Aug 10th, 12:00 AM

Building the Workforce of Tomorrow: Blockchain Curriculum in Higher Education

Miloslava Plachkinova
Kennesaw State University, mplachki@kennesaw.edu

Ace Vo
Loyola Marymount University, ace.vo@lmu.edu

Tim Smith
Iowa State University, timsmith@iastate.edu

Thomas A. Chapman
Woodbury University, thomas.chapman@woodbury.edu

Building the Workforce of Tomorrow: Blockchain Curriculum in Higher Education

Emergent Research Forum (ERF)

Miloslava Plachkinova
Kennesaw State University
mplachki@kennesaw.edu

Ace Vo
Loyola Marymount University
ace.vo@lmu.edu

Tim Smith
Iowa State University
timsmith@iastate.edu

Thomas Chapman
Woodbury University
thomas.chapman@woodbury.edu

Abstract

Although blockchain is a relatively new concept, it has become an important part of various industries such as fintech, healthcare, real estate, and supply chain. Thus, it is essential to educate the workforce of tomorrow on this new technology to ensure that students are prepared for the challenges of the competitive job market after graduation. This study aims to start a dialogue on curriculum innovation in higher education by examining current trends and course offerings. We analyzed 266 R1 and R2 institutions in the US and found that only a small number of them offer such courses. Thus, our next steps would be to provide some guidance for curriculum innovation, as well as pedagogical strategies that can reflect the dynamic nature of the IS field.

Keywords

Blockchain, higher education, curriculum, workforce development

Introduction

Blockchain is a relatively new technology with the potential to disrupt many areas of our lives. The design of the blockchain-based cryptocurrencies was established in 2008 (Nakamoto, 2008). Since then, the concept has been extended to fields such as fintech (Du et al., 2019), healthcare (McGhin et al., 2019), and real estate (Karamitsos et al., 2018). Blockchain is a valuable tool for any sort of transaction where values and timestamps need to be securely recorded, thus its widespread application across the financial industry. The option to track the movement of data between parties makes it a valuable tool for other areas such as supply chain (Saberi et al., 2019), logistics (Tijan et al., 2019), and provenance (Kim & Laskowski, 2018). The endless opportunities presented by blockchain signify the importance of incorporating it in higher education technology curricula such as information systems (IS), cybersecurity, and other related disciplines.

The term "blockchain" still sounds like a buzzword to many. We argue that it is crucial to understand its characteristics further to identify how to implement it most successfully in higher education curricula. Prior work has explored the application of blockchain in education, but those studies focused primarily on supporting academic degree management and summative evaluation for learning outcomes (Sharples & Domingue, 2016; Skiba, 2017) and reducing degree fraud (Priya et al., 2020). However, there are innumerable other examples of how this new technology can revolutionize how we go about many activities in our lives. Thus, it is vital to examine it further and identify the skills necessary for mastering it in the face of the changing workforce of tomorrow.

Blockchain is yet to be widely implemented across higher education. Dettling (2018) identified several factors contributing to this problem. First, the technology itself is relatively new, and there are not that many trained academics with the skills to teach it properly. Faculty should be up to date not only on the theory of Blockchain but also on practical ways to demonstrate managed blockchains for their students by

using, as one example, Amazon AWS to create and deploy working blockchains. Second, the technology itself is almost indelibly entwined with digital currencies such as Bitcoin, where almost every day there are new developments. Instructors understandably, therefore, struggle to keep track of all these new developments and update their courses accordingly. A focus on differentiating the underlying blockchain technology from its many applications, i.e., as the basis for digital currencies, needs to be made explicit in any blockchain curriculum.

Our work addresses these challenges by providing an overview of the current state of blockchain across academia in the US and highlights some trends and themes. Our goal is to identify possible gaps and suggest areas for improvement. The research question guiding this project is: "What is the current state of blockchain curriculum in R1 and R2 institutions in the United States?" Through this work in progress, we aim to study further some of the main challenges in implementing blockchain-focused courses in such institutions as well as to provide solutions to overcome them. Furthermore, we will examine course offerings across R1 and R2 institutions in the United States to find which programs and departments typically offer such courses.

Background

Curriculum Development

The goal of any successful educational program is to meet the current and future needs and demands of the culture, the society, and the population being served (Alsubaie, 2016). Therefore, curriculum development and the educational reform process must undergo review, revision, and constant change (Johnson, 2001). We posit that blockchain is one of those relevant trends that educators need to consider and integrate as part of the standard IS curriculum. Again, blockchain needs to be understood as being wholly separate from its possible applications. As a case in point, FinTech has become one of the largest growing industries in finance and technology, but it relies heavily on blockchain to process transactions and to establish trust (Kursh & Gold, 2016). Therefore, one of the biggest challenges in revising the existing curriculum and developing new courses is the lack of blockchain expertise among academics. As it is a relatively new field, few individuals are knowledgeable enough to create and teach such courses. One solution to this problem is educating the educators – i.e., providing more opportunities for professional development among academics, who will then use this experience to develop new programs and courses (Ocheja et al., 2022). Blockchain has already demonstrated a positive effect on higher education in areas such as improving motivation and learning performance (Bucea-Manea-Ţoniş et al., 2021). These studies motivate us to explore further the current state of blockchain in higher education institutions in the US.

Digital and Pedagogical Innovations

Digital innovation is vital for the information systems (IS) curriculum. A solid technical background is essential for any business education. As a result, most business schools offer a core IS course. However, Fichman et al. (2014) argue that this is not enough and that future managers and leaders need to possess a deeper understanding of the latest advancements in the field. Furthermore, the authors call for more involvement from the IS field to prepare students to thrive in and contribute to digital innovations. This study highlights the importance of incorporating a more relevant and hands-on experiential curriculum focused on new technologies and trends. In addition, as such courses often span across various fields, it is easier to market them to non-IS majors and even non-business students, thus increasing enrollment numbers.

Pedagogical innovations and new course development are equally crucial for retaining student interest and establishing a strong, forward-looking curriculum (Shankaranarayanan et al., 2021). Blockchain is already an essential aspect of many companies and technological platforms (Akram et al., 2020). Thus, as educators, it is our responsibility to reflect these trends in the curriculum and provide students with the necessary knowledge and skills to thrive in a competitive job market.

Methodology

We focused our research on institutions that obtained the R1 and R2 classification in the Carnegie Classification of Institutions of Higher Education as of June of 2021. We chose to limit our sample to these

two types of institutions to view a broad spectrum of curricula rather than restrict our scope to business schools only. We used publicly available data from university websites to answer our research question. We created queries using the term "blockchain" when searching through each university's website. Due to the differences in catalog formats and the complexity of the search procedures (online database, PDF files, etc.), we had to conduct this search manually to validate all results.

There were 131 R1 institutions and 135 R2 institutions, totaling 266 institutions. We perused each institution's catalog and schedule of classes to find out (1) whether there were any blockchain courses in the institution's catalog; (2) if there were, what were the descriptions and properties of these courses, and (3) whether the courses were offered since Fall 2020. Out of 266 institutions, there were 86 that offered at least one blockchain course in their curriculum, as evident in their 2021-2022 catalog. The following are the results of our preliminary analysis.

Results and Discussion

Of the 266 institutions, only 97, or 36.5%, had at least one blockchain-related course (Table 1). Stanford University offered the most courses in blockchain – 31, followed by Fordham and Portland State with 18 courses each. When comparing R1 and R2 schools, it was not surprising that R1 schools, with their very high research activity, were also leading in the number of blockchain courses offered. Of the 232 courses we found in total, 206 courses (64%) were offered by R1 institutions and only 117 (36%) by R2 institutions. Of those, 36% were at the undergraduate level and 29% at the graduate level. A very small portion of courses, less than 3%, were offered by continuing education programs and/or were marked as available to both graduate and undergraduate students. Unfortunately, many of the courses (32%) did not have a clear designation, so we could not attribute them to either type of program.

Number of Courses	Count of Universities
0	158
1	50
2	21
3	13
4	11
5-10	8
11-20	4
21+	1
Total:	266

Table 1. Number of Course Offerings

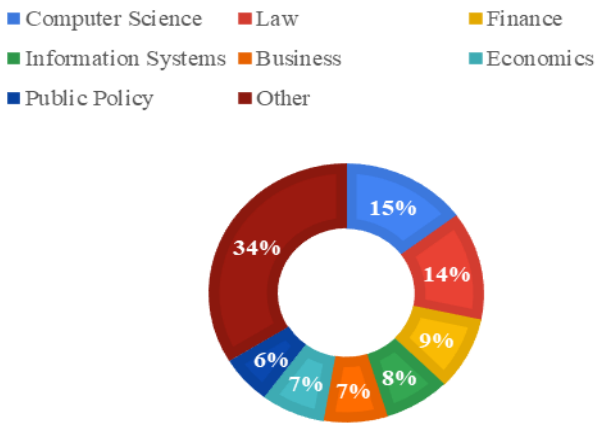

Figure 1. Course Offerings by Program

We examined the distribution of blockchain courses across states and found that the three states offering the most courses were California (21%), New York (15%), and Pennsylvania (7%). We also explored where the blockchain courses were housed to see if certain schools or departments were championing this initiative. 157 courses (49%) were offered by the college of business in departments such as finance, information systems, business technology and analytics, economics, and accounting (Figure 1). Of all business school blockchain courses, about 41% are offered by an information systems/decision sciences department. Outside of college of business, the college that offers the second most blockchain courses in Computer Science (114 courses), closely followed by Law (105 courses).

We used the course description information to visualize the main topics offered in our sample's courses through a word cloud diagram. Each course description is cleaned by removing any non-UTF-8 encoding and non-printable characters, stop words, and common words such as students, study, course, majors, and overview. Following is a word cloud diagram (Figure 2). Some of the most common themes we identified were distributed technology, systems, applications, financial, legal, and business. Although our sample included courses from various departments and schools throughout the institutions, it is interesting that

most courses were relevant to both the technologies and the business and legal process behind the blockchain mechanism.

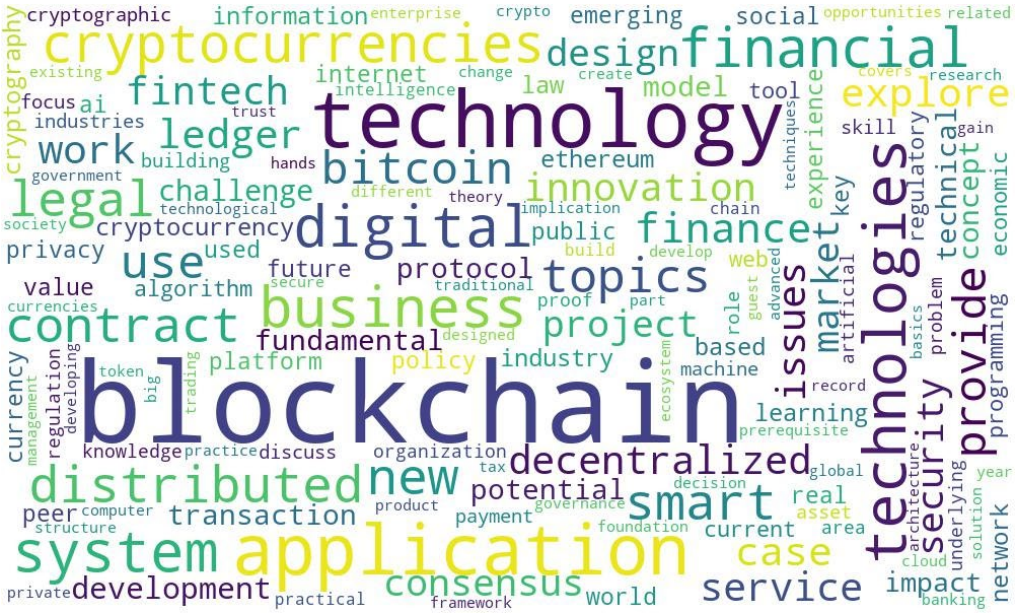

Figure 2. Blockchain Word Cloud Diagram

It is worth mentioning that of the 323 courses we found total, 17 had no course descriptions in the catalogs. This lack of course descriptions could be a simple oversight. Still, it is worthwhile mentioning because catalogs are official university documents where students can find the most relevant information, and they should be up to date with such course descriptions. In addition, although some courses exist in the catalog, they were not being offered in the current academic year.

The goal of our study was to provide a snapshot of the current state of blockchain curriculum in the US. These findings highlight some existing trends, such as the general lack of blockchain-relevant courses across R1 and R2 institutions. Furthermore, our results demonstrate that IS as a field can have a significant role in the curriculum development process. Thus, we encourage our colleagues to consider offering blockchain courses as part of their digital innovation strategies. It is essential to provide students with the necessary skillsets to thrive in the challenging job market. Institutions will serve their students better by integrating the latest technological advances into existing IS courses and creating new courses that highlight the latest developments in blockchain technology.

Limitations and Future Work

This is a preliminary study, and we realize it is not possible to examine every single course on blockchain being offered. In addition, using catalogs means dealing with incomplete data. Our next step would be to collect primary data from the instructors teaching the blockchain courses. Such information could be found through each department's website and through the instructors' personal websites. Our goal is to paint as complete a picture as possible about the state of the blockchain curriculum and the courses offered in higher education within the US so that institutions can revise their curricula and incorporate new courses that can help prepare the workforce of the future. The current study is among the first to examine this problem, and we encourage our colleagues to build upon this work in the future.

Conclusion

The current study aims to start a discussion about the gaps between existing higher education curricula and employers' needs in the next five to ten years. While we cannot predict with certainty what will happen in the future, our goal is to prepare students for the challenges of entering the workforce. By understanding the current trends and course availability, we want to highlight the existing disconnect, and encourage

educators to revisit their course offerings. While the curriculum development process may be tedious and time-consuming, it is necessary to keep up with technology to ensure that students have a solid background in the latest advancements of the field to be competitive on the job market. We argue that the IS field plays a key role in this process, and our findings suggest that more work can be done to educate students on blockchain technologies.

REFERENCES

Akram, S. V., Malik, P. K., Singh, R., Anita, G., & Tanwar, S. (2020). Adoption of blockchain technology in various realms: Opportunities and challenges. *Security and Privacy*, *3*(5), e109.

Alsubaie, M. A. (2016). Curriculum development: Teacher involvement in curriculum development. *Journal of Education and Practice*, *7*(9), 106-107.

Bucea-Manea-Ţoniş, R., Martins, O., Bucea-Manea-Ţoniş, R., Gheorghiţă, C., Kuleto, V., Ilić, M. P., & Simion, V.-E. (2021). Blockchain Technology Enhances Sustainable Higher Education. *Sustainability*, *13*(22), 12347.

Dettling, W. (2018). How to teach blockchain in a business school. In *Business Information Systems and Technology 4.0* (pp. 213-225). Springer.

Du, W. D., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation and actualization of FinTech: A blockchain implementation study. *The Journal of Strategic Information Systems*, *28*(1), 50-65.

Fichman, R. G., Dos Santos, B. L., & Zheng, Z. (2014). Digital innovation as a fundamental and powerful concept in the information systems curriculum. *MIS Quarterly*, *38*(2), 329-A315.

Johnson, J. A. (2001). Principles of effective change: Curriculum revision that works. *Journal of Research for educational Leaders*, *1*(1), 5-18.

Karamitsos, I., Papadaki, M., & Al Barghuthi, N. B. (2018). Design of the blockchain smart contract: A use case for real estate. *Journal of Information Security*, *9*(03), 177.

Kim, H. M., & Laskowski, M. (2018). Toward an ontology-driven blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management*, *25*(1), 18-27.

Kursh, S. R., & Gold, N. A. (2016). Adding fintech and blockchain to your curriculum. *Business Education Innovation Journal*, *8*(2), 6-12.

McGhin, T., Choo, K.-K. R., Liu, C. Z., & He, D. (2019). Blockchain in healthcare applications: Research challenges and opportunities. *Journal of Network and Computer Applications*, *135*, 62-75.

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

Ocheja, P., Flanagan, B., Ogata, H., & Oyelere, S. S. (2022). Visualization of education blockchain data: trends and challenges. *Interactive Learning Environments*, 1-25.

Priya, N., Ponnavaikko, M., & Aantonny, R. (2020). An efficient system framework for managing identity in educational system based on blockchain technology. 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE),

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research*, *57*(7), 2117-2135.

Shankaranarayanan, G., Stoddard, D., Gilleran, R., Beitelspacher, L. S., & Bravo, S. (2021). Experiential Learning of Information Systems in Functional Contexts: The Digital Brand Strategy Project. *Communications of the Association for Information Systems*, *49*(1), 1.

Sharples, M., & Domingue, J. (2016). Adaptive and adaptable learning. *Lecture Notes in Computer Science. Switzerland*, *9891*, 13-16.

Skiba, D. J. (2017). The potential of blockchain in education and health care. *Nursing education perspectives*, *38*(4), 220-221.

Tijan, E., Aksentijević, S., Ivanić, K., & Jardas, M. (2019). Blockchain technology implementation in logistics. *Sustainability*, *11*(4), 1185.