

In this issue:

- 4. *Invited Paper***
Treating problematic smartphone usage in the TikTok era: cultural dimension bias in the current research
David Firth, University of Montana
Tyler Johnson, University of Montana
Shawn F. Clouse, University of Montana
Patricia Akello, University of Montana
- 20. *Blockchain Education: Evaluating Programs, Curricula, and Integration with Emerging Technologies in Higher Education***
Tan Gürpınar, Quinnipiac University
Aashman Verma, Quinnipiac University
Lori N. K. Leonard, The University of Tulsa
Kiku Jones, Quinnipiac University
Wendy Ceccucci, Quinnipiac University
- 30. *Exploring VR-Enhanced Learning in Business Education: A Multi-Site Study***
Kevin Mentzer, Nichols College of Business
Mark Frydenberg, Bentley University
Suhong Li, Bryant University
- 44. *Assessing the Impact of Prerequisite Courses on Student Performance in Database Normalization***
Kevin Slonka, Saint Francis University
Matthew North, Utah Valley University
Neelima Bhatnagar, University of Pittsburgh
Anthony Serapiglia, Saint Vincent College
- 53. *Teaching Case***
Countering the “Plagiarism Slot Machine”: Protecting Creators and Businesses from AI Copyright Infringement
Christine Ladwig, Southeast Missouri State University
Dana Schwieger, Southeast Missouri State University
Reshmi Mitra, Southeast Missouri State University

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ISEDJ is published online (<https://isedj.org>). Our sister publication, the Proceedings of the ISCAP Conference (<https://iscap.us/proceedings>) features all papers, abstracts, panels, workshops, and presentations from the conference.

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Blockchain Education: Evaluating Programs, Curricula, and Integration with Emerging Technologies in Higher Education

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Abstract

As blockchain technology, along with its convergence to other emerging technologies such as AI and the Internet of Things, shows promising pilot projects across industries, academic institutions are tasked with preparing students for careers in this rapidly evolving field. To address the growing demand for blockchain professionals, specialized educational programs have already been developed. This study examines the curricula of blockchain programs offered by universities with AACSB-accredited business schools in the US, highlighting their similarities and differences. Utilizing a dataset with 533 institutions, the research evaluates the scope of blockchain offerings, drawing from university websites and catalogs, and considering a broad range of disciplines, including computer science, business, and engineering. The findings reveal that approximately 28% of higher education institutions offer blockchain courses within their programs, addressing the interplay with emerging technologies and meeting industry needs for diverse competences. Key courses consistently included are Blockchain Technology Fundamentals, Smart Contract Development, and Cryptocurrency Economics. This study provides valuable guidance for academic institutions planning to introduce blockchain programs and offers a foundation for developing relevant curricula. By identifying commonalities and differences across blockchain and related fields, educators can design programs that prepare students to thrive in the blockchain sector. Additionally, this research acts as a resource for institutions striving to bridge the gap between traditional disciplines and the dynamic field of blockchain technology.

Keywords: Blockchain Education, Digital Learning, Interdisciplinarity, Distributed Ledger Technology.

Recommended Citation: Gürpınar, T., Verma, A., Leonard, L.N.K., Jones, K., Ceccucci, W. (2025) Blockchain Education: Evaluating Programs, Curricula, and Integration with Emerging Technologies in Higher Education. *Information Systems Education Journal*, v23, n5, pp.20-29. DOI# <https://doi.org/10.62273/WNRJ3445>

Blockchain Education: Evaluating Programs, Curricula, and Integration with Emerging Technologies in Higher Education

Tan Gürpınar, Aashman Verma, Lori N.K. Leonard, Kiku Jones, Wendy Ceccucci

1. INTRODUCTION

Blockchain technology has emerged as a transformative force across industries, promising enhanced security, transparency, and efficiency (see current industry projects [here](#)). However, its technological impact extends beyond these aspects, addressing not only economic sustainability but also embracing social and ecological dimensions (Schwarzer, Gürpınar, & Henke, 2022). From financial services to supply chains and healthcare, organizations are exploring the potential of blockchain to decentralize operations, establish audit trails for tracking environmental impact, and provide verifiable proofs of resource origins to uphold ethical practices (Grünewald, Gürpınar, & Culotta, 2024).

However, the adoption and effective integration of blockchain technology within enterprises remain a complex and challenging endeavor. In this era of dynamic digital innovations, the knowledge gap surrounding blockchain and connected technologies is striking. While businesses recognize the potential benefits of blockchain, there exists a significant disparity between this recognition and a comprehensive understanding of how to harness its power (Düdder et al., 2021) and move from proof-of-concepts to actual at scale solutions (Gürpınar, Henke, & Ashraf, 2024). According to recent surveys (Fomin, Gürpınar, & Baleviciene, 2024), Enterprises are struggling with fundamental questions: *Which competences are required to implement and later operate blockchain solutions?* *How can employees acquire the necessary competences and expertise to navigate the evolving landscape around blockchains?*

This knowledge gap within enterprises is a critical issue that must be addressed (Malik, Chadhar, Chetty, & Vatanasakdakul, 2022). Without a skilled and well-trained workforce, the full potential of blockchain technology may remain untapped, hindering the competitiveness and innovation of organizations in an increasingly digital world. Bridging this gap requires a concerted effort to provide education in blockchain technology and equip the workforce

with the necessary tools to harness its potential.

To this end, this paper sheds light on the state of blockchain technology programs in higher education. By examining the curricula of university programs, we aim to identify the existing landscape of academic blockchain education. The collection and comparison of data from higher learning institutions offering blockchain courses provide valuable insights into the structure, content, and focus of blockchain education. This research is a crucial step toward understanding how academic institutions are preparing students and professionals for careers in the blockchain industry. The need for this research becomes increasingly evident as the demand for blockchain expertise continues to grow as observed by Fomin et al. (2024). This is further demonstrated on LinkedIn, where approx. 4,000 blockchain jobs are advertised in the US. By examining the current academic offerings, we discern trends, commonalities, and distinctions among university programs teaching blockchain courses. This knowledge will serve as a foundation for improving existing curricula, guiding the development of new blockchain programs, and ultimately addressing the knowledge gap within enterprises. Therefore, in the following sections, we discuss the scientific background of enterprise blockchain projects and the specific needs for respective learning courses. We then present our methodology, findings, and implications of our investigation into academic blockchain programs. Through this research, we strive to contribute to the development of a well-informed and blockchain-savvy workforce, enabling enterprises to seize the opportunities presented by this technology.

2. SCIENTIFIC BACKGROUND

Blockchain technology, with its inherent characteristics, is not just a tool; it's a cross-functional force that necessitates the involvement and collaboration of various key areas within an enterprise. Its integration goes beyond singular departmental efforts, making it a technology with high strategic impact and organizational scope. Figure 1 illustrates enterprise functions involved

in the integration and operation of blockchain solutions (Düdder et al., 2021).

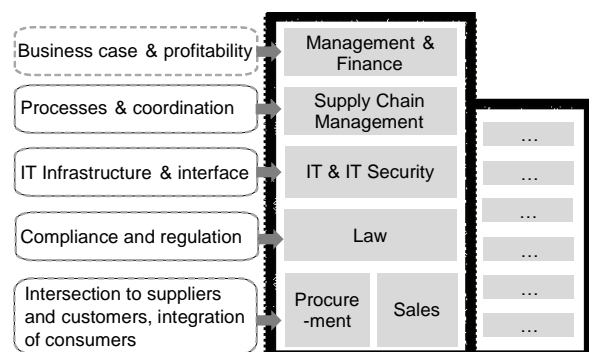


Figure 1: Enterprise Functions Involved in Blockchain Integration Projects

In the area of management and finance, blockchain demands a comprehensive business case and offers adaptations to existing ones. While integration costs are high, the technology shows potentials in both information flows (data storage, increased transparency, reduced costs for data exchange) and financial flows (faster, cheaper, and automatized transactions) (Pennekamp et al., 2024). For these reasons, business implications and potential returns must be thoroughly analyzed to justify an investment in the technology (Al Kemyani, Al Raisi, Al Kindi, A. R. T., Al Mughairi, & Tiwari, 2022; Sinha, Kumkum, & Bathla, 2019).

Supply chain management becomes a pivotal focus for blockchain integration, as the material flows between companies are transformed (Stammes, Burov, Ludwig, & Gürpınar, 2022). From tracking and tracing of goods to supply chain visibility, blockchains impact trust relationships and improve process efficiency (Grosse, Gürpınar, & Henke, 2021). The decentralized nature of blockchain facilitates real-time updates, reducing delays and enhancing the overall agility of cross-company processes (Queiroz, Telles, & Bonilla, 2019). Ultimately, blockchains afford the ability to reduce the need for intermediaries and therefore requires advanced governance concepts (Cole, Stevenson, & Aitken, 2019; Schwarzer et al., 2022).

In the IT domain, blockchain integration not only affects the existing system infrastructures but also reinforces security measures (Düdder et al., 2021). The decentralized and tamper-resistant nature of blockchains demand robust cybersecurity protocols to protect sensitive data (Iqbal & Matulevičius, 2019). IT departments play a critical role in ensuring the seamless

incorporation of blockchains without compromising the organization's overall digital security (Düdder et al., 2019).

In the law sector, compliance and regulation functions can be insured. Blockchains enable full traceability and auditability of information (Roy, 2023). Additionally, they improve regulatory transparency with real-time transaction visibility. This is particularly apparent in the multi stakeholder use of blockchain in tax compliance (Adelekan et al., 2024; Bons, Keitzl, Schulz, Stuckmann-Blumenstein, & Gürpınar, 2023). Finally, also procurement and sales functions find intersections with blockchain integration and operation as suppliers and customers need to be involved. Here, blockchain-based smart contracts automate and streamline procurement processes while sales benefit from verifiable product and origin information (Gürpınar, Brüggelolte, Meyer, Ioannidis, & Henke, 2020).

The collaborative nature of blockchain integration underscores its complexity, as it requires coordination across multiple functions, each contributing its unique discipline and expertise. Successful integration and operation of blockchain solutions necessitates a holistic approach that considers interdisciplinary cooperation and management between the beforementioned and further functions and areas of an enterprise.

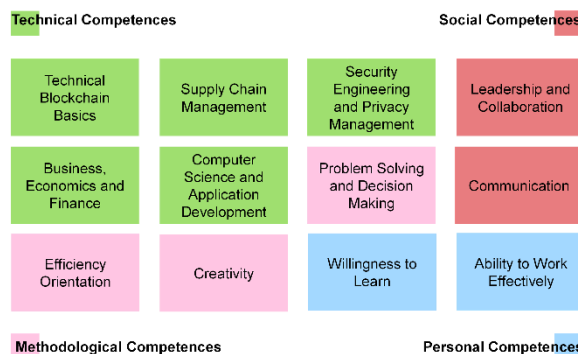


Figure 2: Competences to Integrate, Manage, and Operate Blockchain Solutions

Achieving successful integration and utilization of blockchain solutions within enterprises demands a multifaceted skill set that extends beyond technical expertise. While technical competencies are undeniably crucial, a holistic approach is essential, involving social, methodological, and personal competences as depicted in Figure 2. Social competences include effective leadership and communication, fostering collaboration, and ensuring that diverse teams work cohesively

towards blockchain integration goals. Methodological competences, such as creativity and problem-solving abilities, are indispensable for navigating the complexities of blockchain solutions, addressing unforeseen challenges, and optimizing the technology's functionalities to suit the unique needs of an enterprise. Additionally, personal competences, like the willingness to learn and adaptability, are necessary in an ever-evolving technological landscape. The successful integration of blockchain technology depends on building a team with a mixed skillset combining technical expertise with social, methodological, and personal skills (Düdder et al., 2021; Fomin et al., 2024).

3. RESEARCH METHODOLOGY

To begin, in March 2024, a search was conducted on the AACSB website for US-based universities with AACSB accredited business schools with undergraduate, masters, and/or doctoral programs. This resulted in 533 universities. The term "blockchain" was then searched for on websites and catalogs of these universities. Out of this list, 151 were found to have at least one course pertaining to blockchain. This accounts for approx. 28% of the total AACSB business schools. Data such as the course key facts (offering department, number of courses, course level) and descriptions were collected from the schools' catalog and materials available on their websites and analyzed according to our evaluation scheme:

- Classification of Courses: Categorizing each course based on content and subject matter.
- Field Analysis: Determining the scientific field to which each course belongs.
- Technology Analysis: Identifying the interconnections between blockchain and other emerging technologies covered.
- Reconciliation and Peer Review: Ensuring the accuracy and consistency of the categorization through independent review and discussion among authors.

Classification of Course Topics

Each of the courses needed to be classified into one of the categories pertaining to blockchain. However, the categories first needed to be determined. The authors began by reviewing the course descriptions of the identified 361 blockchain courses. A set of categories was created based on this initial review. After the data was collected, the courses were mapped to this list of categories, similar to a process followed by Yang & Wen (2017) where they surveyed university IS program curricula found on their

websites. Multiple authors independently reviewed the course descriptions and determined which category each course mapped to. If a course did not match any existing category, a new category was created, and all authors were notified of the new category. The next step was to reconcile the independently categorized lists. In cases where different categories were selected, the authors discussed and decided on the final categorization through peer debriefings following a consensual qualitative research approach.

Scientific Field and Technology Analysis

In addition to categorizing courses, the scientific fields to which these blockchain courses primarily belong were determined. The analysis involved examining the offering department titles and course descriptions to ascertain the primary field they were associated with. This classification helps in understanding the interdisciplinary nature of blockchain education as lots of courses have multidisciplinary approaches.

The interplay of blockchain with other emerging technologies was another critical area of analysis. Courses were reviewed to identify content covering the intersection of blockchain and artificial intelligence (AI), internet of things (IoT), and cybersecurity. This was achieved by carefully selecting synonyms and searching the course descriptions for references to these technologies. Understanding these connections provides insights into how blockchain is being positioned within the broader technological landscape and its relevance as an enabler of innovation.

4. FINDINGS AND DISCUSSION

Various university departments are providing blockchain courses as listed in Table 1. While Computer Science and Information Systems departments host the majority of the blockchain courses, individual courses are also offered by more uncommon departments such as Biology, Literature, and Political Science. A more detailed overview of departments and an allocation to respective scientific fields is shown in Appendix A.

The number of blockchain courses offered by universities varies. Most schools (381) do not offer any blockchain courses (Figure 3). However, 151 schools offer at least one; 76 at least two; and two schools offer a portfolio of at least 10 blockchain courses (Figure 3).

Department	Count
Computer Science	70
Information Systems	67
Finance	46
Business & Strategy	34
Law	31
General Management	14
Technology Management	11
Accounting	10
FinTech	8
Mechanical & Electr. Engineering	7
Comp. Science and Engineering	7
Supply Chain Management	7
Math, Statistics, and Insurance	6
Economics	6
Business Analytics	5
Cyber Security	4
Public Administration	3
Data Science	3
Entrepreneurship	3
International Business	2
Other	17

Table 1: Departments Offering Blockchain Courses

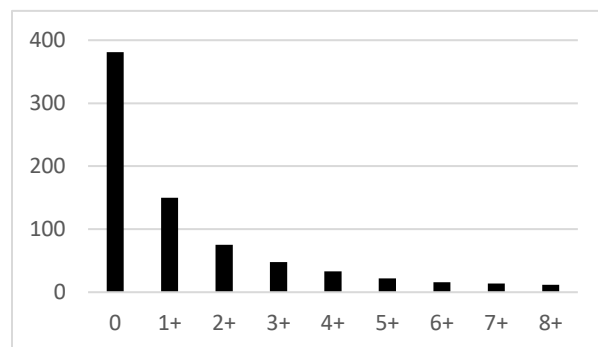


Figure 3: University's Number of Blockchain Courses

The majority (72%) of the blockchain courses being offered are at the undergraduate level; 23% at the graduate level; and 5% can be taken at both the graduate and undergraduate levels.

A greater total number of public universities offer blockchain courses (89 Public vs 62 Private, see Table 2). However, in looking within the university types, a greater percentage of the private universities offer blockchain courses. 36% of the private universities offer at least one blockchain course. Whereas only 24% of the public universities offer blockchain courses.

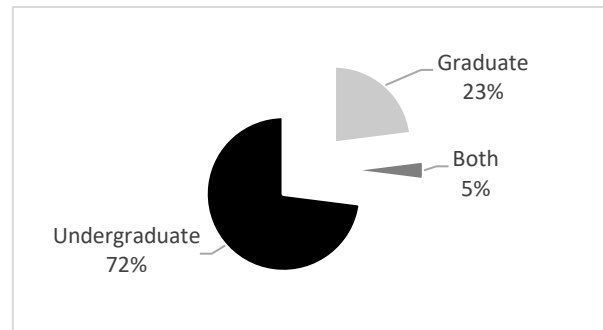


Figure 4: Academic Level of the Offered Blockchain Courses

	Count	Total	Percentage
Private	62	172	36.1%
Public	89	366	24.3%

Table 2: Universities Offering Blockchain Courses

In general, universities that have a larger undergraduate population offer at least one blockchain course. Universities with 25,001 to 30,000 students show 56% offering at least one blockchain course. Those with 30,001 to 35,000 students have 63.2% offering at least one course. Ultimately, all the schools reviewed with an undergraduate size of 40,001 to 50,000 offer at least one blockchain course (Table 3).

University Size	Count	Total	Percentage
0 - 5,000	30	169	17.8%
5,001 - 10,000	36	148	23.6%
10,001 - 15,000	18	71	25.4%
15,001 - 20,000	19	46	41.3%
20,001 - 25,000	11	34	32.4%
25,001 - 30,000	14	25	56.0%
30,001 - 35,000	12	19	63.2%
35,001 - 40,000	3	9	33.3%
40,001 - 45,000	2	2	100.0%
45,001 - 50,000	2	2	100.0%
>50,001	2	3	66.7%

Table 3: Number of Undergraduate Students

Appendix A provides a diagram showing the number of blockchain offerings by scientific field and university department. The largest area offering blockchain courses is Business with 216 courses overall. Within this area, Information Systems (67) as well as Finance and FinTech (54) have the greatest number of courses being offered. These two fields make up 56% of the total area course offerings. The second largest field with 85 courses is Computer Science including subcategories such as Cybersecurity and Data Science, along with the majority of courses (70) dedicated to general computer science, constituting 82% of the total area course offerings. Law makes up the third largest field with 31 offerings comprising of Law & Compliance departments. Arts & Sciences as well as Engineering are close to one another with their number of courses at 14 and 15, respectively. Eight courses in Math, Statistics, and Insurance departments made up 57% of the offerings in Arts & Sciences. Mechanical & Electrical Engineering (7) and Computational Engineering (7) department offerings made up 93% of the Engineering area offerings.

Category Name	Courses in Category
Fundamentals & Overview	140
Digital Assets & Cryptocurrencies	71
Technical Development	66
Business Implications	33
Law and Compliance	29
Supply Chain and Governance	12
Interplay with other Technologies	6
Other	4
Grand Total	361

Table 4: Blockchain Course Categories

To categorize the courses, we reviewed the data collected from each university and identified distinct thematic areas based on the content and focus of the courses. Table 4 shows the categories and the number of courses which were identified in these categories. The largest category of courses with 140 identified was the Fundamentals & Overview category. Digital Assets & Cryptocurrencies as well as Technical Development categories follow that with 71 and 66 courses identified in those categories, respectively. The next grouping of categories is those that focus on Business Implications (33) as well as Laws and Regulations (29). The final two

categories are the ones on Supply Chain and Governance, which dropped to 12 and Interplay with Other Technologies with six courses identified in this category.

In addition to these findings, the review of the courses also reveals a focus on how emerging technologies interrelate with blockchain, either by enhancing its functionalities or by relying on them as foundational support and trust anchor. Appendix B provides a chart showing the different types of emerging technology trends which were discussed within the Blockchain courses. AI & Machine Learning was mentioned by the most blockchain courses (30). This was followed by Internet of Things (18) and Non-Fungible Tokens (15). Finally, Appendix C provides exemplary course descriptions of current blockchain courses showing how necessary competences and meaningful synonyms are covered, including the quantitative analysis of how frequently the requested competences appear across these courses.

5. CONCLUSION

This study explores blockchain course offerings in AACSB universities in the US. After assessing 533 universities, it was found that 151 of them offer at least one blockchain course, with a higher likelihood of such courses being offered in universities with larger undergraduate populations. While there are varying course topics, the majority deal with fundamentals of blockchain solutions and their basic functionalities. Additionally, a significant number of courses cover topics related to digital assets and cryptocurrencies. The largest percentage of course offerings occurs in computer science departments, with information systems and finance following. The interdisciplinary nature of blockchain technology is demonstrated by also having exceptional domains, such as biology, literature, and political science represented.

According to our findings, blockchain education is increasingly interconnected with other relevant emerging topics, such as artificial intelligence and digital twins. This integration underscores the necessity for students to understand the interconnected nature of modern technological ecosystems. It is also demonstrated that more than just technical skills are required; social, methodological, and personal competences are also relevant and addressed in many courses. This holistic approach to competency development is crucial to ensure that students are well-equipped in a multifaceted landscape of

emerging technologies.

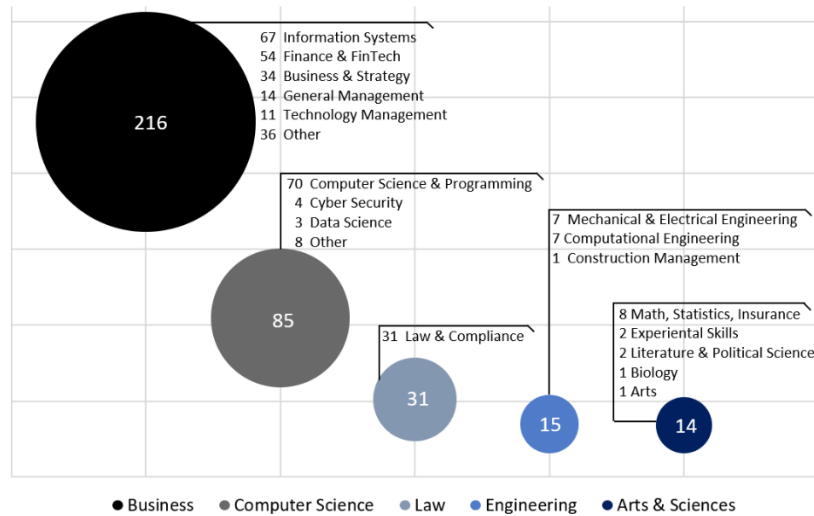
Future research should aim to further evaluate the topics covered in blockchain courses, as well as industry needs. It would be valuable to determine which disciplines are addressing each competency and how that aligns with industry demands. Researchers should look at job level competency needs and determine how they reconcile with the blockchain competencies. Research should also replicate this study in five years to assess any changes in course offerings. This will not only be valuable for blockchain research but will also help illustrate how topics evolve over time in any discipline.

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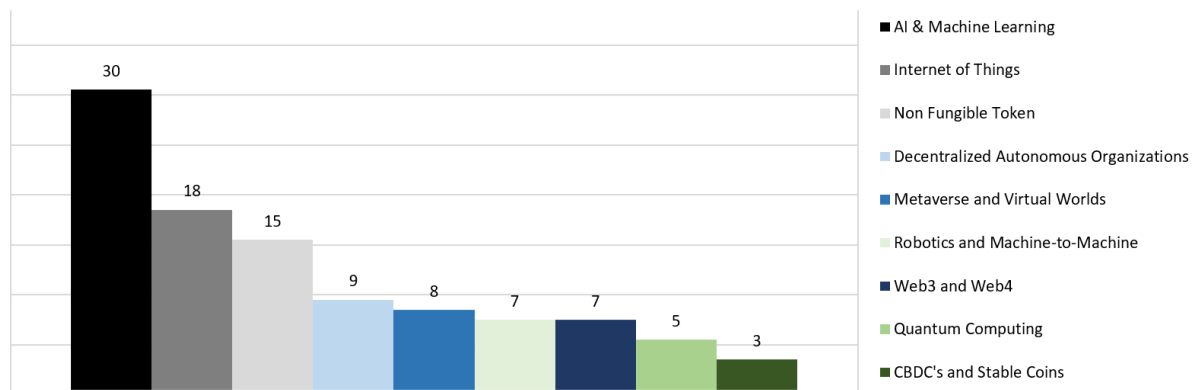
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Appendix A. Number of Blockchain Courses by Scientific Field and Department



Appendix B. Mentions of Emerging Technology Trends Considered in Blockchain Courses



Appendix C. Course Examples Addressing Relevant Blockchain Skills

Technical Competences

Technical BC Basics

"Topics include blockchain fundamentals: what it is and what it can do, as well as the value proposition to different stakeholders." [1]

228

Supply Chain Mngmt.

"The course teaches the importance of creating a secure end-to-end supply chain infrastructure and the use of blockchain-enabled smart contracts." [2]

30

Communication

"The course contains principles and practices of how to provide secure communication between computer systems." [3]

6

Social Competences

Leadership Collaboration

"Students will build practical knowledge of blockchain business applications and enhance management and leadership skills" [4]

15

Business and Finance

"Course topics include the overall concepts and use cases to understand the potential business value and integration hurdles of blockchain technologies." [5]

185

Appl. Development

"The course discusses DApp development using programming in Solidity language to illustrate smart contracts with Remix and Truffle environments." [6]

91

Security Engineering

"Consensus mechanism design and its security, privacy enhancement for blockchain applications and performance improvements" [7]

75

Willingness to Learn

"The course requires a willingness to read and reread and discuss technical documentation and literature that is essential." [8]

2

Efficiency Orientation

"The course demonstrates how the blockchain technology is applied in different business areas to improve efficiency and effectiveness of operations." [9]

5

Creativity and Research

"Students discuss the laws, theoretical justifications, and suggest new and creative reforms." [10]

19

Problem Solving

"A course to understand blockchain technology and its applications to solve real life problems in various domains." [11]

16

Work effectively

"This course equips business managers to effectively, identify, recognize, and evaluate key risks to business information systems." [12]

13

Methodological Competences

Personal Competences

[1] American University - School of Business - "Blockchain Applications"

[2] California State University - College of Business & Public Administration - "Supply Chain Security and Blockchain"

[3] University of Connecticut - College of Engineering - "Network Security"

[4] Pepperdine University - Business School - "Emerging Technologies and Blockchain Security"

[5] Saint Louis University - School of Business - "Blockchain Technologies"

[6] University of Buffalo - School of Engineering and Applied Sciences - "Introduction to Blockchain"

[7] University of Tulsa - School of Computer Sciences - "Blockchain FinTech"

[8] Wake Forest University - School of Business - "Blockchain and Crypto Assets"

[9] Purdue University - School of Business - "Blockchain Technology For Business Applications"

[10] Fordham University - School of Business - "Blockchain Technology"

[11] Boise State University - College of Engineering - "Introduction to Blockchain"

[12] Cornell University - College of Business - "Introduction to Digital Technology/Transitions"