Blockchain for Education Management[1]

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Introduction

Management as a discipline emphasizes knowing of what is to be managed. For our purpose it is 'education'. To apply management discipline to education the first requirement is to have a broad understanding of education in general and then narrow down to the specific aspect. Education as a system is highly multi-dimensional, complex and poses daunting leadership challenges for managers. The broad components of the internal system are students, teachers, the environment of the institute. The external environment comprises of immediate external environment- ranging from the region to the nation and the global environment. The linkages between the internal and external systems are provided by the employability of the students in the productive or value enhancement segments of the region and the nation, expectations of the society. The global environment entails degree of global acceptance of students as they pass out, new knowledge created by the institute and capability to adapt global knowledge, skills and culture.
The primary value chain in management of education revolves around students and teachers. The vision, mission, goals and objectives too are based on their contribution. As we apply management theories and practices to education the given state will always be imperfect because perfect systems do not exist in the real world, and if these do they are self-managed.

The purpose of management is to drive the imperfect state towards an acceptable state. The expected levels of accepted state continue to rise. It is here that management deals with quality i.e. performance/expectation[1]. Again, quality in management is a dynamic attribute. What is adequate level of goodness today may not be so in the future. Thus, the need for continuous improvement of quality across the entire spectrum of management system- taking us somewhat closer to Total Quality Management.

Hence when we embark upon education management it entails evolving visions, missions, strategies, goals, objectives, practices, functions, tasks, skills, measurable performance outcomes, feedback mechanism to improve the internal system in the backdrop of immediate external environment and global environment. Since management practices can be best

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applied and understood in the context of specific case we will chose and average university in India for this paper. We will cover the following:

- Broad description of components of internal system and objectives/ goals to be achieved.
- Existing ICT driven System management.
- Relevant aspects of Blockchain Technology
- A simplified architecture for Blockchain use in education management
- Proliferation of blockchain technology for education management globally and in India
- The Future of Blockchain in Education Management

The Internal Environment

Students. A university exists for and is known by its current and past students. For objective management of this component the data points will emanate from visibility and perception of the likely candidates who are looking for university education, student profile in terms of entry level educational background, region, students' diversity in terms of gender, region, education and intellectual background, background of the students in terms of their aptitude, aspirations, capabilities and gaps between capability and aspiration, students' progression through the internal processes, feedback from the students and alumni

Faculty. This is the next most important component of the internal system. Objective data points here would emanate from faculty qualification, compensation contract, research and consultancy contributions, students' feedback on each faculty, learnability captured form additional courses completed and adaption of new technologies/ teaching skills, faculty satisfaction from the internal environment.

Administration. The impact of this component will be felt by the students as well as faculty in terms of ease with which they can operate the teaching learning process. Aspects like cleanliness, hygiene, space, physical environment, water, electricity, responsiveness to resolve related problems.

Infrastructure. This comprises of library, laboratories, class and tutorial rooms, auditoriums, seminar halls, playgrounds, industry and society outlets. Each of these components in the infrastructure will have their quality parameters that will have to be incorporated in the management efforts.

Culture. This aspect is generally neglected while managing and internal system. How do people in the organization relate, collaborate, cooperate and support each other forms part of the organizational culture in the university.

Leadership. Are managers leaders too? There is no consensus on answer to this question. In the Indian psych leaders are different from managers. Leadership emerges from the being of the leaders. The inherent character (spiritual, intellectual, mental strengths), action, visions and expression form the core of the leadership. Managers are generally involved in resource optimization through planning, delegating, controlling, staffing. A leader's impact or influence on the organization emanates from four aspects of his persona. The being, action, seeing and telling in that order.

Objectives and Performance Parameters of Internal Environment

It is only the internal environment that can be managed or controlled. This would entail setting objectives and performance parameters. For the purpose of this paper we may set

these as per the generally accepted norms in the current NAAC guidelines[2]. The Internal Quality Assurance Cell gets involved in continuous quality improvement.[3] For our purpose we can list a few measurable performance parameters of these important components of internal environment.

Students

- **Visibility.** The measurable parameters for this objective will be based on
    - Region wise number of searches and follow up by the prospective candidates seeking admission to the university.
    - Number and type of queries raised, number of searches compared to number of actual application.
    - Number of applications per admission per course.
- **Student Profile.**
    - Gender diversity (female, male)
    - Regional diversity intra and international profile
    - Subject wise diversity where ever multidisciplinary qualifications are accepted for admission to the course (such as MBA courses accept students from a large number of disciplines).
    - Performance diversity. This can be based on percentage of marks scored in the qualifying exams or quartile distribution.
    - Psychometric diversity , in case the university conducts relevant tests on students at the time of admission.
- **Students Progression**
    - Internal and external tests
    - Narrowing the gap between desired and actual capabilities
    - Summer Internship Reports
    - Number of attempts before getting selected for a job
    - Entrepreneurial ventures

Faculty

- Students to faculty ratio for each course
- Faculty academic expectations like teaching, mentoring, research, self-improvement, involvement in academic decisions.
- Qualification. Formal and short term knowledge/skills enhancement courses.
- Students feedback
- Research
- Consultancy
- Real life case studies

Administration

- Number and types of issues raised by the faculty, students, staff against those that are resolved. Average time taken to resolve issues.
- Feedback from the stakeholders

Infrastructure

- Adequacy of infrastructure (class rooms, tutorial rooms, laboratories, libraries, on line resources, seminar halls, auditorium, sports and entertainment facilities.
- Quality of infrastructure as seen by the users

Culture

- Faculty attitude towards the learners
    - High level of concern and high expectations from the students
    - Involvement in mentoring
    - Participative teaching learning process
- Students' attitude towards the faculty and staff
    - Frank and disciplined
    - Attendance and punctuality
    - Participation in events
    - Suggestions for quality enhancement
    - Alumni response and contribution

Leadership

- Transformational or transactional
    - Creating enabling environment to grow for each member based on unique quality of the students, faculty through individualised motivation
    - Rewarding achievers and dis-incentivizing failures
    - Individualized concern for each member as per their special needs
    - Same yardstick for all
- Effective or inspirational
    - Ensures better performance by direct control
    - Creates internal desire among the group to excel

ICT Tools for Monitoring the Performance Parameters of Above Objectives

All the performance parameters of objectives mentioned above can be recorded by using the normal ICT tools. These include creating and monitoring appropriate websites, data entries in the institution's data base, uploading the requisite data on the websites of regulatory bodies and so on. However the prevalent ICT techniques have following weaknesses:

- The data is centrally controlled either by the institutional server or the web
- All the information is password secured- a weak security arrangement. It is not difficult the beach the pass word protection.
- There are no arrangements for authenticating the data.
- There is very high probability for the information to have questionable credibility.
- Data or information can be changed by the web or server manager or the

Blockchain Technology

Satoshi Nakamoto (a pseudo name) wrote the white paper on bitcoins in 2009 with the intention of breaking free from state control- especially the central banks of the world. The group felt that the central banks world over are not just to the customers they serve. Hence, they created a new currency 'bitcoin'. Creation and mining of bitcoins necessitated a network of blocks linked together by a secure chain-hence the name blockchain. In essence it is a peer to peer network that was created for people who do not have to know or trust each other but could still exchange money without cheating.

However, from 2009 to the current times the blockchain technologies have evolved very rapidly. A number of weaknesses observed in the initial blockchains have been removed. More importantly the technologies have been suitably modified and adapted for use in a large

number other non -financial domains like governance, supply chain management, cyber security, health care, education and so on. The basic tenets or the vision of the founders have remained unchanged. These are security, distribution across the network, immutable, based on consensus, provenance, cost effective and fast**.** What differentiates it from other digital data structure are inherent security, distributed digital ledger of data that is shared in the network. The ledger entries are made by the users through mutual consensus and once the entries are made and accepted it becomes impossible to change. Blockchains can be public (open to all participants like the ones dealing with bitcoin), permissioned (where the roles of the members are controlled) or private (where the membership itself is closely controlled). All these three types of blockchains function without any central agency. The members run the show.

'Block 'in this system represents transactions that are recorded in the digital ledger (each transaction is secured cryptographically). Transaction here imply the act of recording the data. It is assigned a value to interpret what that data means. The data in the block is linked to another block through cryptographic hash function (SHA-256) which acts as a digital fingerprint of the data. This hash function is the secure chain.

Nodes in the blockchain comprise of computers running an algorithm in a secured network. Considering the difficulty, cost and time spent on operating the nodes people are incentivized to operate these computers. This brings in the concept of token or bitcoin as reward for transactions and mining. The first and the original blockchain was for financial systems and the reward for transaction/mining was in terms of bitcoins. There is a general tendency to use bitcoin and blockchain as synonyms. However, blockchains are not bitcoins. A blockchain can store personal details, contracts, real world objects and shared reality across the network.

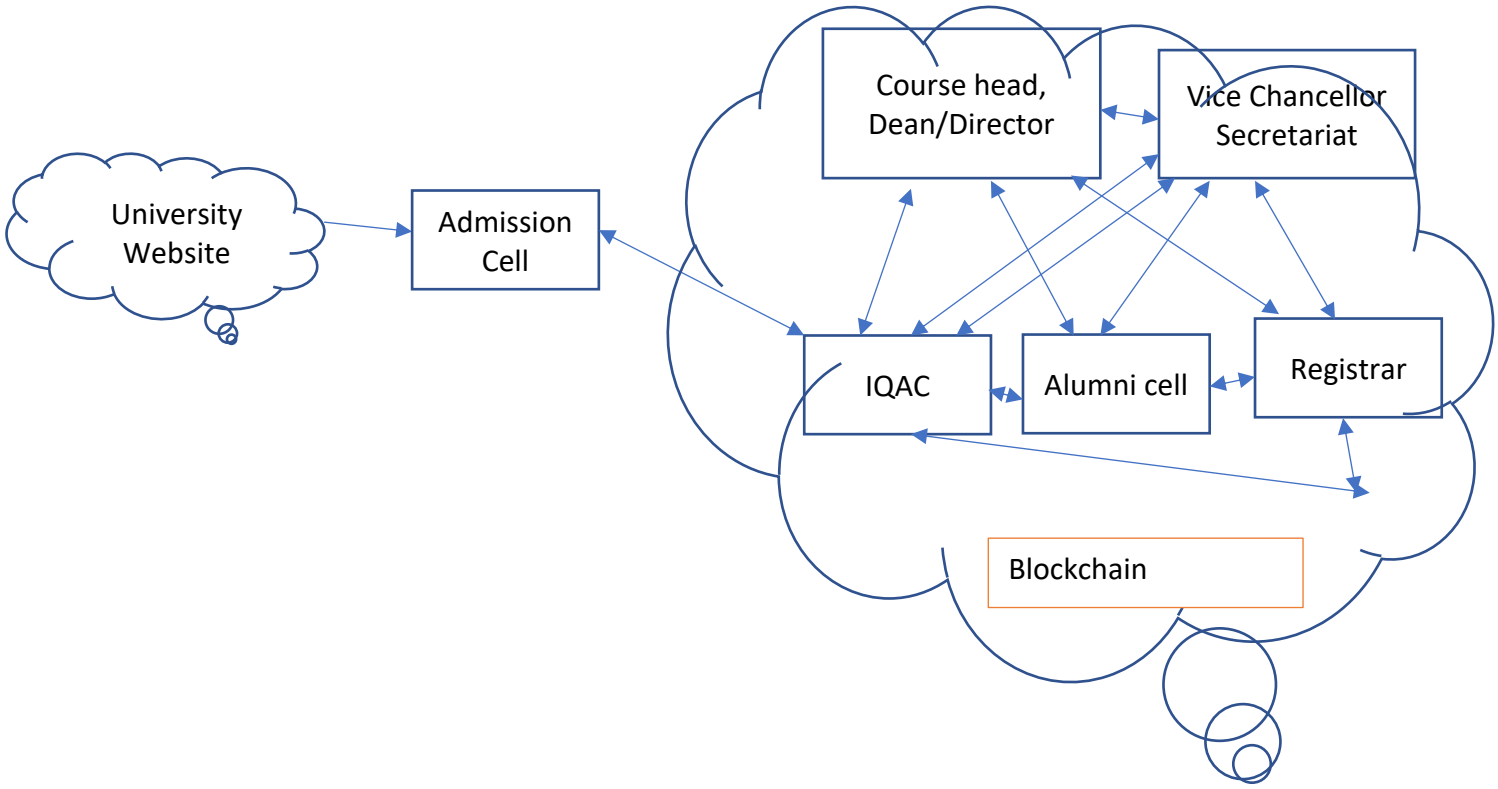
Key Concepts When we intend using the blockchain technologies for business usage the key concepts to remember are shared ledgers, permissions, consensus and smart contracts. In shared ledgers transactions are recorded only once, are time stamped and shared with all who are entitled. No entry can be altered or deleted. Participants see only those transactions that they are authorized to view. If an authorized user 'A' transfers an asset to another authorized user 'B' then all the participants in the blockchain network can see that the transaction has taken place but are blocked from seeing the details of the transaction. When an auditor is required to examine the transactions access can be provided to entire set of details through cryptographic arrangements. Consensus among the participants can be established through multi signature, proof of stake or through a special algorithm. Smart contracts in blockchain define contractual conditions and clauses and can be made partially or fully self-executing, self-enforcing or both. in blockchain include Artificial Intelligence, Big Data and communication. If the programmers know the actual environment of a given block chain then suitable artificial intelligence tools can be developed for trend analysis, forecasting and decision making. Given the nature of AI the efficacy of the AI tool will improve with each iteration. Big Data becomes relevant when very large and rapidly changing data needs to be analyzed. Smart and cooperating agents (codes) can be devised for special automated communication within the agents in the block chain for helping AI and Big Data. [4,5,6]

Applying Blockchain to Education Management

Visibility of the University to the Global Environment .The schematic layout below is an approximate model for applying blockchain technology to one of the parameters discussed above. A dedicated node (computer) in the admission cell will pull out data from the global environment (University website). After scrutinizing the data for validity and relevance the node (which has desired software and security arrangement loaded) will enter the information in the block. This will be registered in the ledger only on consensus by the other peers in the blockchain. Once the information is accepted and entered in the block it will be available to all the peers in the shared ledger. Though software driven automated arrangements can be made to provide relevant permissions to each node. The VC secretariat for example can have all the permissions whereas the alumni cell can be blocked from some of the permissions.

The advantage of using blockchain for this parameter will include:

- Simultaneous availability of the information to more number of stakeholders in a timestamped and secure manner.
- Information once fed to the blockchain cannot be altered by anyone thus enhancing the credibility of the data especially for the IQAC and the regulatory authority.
- Inherent discipline on the admission cell to read, process and share relevant data more frequently rather than waiting for inspections by the IQAC and regulatory authorities

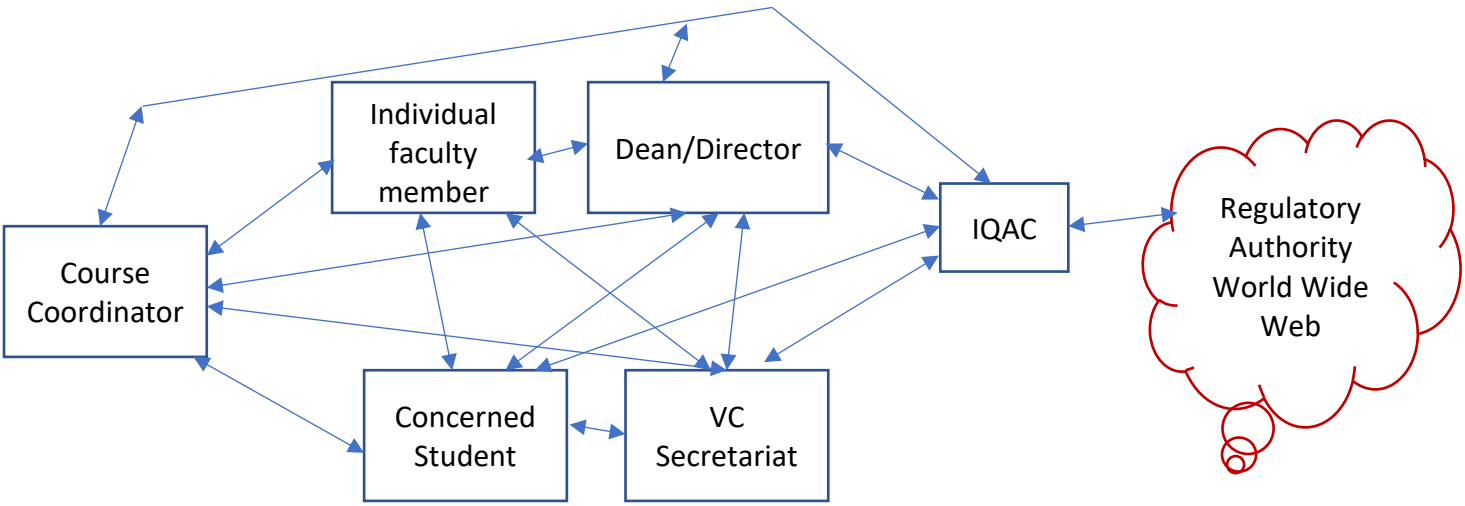


Student Progression

This is a very critical function in the university related to teaching learning process. All the nodes in the peer to peer network are loaded with the requisite software and SHA256 security protocol. These nodes have adequate electricity supply. The blocks are filled by the concerned faculty in contact with their respective students. The information is validated by all the peers especially by the course coordinator before the relevant block is filled with the information. Once the block accepts the data it is available to all the peers. The concerned student can also see her performance in this peer to peer network. However student can be permitted to see only her own performance. For other nodes the entire range of information can be made available.

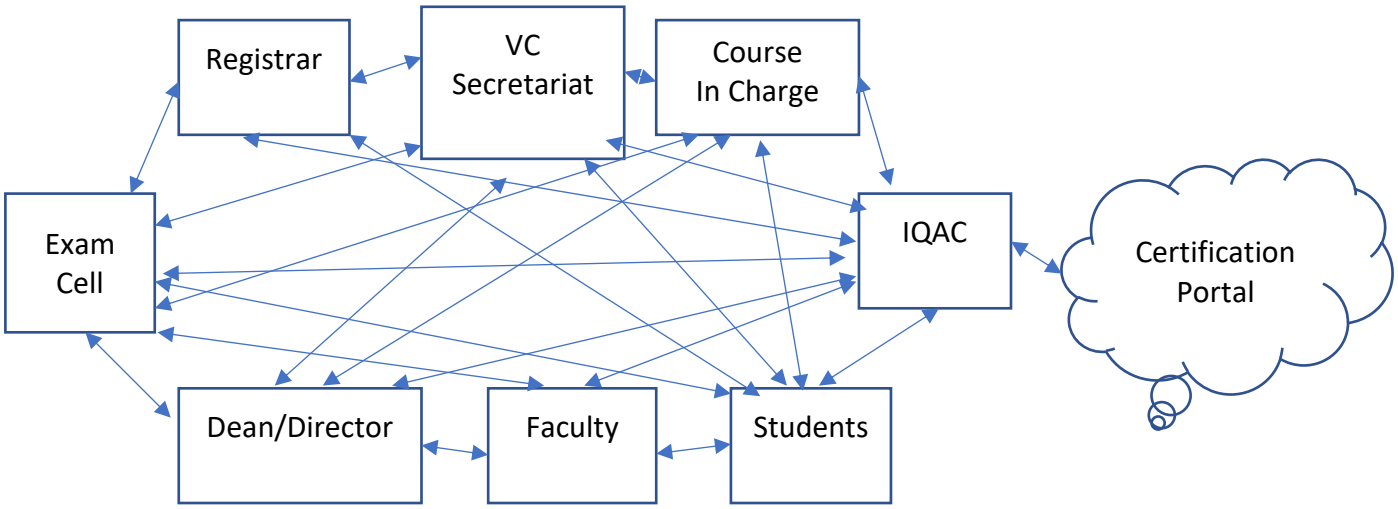
By running appropriate AI tools, trend analysis and decision support activities can be undertaken. The IQAC can feed the authenticated information each quarter to the concerned regulatory authority. An extension of the university blockchain can be created at the regulatory headquarters also. Application of blockchain technology for recording and processing this parameter will have following advantages over the legacy ICT methods:

- Security
- Shared
- Non repudiation
- Speed and accuracy
- Credibility
- Student satisfaction
- Timely submission of data to the NAAC without any extra effort.
- Help the university leadership to ensure data driven continuous improvement processes.



Certification

This is the most widely used application of blockchain technology. The university peer group for this blockchain network is likely to comprise of the university examination cell, registrar, Vice Chancellor's secretariat, dean/director, faculty, course in charge, IQAC and students. A separate blockchain portal with global visibility can be created for access by the students and any one desirous of confirming the credibility of declaration by the students either for employment or for further studies. The network may look as follows:



In the above peer to peer network data emanates from the faculty who examines the students' performance in the examination. The inputs from them are verified by the course in charge and the dean and then cleared for entry in the block chain. The data miners mine the data the proof of work is allowed and data gets registered in the block. Once the data is accepted it can be viewed by all. Restricted permissions can be flagged for the students who can see data pertaining to their individual performance. The IQAC is part of this block chain and loads this data to the certification portal of the university. The certification portal can be accessed by the global network.

The above diagrams and the description of how the blockchain functions is simplified version for the purpose of basic understanding. Objectives and performance parameters for other components like leadership, culture can be identified by the university and suitable peer to peer network with blockchain technology can be established with external linkages.

There are major challenges that need to be addressed before the system functions smoothly. First the storage required is very high. Second for proof of work the mining efforts in terms of processing speed and power supply requirement will be very high. Traditional mining methods for proof of work (as was done in the original blockchains for bitcoins) required exceptionally large quantum of electric power. Thus creating massive carbon footprint. Thirdly the traditional methods using cloud based architecture provide all these facilities at fraction of the cost required to run a blockchain system. Fourthly the awareness and willingness to embrace this technology is quite low at present. Fifthly for most of the academicians blockchain is considered useful for financial functions where the level of trust among the beneficiaries is non-existent. In academic environment It is generally felt that in the academic environment the trust deficiency does not exist. Besides if the nodes for the blockchain supported system are to be operated by officials or participants within the same organization then professional integrity can be 'influenced' by the authorities in the organization.

Nevertheless there are compelling reasons to migrate to blockchain environment for management of education. The rate at which storage and speed of processing are increasing will make the challenges related to these issues look trivial. Secondly newer software and proof of work methods are being invented that will make power and speed requirement manageable. Traditional methods of ICT based education management suffer from some basic drawbacks like lower security, trust deficiency, students' isolation from the system, prone to spoofing and phishing attacks and organized manipulation of data.

Globally more than 24 universities spread over 14 countries(Cyprus, USA, UK, Malta, Slovenia, Greece, UAE, Bahrein, Australia, Mexico, Singapore, China, Canada, Russia) use this blockchain application for issue and storage of certificates and diplomas, payment of fees through blockchain supported digital currency. Other uses of blockchain for education management include students' personality identification solution(MIT and University of Texas of the US), Woolf University of UK makes use of blockchain for administration process, accreditation, students' network with professors[7].

In India Kerala , West Bengal too are initiating actions for deployment of blockchains in their respective educational institutes (in 2018) . Saintgit Group of Institutes in Kerala deployed the blockchain system for scholarship program (student identification). The Globsyn Business School Kolkata applied blockchain technology for awarding digital diplomas[8]. As per PC Quest a Gartner CIO survey conducted in 2019 found that 2 percent of educational institutes have already deployed blockchain in their educational institutes, and 18 percent were planning to deploy this technology for education management by 2021[9]. Ledger Insight reported that the Government of Maharashtra signed an agreement in 2021 with LegitDoc for deploying blockchain in educational institutes. Each document is stored in the blocks with a document hash hence no personal information is visible to an outsider. Students' verification that used to take weeks earlier takes just a few seconds after deploying blockchain[10]. On 28 December 2021 the Indian Prime Minister awarded degrees in blockchain based digital form to the IITians. (Indian Express)[11].

The Future of Blockchain and its Application for Education Management

A large number of other blockchains have been developed to make this technology more versatile. These include Ethereum, ripple, factom, DigiByte, HyperLedger, Microsoft Azure and IBM Bluemix. In many applications the 'proof of work' requirement is done away with since proof of work requires unnecessarily huge investment in computing speeds and electric power. For applications like education management where internal network with reasonable trust among the users exists and validity of the data can be checked through multiple means proof of work may not be required.

Since extensive use of blockchain technology in education management can revolutionize the knowledge eco system many countries have recognized the digital currency and encouraged education and commerce through blockchain. These countries have legislated new laws to make the blockchain supported systems legal. During the recent budget speech, the Indian Finance Minister introduced the concept of digital rupee using blockchain technology supported by the Reserve Bank of India. It is quite likely that many of the IT and data privacy laws will be amended to ensure liberal use of blockchain technology. There has been more than eightfold increase in the number of accredited online courses that students could choose. Even students studying on campus can earn up to 40 percent credits from on line courses as against 20 percent credits earlier. All institutes of higher education with NAAC grade 3.26 and above have been allowed to offer online courses. Even professional degrees like MBA, B Sc in programming and data science (IIT Madras) are being offered online.[12] It is here that blockchain has tremendous scope to make the online courses more acceptable and credible. This will ensure a collaborative, transparent, secure knowledge transfer and knowledge creation eco system in the country. It will link the teachers and students in an environment of trust, efficiency of performance and provide continuous and flexible learning environment.

End Notes

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Certificate by the Author

Certified that the paper is original and has not been sent for publication to any other platform. The references are accurate to the best of my knowledge.

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