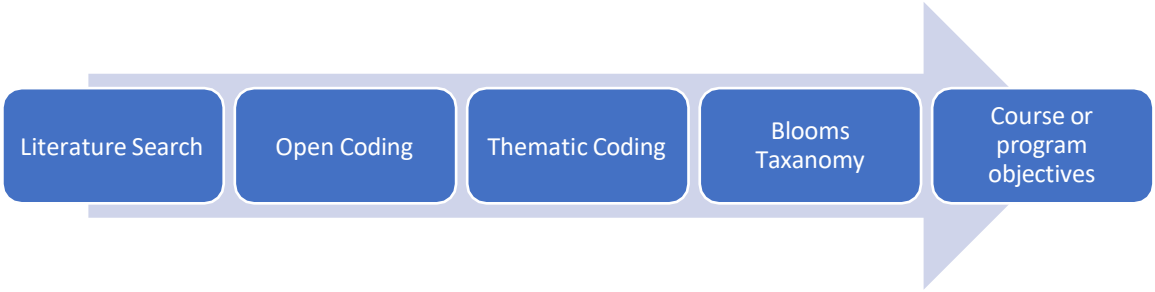

Figure 1 – Methodology Used in This Paper

Open Coding

Open coding refers to developing codes during the review of qualitative data, and it involves three steps: noticing, collecting, and thinking about issues related to the subject being searched (Khandkar, 2009). In the first step, the intent is to notice things that are related to the subject being researched. The "things" noted here could be observations, interpretations, or relevant words related to the subject of the study. All these translate to keywords related to the study's subject. This open coding step searches and builds a corpus of "Keywords" that can be used in subsequent steps.

The open coding framework has been used in different studies to arrive at the relevant concepts at the end of the literature review. Labazova, Dehling and Sunyaev (2019) used this method to develop a taxonomy of Blockchain applications. The study illustrated the taxonomy in a table that summarized the applications used in Blockchain and the different characteristics of each application. Hassan et al. (2018), used this model to study the dialogue between users and developers regarding free applications downloaded from the Google Play store. While these studies have applied the "Open Coding" framework somewhat differently, this current study will follow the steps outlined before: A literature search is conducted to find a list of keywords to be used in the later steps.

Thematic Categorization

Thematic categorization, as explained by Gibbs (2007) results in groups of categories that are formed based on similar characteristics for each group formed. The formation of the groups makes it easier for the researcher to describe or apply general characteristics that characterize each group. The challenge is to find characteristics that make each group different than the others. The purpose of the categories is to make them easier to manage, analyze and describe. Williams and Moser (2019) stressed the importance of thematic

categorization in qualitative explorative studies. Thematic categorization is a critical step in achieving the goals and objectives of this paper.

An approach similar to thematic categorization was followed by Clarke and Braun (2013) and is termed as thematic analysis / thematic development. In this kind of analysis, the search is conducted for keywords to find common "themes" that collectively describe each group. Each of them can then be separately described and discussed for further work. In essence, the end result is the grouping of keywords into categories sucah that each category can be discussed or studied separately. The approach in this study is to find keywords and find commonalities among the keywords to form categories or themes that will be used, along with Bloom's taxonomy to form program/course objectives in Blockchain.

Bloom's taxonomy

Bloom's Taxonomy or The Taxonomy of Educational Objectives is a framework widely used in academia to explain the intent or the learning outcome of taking a course or completing a program of study (Krathwohl, 2002). The purpose of this taxonomy is to phrase course objectives (or intended learning outcome from taking the course) in a systematic way that make it consistent when writing course or program objectives (Forehand, 2010). Krathwohl (2002) explained that a statement of a course objective in Bloom's taxonomy is constructed from four components: object, verb, keyword, and subject. For example, table 1 below shows the components used to construct the objective: "The student shall be able to describe the law of supply and demand equilibrium in economics".

Table 1: Example of a Course Objective.

Object	Verb	Keyword	Subject
The student	shall be able to describe	the law of supply and demand equilibrium	in economics

Krathwohl further suggested that most institutions omit the first column (the object) from the objective sentence listed in table 1 above. In this study, we followed this suggestion and omitted "The Student" from listing the program's objectives. Thus, the course/program objectives that we developed in this study will start with a verb, followed by a keyword, and then the subject.

Literature Search

This section conducts a literature search on Blockchain to find keywords or key phrases that they can be grouped or put into themes for later stages in the development of learning objectives. The literature search targeted the following broad areas:

- Blockchain definition
- Blockchain history
- Blockchain applications

The philosophy of "Scoping Literature Review" (Arksey & O'Malley, 2005; Chang, 2018) was followed. In scoping literature review, researchers search (scope) for the purpose of finding keywords related to the topic being searched. The literature was searched first, and then the content was critically examined to arrive at the relevant keywords. Since Blockchain is a relatively new and evolving area, practioner literature and media resources were also used in addition to academic literature.

Blockchain Definitions

The starting point for the identification of keywords related to Blockchain program/course objectives is in Blockchain definition. Definitions can sometimes vary in new technology areas, especially in an area like Blockchain, but they contain rich content and adequate coverage of keywords. Table 2 lists sample definitions from four different sources that attempt to provide a comprehensive explanation for Blockchain and that can be used for extracting keywords at a later stage.

Table 2 – Blockchain Definitions

Source	Definition
Broderson et al., (2016, p. 2)	A distributed tamper-proof database that secures all records that are added to it, wherever they exist.
Crosby et al., (2016)	A blockchain is essentially a distributed database of records or public ledger of all transactions or digital events that have been executed and shared among participating parties. Each transaction in the public ledger is verified by the consensus of a majority of the participants in the system. Once entered, information can never be erased. The Blockchain contains a certain and verifiable record of every single transaction ever made.
Tapscott (2018, p. 3)	The Blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value. Each unit of value is represented by transactions recorded in a blockchain which leverages the resources of a large peer-to-peer network to verify and approve each transaction.
Iredale (2020)	Blockchain is a peer-to-peer distributed ledger that is secure and used to record transactions across many computers. The ledger's contents can only be updated by adding another block linked to the previous block. It can also be envisioned as a peer-to-peer network running on top of the internet. In layman or businesses term, Blockchain is a platform where people are allowed to carry out transactions of all sorts without the need for a central or trusted arbitrator.

Keywords from Blockchain Definitions

After an examination of the definitions, some keywords were arrived at. These keywords can be used in the search for program/course objectives. 20 keywords were arrived at, that were considered pertinent to the definitions examined. At least two researchers independently arrived at the keywords and then deliberated to come up with one list. Table 3 lists the keywords specific to Blockchain technology that are deemed helpful for use in the next step of the study to develop learning objectives for the study of Blockchain.

Table 3: Keywords Extracted from Definitions of Blockchain

Tamper-proof database	Decentralized storage	Commonly shared ledger	Peer to peer architecture	Consensus protocol
Integrity and consistency	Consistent digital ledger	Transactions and blocks	Common, unambiguous transactions ordering	Geographically distributed nodes
Distributed database	Consensus of majority	Bublic ledger	Verifiable record of every transaction	Peer-to-peer network
Secure	Block links	Trusted arbitrator	Block	Chain

Blockchain History

The history of Blockchain goes back to the early days of 1991 (Iredale, 2020; Sheldon, 2021). It has evolved into a powerful technology through years of development and expansion into areas that require trusted decentralized recordkeeping. The years of development can be grouped into four stages, each stage has a set of characteristics that have led to the Blockchain becoming both a more popular and powerful technology. Figure 2 depicts the stages of development of Blockchain.

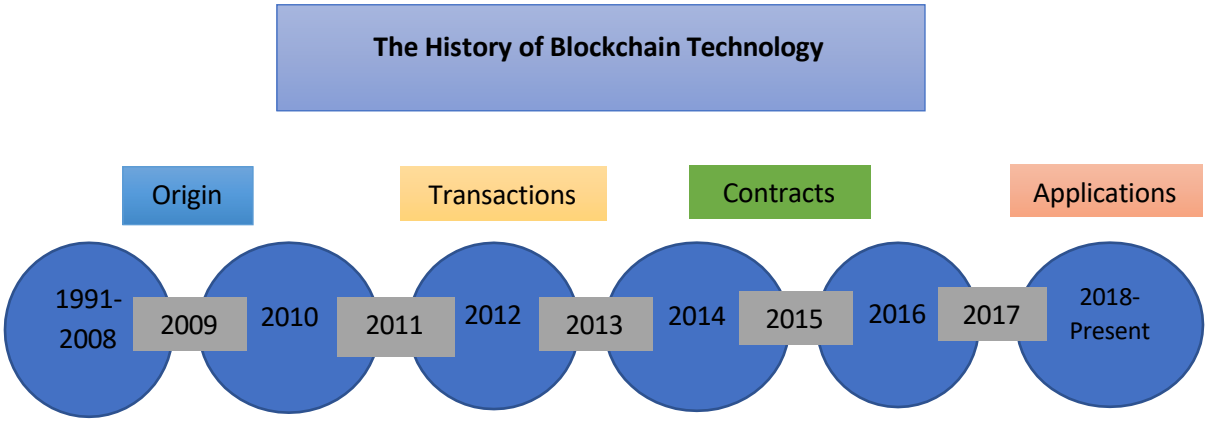

Figure 2 Blockchain History

Source: Iredale, 2020. https://101blockchains.com/history-of-blockchain-timeline/

As it has evolved, Blockchain has increased in usage and power and has overcome several initial issues like proof of work effort which is linked to the time required to validate a transaction. While these phases may seem to represent milestones that distinguish each phase from the others, the reality is that this is just a

representation, and the transitions were continuous and seamless. Some details of the developments in each of the stages follow:

Phase 1: Blockchain Origin:

This phase spans from 1991 to 2008, and it represents the years before the beginning of the full evolvement of Blockchain. Most authors (Amoah & Oh, 2021; Gu, 2019; Gupta, 2019; Iredale, 2020) highlight the seminal paper by Nakamoto (2008) as the most significant event of this phase. This paper suggested the use of Bitcoin as peer-to-peer electronic cash system running on top of a decentralized, encrypted, and tamperproof database called the Blockchain. The concept of "proof of work" was perhaps the cornerstone of how this system would work and ensure a decentralized system of trust. The introduction of Bitcoin made possible the use of decentralized yet still trustable digital currency without using third-party and/or centralized banking systems. Digital currency, in some sense, was the primary motivation for the conceptualization and invention of Blockchain.

In a study conducted by Rose (2015) to evaluate the evolution of digital currencies, Rose found that Blockchain technology makes it possible to have a digital currency that can be issued without any central authority and, at the same time are, anonymous. This contrasts with the traditional money that is issued and guaranteed by central governments. Characteristics of the Blockchain make the underlying transaction database tamper-proof (very difficult to be hacked and tampered with), thereby maintaining trust in the system. The proof of work and the tamper resistance ensured that people felt comfortable in exchanging and trading without needing to have a central authority while using the Blockchain.

Phase 2: Blockchain Transactions Year 2009 to 2012:

One notable development in this phase is the increased usage of the term "cryptocurrency" as a general term noted when discussing Blockchain. The literature used the word "cryptocurrency" more frequently as opposed to the phrase "Digital Currency" as was prevalent in the previous phase. The change from the word "Digital" to "Crypto" as a prefix for the word "currency" is not a simple exchange of synonyms. Instead, this change means understanding the application of cryptography in the exchange of money between parties more often by recording transactions using cryptography (Underwood, 2016).

Using Cryptography in the exchange of money implies robust security for the people conducting transactions (Rose, 2015). This can be seen as equivalent to the increase in Internet security that enabled e-commerce to flourish. It is evident that e-commerce would not have advanced to the level of popularity it has, was it not for the increase in levels of security and trust on the web through the use of cryptography. Use of cryptography has allowed for trust and security through strong encryption methods used in exchanging information, especially while paying for goods and services on the Internet.

The use of encryption to secure transactions that involve the use of digital currencies and storing these transactions in a distributed fashion makes it difficult to tamper with the Blockchain thereby increasing its security and thereby establishing trust in the system. Added to this, consensus mechanisms ensure that that all parties approve the transaction before it becomes part of the Blockchain. This kind of multi-party approval (or consensus mechanism) adds an important layer of security. It is typically much harder to break into a system where multiple parties are involved. To break into the Blockchain system, intruders need to break into the system of all parties involved in the chain of trust. This makes it much harder to do than to break into a single system and more so compromise Blockchain's integrity.

Phase 3: Year 2013 to 2016

During this phase, business contracts could be executed on the Blockchain. Iredale (2021) suggested that the inclusion of the NEO Cryptocurrency made a difference in the continuation of the expansion of Blockchain. However, numerous other currencies were developed to make it easier for participants to complete transactions on the web, and thanks to Blockchain, no central authority is involved. The capability of the smart contracts was pioneered by Ethereum and brought into the mainstream by incorporating code storage on Blockchain and automatic code execution if the conditions of the contract were met.

Subsequent developments led to the expansion in the use of cryptocurrencies. This expansion was such that one study contemplated if cryptocurrencies could overtake fiat money (Jumde & Cho, 2020). To illustrate the increased use of Cryptocurrencies, Hayes (2022) reviewed the cryptocurrencies available. Rice (2019) listed the top ten cryptocurrencies. This list of cryptocurrencies included Ethereum, Litecoin, Cardano, Poladot, Bitcoin Cash, Stellar, Dogecoin, Binance, Tether, and Monero.

Iredale (2020) also noted that using open-source software for the Blockchain created more opportunities for the software to expand and develop new capabilities. From our review, we noticed that some Literature repeatedly notes a platform named Corda (www.corda.net) that supports Blockchain projects. Brown, Carlyle, Grigg, and Hearn (2016) describe Corda as:

> A distributed ledger made up of mutually distrusting nodes that allow for a single global database that records the state of deals and obligations between institutions and people. It eliminates much of the manual and time-consuming effort currently required to keep disparate ledgers synchronized with each other. It also allows for greater levels of code sharing than presently used in the financial industry, reducing the cost of financial services for everyone (P.1).

Phase 4: from 2016 to present

Blockchain continues to evolve, and the number of digital currencies continues to increase. The number of applications that use Blockchain has multiplied. Iredale (2020) noted another novel application of Blockchain, and that is data storage from sensors that form the Internet of Things (IoT) (Chen et al., 2020). IoT refers to connecting various devices to the Internet so the transmission of data from these devices can take place over the Internet. The devices that transmit data are numerous, including home appliances, sensors, and can be monitored and controlled remotely (Dorri, Kanhere & Jurdak, 2017). The data generated by these IoT devices, such as Medical Internet of Things (MIoT) is voluminous and needs to be stored and shared securely. Web 3.0 (Liu et al., 2021) has been recently postulated to drastically change our lives. It is comprised of individual blockchains, federated or centralized platforms capable of publishing verifiable states, and an interoperability platform to hyperconnect those state publishers. The phenomena of Non-fungible Tokens or NFTs (Chohan & Paschen, 2021) is also gaining ground as digital assests and Metaverse (Ning et al., 2021) are beginning to come mainstream and are in need of secure mechanisms of ensuring custody and ownership.

Keywords from Blockchain History

The following keywords were arrived at upon examining the history of Blockchain :

Table 4 – Keywords Extracted from Review of the History of Blockchain

Digital currency	Cryptocurrency	Peer to peer network	Bitcoin	Anonymity
Ethereum	Litecoin	Cardano	Poladot	Bitcoin Cash
Stellar	Dogecoin	Binance	Tether	Monero
Open-source	IoT	Infrastructure	Smart Contracts	MIoT
Web 3.0	Tokens	Metaverse		

Other relevant keywords can be gleaned from the examination of the past, current, and new emerging applications of Blockchain. The following section details some typical applications in Blockchain. Given that new and novel applications of Blockchain are constantly emerging, it may not include some of the latest applications of the Blockchain.

Common Applications in Blockchain

The basic underlying technology of Blockchain remains a distributed (non-centralized) ledger for recording transactions in a secure and tamper-proof fashion. While the original conceptualization of the ledger was for the ledger to be public so that anyone has access the ledger and the record of transactions, this concept has evolved to include private and consortium blockchains.

A popular application for the use of Blockchain in the business financial sector (Nofer et al., 2017) but more specifically, mortgage lending for the use of Blockchain technology. The competitive advantage of Blockchain comes from the use to eliminate most and any middlemen from the lending and paying process. The main reason for attempting to eliminate the middleman is that middlemen cause an added cost for the consumer through fees and delays. It also creates redundant and onerous paperwork thereby opening up opportunities for fraud and crime. Ali and Smith (2018) suggested that Blockchain use in mortgage lending solved these problems. Ali and Smith also explained that the problems in mortgage lending can be helped through certain features available in Blockchain, including Interoperability, the trust relationship amongst involved parties, and security levels in transactions. To further explain the positives of using Blockchain, they explain different concepts and their benefits. These concepts include: The Block, The Chain, Digital Ledger Transaction (or DLT), Public and Private Key, Digital Signature, and the Consensus Model

Labazova, Dehling, and Sunyaev (2019) conducted a study and searched the literature to develop a taxonomy of Blockchain applications. The taxonomy was developed along with six categories of applications: Financial transactions, smart contracts, data management, storage, communication, and banking. In reviewing the developed taxonomy, several keywords were identified that could be added to the list, including the following: anonymous cryptocurrencies, global/central issues, financial instruments, smart contracts, global agreement, global authentication, and IoT communication.

Gu (2019) completed a study about the applications of Blockchain. It started by identifying the benefits of using Blockchain in different applications. It elaborated further on the following different categories of Blockchain:

- The Bitcoin Blockchain
- The Ethereum Blockchain
- Private versus public Blockchain
- The consortium Blockchain

Dorri, Kanhere, and Jurdak (2017) presented a study to optimize Blockchain for IoT devices. The study included discussions on the issues of privacy, security, smart home architecture, peer-to-peer network overlay, and cloud storage issues. Additionally, the study discussed some potential issues with Blockchain that include storage, accessing, monitoring, and performance evaluation in systems working through Blockchain architecture.

Powell, Hendon, Mangle, and Wimmer (2021) discussed the use and issue of energy usage in Blockchain. The study applied concepts related to Blockchain, including digital currency, decentralization, transparency, immutability, and security in the context of energy usage.

Walso (2019) explained that despite its growth, Blockchain remains a mystery to many, and practical use cases have not received much traction. In the same study, Waldo explained some issues and problems with Blockchain. These relate to replacing old technology (Blockchain with Cryptocurrency) with an updated notion of currency. Another issue raised was that of trust. The issue regarding trust is different in Blockchain, specifically, to list the people we trust. This includes trusting the developers who wrote the software, the ledger that the transactions are written into, and the process of purchasing the digital/cryptocurrencies.

Keywords from Common Applications of Blockchain

The review of the applications of Blockchain and some issues related to the adoption of Blockchain brought forward more keywords that can be included in the list of keywords for Blockchain objectives. 25 keywords agreed by consensus between the researchers, are listed in table 4:

Table 4 – Keywords Extracted from reviewing common applications of Blockchain

Anonymous cryptocurrencies	Global financial instruments	Smart contracts	Global agreement	Decentralization
The Bitcoin Blockchain	The Ethereum Blockchain	Public Blockchain	Private Blockchain	Immutability of Blockchain
Anonymous cryptocurrencies	Legal and regulatory framework	Trust	Anonymous cryptocurrencies	IoT communication
Security of Blockchain	MIoT	Mining	Transparency	Consensus Protocol
Developer trust	Privacy issues	IoT	Trust issues	Overlay

Categorization of Keywords

From the review of literature, different keywords were arrived at. There are more than 75 keywords that have been outlined. There was some limited repetition across categories. These keywords can be used to

arrive at a list of categories and objective to formulate objectives for the course or program in Blockchain. The keywords in tables 2 to 4 were examined to find commonalities amongst them to make them more manageable as mentioned before, some keywords were similar and repeated (although some which may be deemed as synonymous can be grouped with some kind of explanation). Based on the search and to keep the list of categories manageable, it was decided to limit the search to ten categories. These categories can then be used later in the course/program objectives development. The following is the list of ten categories that were arrived at by the researchers which may be used to write course/program objectives:

1. Cryptographical and technological foundations of Blockchain
2. History and evolution of Blockchain
3. The digital ledger, transaction recording, block formation, and consensus forming.
4. Digital currency and cryptocurrency
5. Proof of work, its advantages, limitations, and potential solutions
6. Network issues in Blockchain
7. Legal and regulatory issues in Blockchain.
8. Blockchain framework (public, private, public-private)
9. Blockchain, IoT and MIoT
10. Trust, Security and privacy issues with Blockchain

Selecting verbs from Bloom's taxonomy

For selecting the phrases to complete the course learning and program objectives, verbs suggested in Bloom's Taxonomy were used. Bloom's taxonomy suggests different verbs that can be included in a course or program objectives. The benefit of these verbs is that they are measurable. That is, the outcome from these verbs can be measured, and this achievement can be gauged whether the objective is met or not.

Our goal was also to diversify the inclusion of verbs and possibly cover all levels of verbs from Bloom's Taxanomy to have a mix of verbs at all levels. The verbs would be appropriate for the level of learning that would occur in the courses and program. For coverage that requires the knowledge of technologies, we considered that a higher level of coverage is helpful to the students. Other topics like "security" and "ethical values" may require less coverage because other courses within the program of study may cover similar topics.

The Resulting List of Objectives

Based on the previous analyses, the learning objectives are outlined below in conjunction with the verbs from Bloom's Taxonomy. It should be noted that these program objectives are in the context of a department like Management Information Systems (MIS), Business Information Systems (BIS), and/or Computer Information Systems (CIS) where the objectives are always balanced between the learning of the technology along with the business applications.

- Explain the cryptographical and technological foundations of Blockchain
- Describe the evolution stages of Blockchain
- Illustrate the use of digital ledger through various stages of working with Blockchain
- Elucidate the concepts of digital currency and cryptocurrency in the evolvement of Blockchain
- Analyze proof of work, its advantages, limitations, and potential solutions
- Evaluate network issues in Blockchain
- Assess the legal and ethical issues of using Blockchain.

- Classify Blockchain frameworks (public, private, public, private, hybrid and others)
- Relate the use of Blockchain with IoT, MIoT, and other applications
- Clarify the issues of trust, security, and privacy issues in working with Blockchain

Summary

In this paper, a set of course and program objectives (which could be formulated with a collection and refinement of course objectives) have been arrived at through the use of a literature search that feeds into a formal research methodology. The methodology began with a literature search and then used open coding and categorization to identify a set of keywords. While not explicitly mentioned, the literature review involved both a review of the academic literature and also constant monitoring and review of the practitioner literature. These keywords were then grouped into themes by applying "categorization". These steps then were applied to arrive at the Blockchain course/program objectives, which was the goal of our writing of this paper.

These objectives can serve as a starting point for programs looking to venture into the topic of Blockchain technology to design their courses and program objectives. The list of keywords also provides an initial starting point towards key concepts in blockchairn and this keyword list can be modified and/or added to as the Blockchain technology evolves and different technologies come into foray. For example discussions of proof of stake could be incorporated in depth once the Ethereum Blockchain has successfully forked and proof of stake has been successfully employed.

What is explained above is also needed to overcome the limitation of this study which is that it is a snapshot in a point in time of a technology which is continuing to evolve and is of great interest to a variety of stakeholders and affects everything including international trade and our retirement accounts. So a continous refresh (more so an addition) of the keywords, categories, and objectives may be needed. This research and its methodology can serve as a starting point for univerisities to design their Blockchain curriculum.

References

Ali, A. I., & Smith, D. T. (2018). Developing program objectives in data analytic field of study using three frameworks. *Online Journal of Applied Knowledge Management (OJAKM)*, *6*(1), 54-66.

Ali, A. I., & Smith, D. T. (2019). Blockchain and mortgage lending process: A study of people, process, and technology involved. *Online Journal of Applied Knowledge Management (OJAKM)*, *7*(1), 53-66.

Amoah, E., & Oh, J. Y. (2021). Blockchain adoption in project management. *Issues in Information Systems*, *22*(4), 143-156.

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International journal of social research methodology*, *8*(1), 19-32.

Broderson, C., Kalis, B., Leong, C., Mitchell, E., Pupo, E., & Truscott, A. (2016). *Blockchain: Securing a New Health Interoperability Experience*. Accenture.

Brown, R. G., Carlyle, J., Grigg, I., & Hearn, M. (2016). Corda: an introduction. *R3 CEV, August*, *1*(15), 14.

Chang, S. (2018). Scoping reviews and systematic reviews: is it an either/or question?. *Annals of internal medicine*, *169*(7), 502-503.

Chen, F., Xiao, Z., Cui, L., Lin, Q., Li, J., & Yu, S. (2020). Blockchain for Internet of things applications: A review and open issues. *Journal of Network and Computer Applications*, *172*, 102839.

Chohan, R., & Paschen, J. (2021). What marketers need to know about non-fungible tokens (NFTs). *Business Horizons*.

Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The psychologist*, *26*(2).

Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation*, *2*(6-10), 71.

Dorri, A., Kanhere, S. S., & Jurdak, R. (2017, April). Towards an optimized blockchain for IoT. In *2017 IEEE/ACM Second International Conference on Internet-of-Things Design and Implementation (IoTDI)* (pp. 173-178). IEEE.

Forehand, M. (2010). Bloom's taxonomy. *Emerging perspectives on learning, teaching, and technology*, *41*(4), 47-56.

Gibbs, G. R. (2007). Thematic coding and categorizing. *Analyzing qualitative data*, *703*, 38-56.

Gu, H. (2019, December). Applications of Blockchain. *International Journal of Computer Science and Technology*, 7(6), 82-86.

Gupta, V. (2019, August 21). A Brief History of Blockchain. Harvard Business Review. https://hbr.org/2017/02/a-brief-history-of-blockchain

Hassan, S., Tantithamthavorn, C., Bezemer, C. P., & Hassan, A. E. (2018). Studying the dialogue between users and developers of free apps in the google play store. *Empirical Software Engineering*, *23*(3), 1275-1312.

Hayes, A. (2022). 10 Important Cryptocurrencies Other Than Bitcoin. Investopedia. Updated, 17.

Iredale, G. (2020, December 21). History of Blockchain Technology: A Detailed Guide. 101 Blockchains. https://101blockchains.com/history-of-blockchain-timeline/

Iredale, G. (2021, May 31). List of Top 50 Companies Using Blockchain Technology. 101 Blockchains. https://101blockchains.com/companies-using-blockchain-technology/

Jumde, A., & Cho, B. Y. (2020). Can cryptocurrencies overtake the fiat money?. *International Journal of Business Performance Management*, *21*(1-2), 6-20.

Krathwohl, D. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory Into Practice*, *41*(4), 212-218.

Khandkar, S. H. (2009). Open coding. *University of Calgary*, *23*, 2009.

Labazova, O., Dehling, T., & Sunyaev, A. (2019, January). From hype to reality: A taxonomy of blockchain applications. In *Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS 2019)*.

Liu, Z., Xiang, Y., Shi, J., Gao, P., Wang, H., Xiao, X., & Hu, Y. C. (2021). Make Web3. 0 Connected. *IEEE Transactions on Dependable and Secure Computing*. doi: 10.1109/TDSC.2021.3079315.

Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. *Business & Information Systems Engineering*, *59*(3), 183-187.

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Decentralized Business Review*, 21260.

Ning, H., Wang, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., & Daneshmand, M. (2021). A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges. *arXiv preprint arXiv:2111.09673*.

Pilkington, M. (2016). Blockchain technology: Principles and applications', in F. Olleros, M. Zhegu (eds) *Research Handbook on Digital Transformations*. Edward Elgar, Cheltenham.

Powell, L. M., Hendon, M., Mangle, A., & Wimmer, H. (2021). Awareness of blockchain usage, structure, & generation of platform's energy consumption: Working towards a greener blockchain. *Issues in Information Systems*, *22*(1).

Rice, M. (2019). Cryptocurrency: History, Advantages, Disadvantages, and the Future.

Rose, C. (2015). The evolution of digital currencies: Bitcoin, a cryptocurrency causing a monetary revolution. *International Business & Economics Research Journal (IBER)*, *14*(4), 617-622.

Sheldon, R. (2021, August 9). A timeline and history of blockchain technology. WhatIs.Com. https://whatis.techtarget.com/feature/A-timeline-and-history-of-blockchain-technology

Tapscott, D. (2018, May). Blockchain Revolution: The Internet of value. Insight Investment.

Underwood, S. (2016). Blockchain Beyond Bitcoin. *Communication of the ACM, 59* (11), 15-17.

Walso, J. (2019). A Hitchhiker's Guide to the Blockchain Universe. *Communications of the ACM*, *62*(3), 38–42. https://doi.org/10.1145/3303868

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, *15*(1), 45-55.