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A Study of Awarding Student Achievement Using Blockchain

Mohammed Rehan Ansari
Department of Computing Technologies, SRM Institute of Science and Technology, Kattankulathur, India

Navratan
Department of Computing Technologies, SRM Institute of Science and Technology, Kattankulathur, India

K. M. Umamaheswari
Department of Computing Technologies, SRM Institute of Science and Technology, Kattankulathur, India

***Abstract*---**Blockchain technology will soon have progressed from being an innovation to the norm of application development and the digital revolution. The technology of a blockchain is essential based on a widely distributed, peer-to-peer ledger of transactions and balances. This ledger is essentially a huge database broken down into chunks known as blocks. These blocks and the entire ledger are stored in millions of copies on that particular blockchain network on extremely powerful computers known as nodes. There is a majority-based consensus that exists for every transaction that is carried out and put in a block. To tamper with this ledger would require computing power either equal to or greater than 51% of all the nodes active for that particular blockchain. Even if this power were acquired to tamper with or hack the particular blockchain, the cryptocurrencies or tokens that are transacted on the blockchain would essentially be overturned and considered worthless due to the other nodes detecting a hack or attempt to steal tokens or wallet balances. This is how the first cryptocurrency like bitcoin, along with many other cryptocurrencies on their respective blockchain technologies, operate.

***Keywords*---**awarding students, blockchain technology, dedication, student achievement, student potential.

***Corresponding author**: Umamaheswari, K. M.; Email: umamahek@srmist.edu.in*
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Introduction

For decades, students across all academic disciplines and sectors have strived towards performing well with regard to their studies. The sense of achievement that is felt after putting in the time and energy towards acing their exams and receiving the corresponding level of scholastic results is a valued outcome for every individual enrolled in an academic institution. These results and rankings are also fair indicators of their understanding and potential as learners who can then apply this knowledge where needed. That being said, they eventually progress from the educational phases of their lives such as undergraduate studies into a professional working environment, or the realm of master's degrees. Once here, they come to the realization that the raw academic efforts they had exhibited while excelling on tests and assignments in college are far from the only skills required to succeed, amidst an environment of hundreds, if not thousands of similarly accomplished individuals. What got them to where they currently are, by virtue of studying for hours and hours and learning the concepts and applicatory methods of their educational backgrounds, is not the same array of skills and qualities that is necessary to reach similar heights in their new lives (Suhifatullah et al., 2021; Jancowicz-Pitel, 2019; Widana et al., 2020).

Now, consider another set of students who did not just put in time to excel in their studies, but also participated in various cocurricular and extracurricular activities, such as sports tournaments, research and publications, internships, and social services. While in comparison to the first set of students who had stellar academic achievements, their absolute scores and grades might not be the highest (Gordon & Berhow, 2009; Reback, 2008; Abbas et al., 2021). But they have achieved something very different by diversifying their array of experiences and endeavors. They have built non-academic skillsets that have much better prepared them for the rigors and interactions of corporate life and more advanced graduate studies. Many of these skillsets would comprise of, but are not limited to:

- Communication
- Collaboration
- Research
- Physical exertion in the case of athletic pursuits
- Creating and giving presentations
- Professional writing
- Corporate work experience
- Creating and experimenting with various personal projects

These are crucial advantages when it comes to furthering an individual's candidature for the further roles and responsibilities in his/her career. Yet, students are not primed to pursue such activities due to the primary reward system for their efforts in their studies being grades. This doesn't necessarily indicate a disadvantage of today's education systems and institutions, but what it tells us is that there is no exact method to quantify and reward these achievements to motivate students to pursue them. This is something that can be addressed by the implementation of a reward system, in this case, built using blockchain and cryptocurrency tokens (Clotfelter et al., 2007; Egalite et al., 2015).

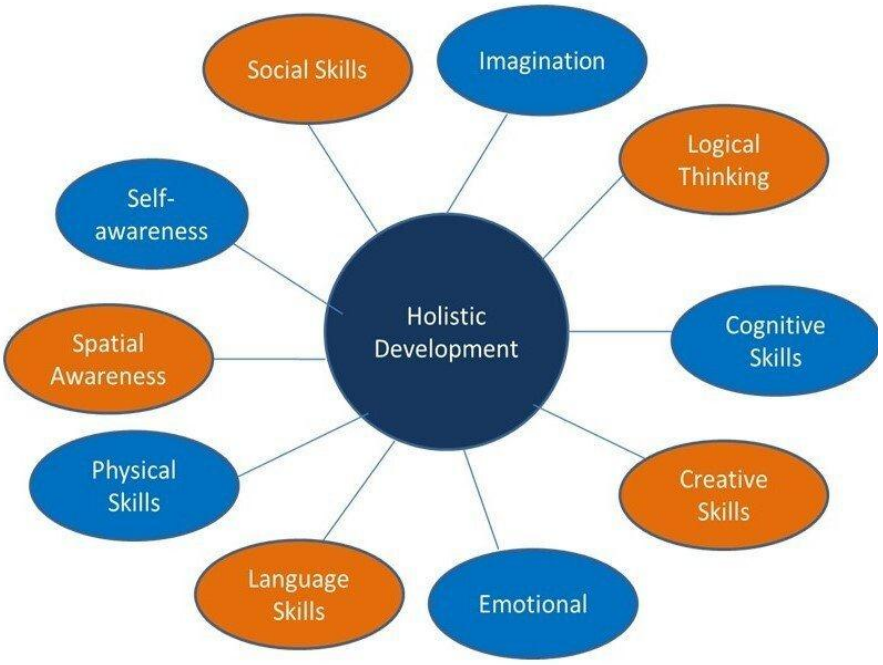


Figure 1. Dimensions of holistic development in students

Gamification of rewards in university

Gamification is a technique that is frequently being employed in both learning environments as well as corporate workplace training and performance. Borrowing a point or token concept from the gamification process, we can emulate a similar reward system in our case. The purpose would be to motivate students to excel in all their respective domains, while transferring them custom ERC-20 tokens created for this very purpose. As is the financial nature of some other cryptocurrency tokens, a likelihood can be considered for this ideology to correlate the earning of these tokens as award as motivation to build careers with corresponding financial and similarly quantifiable rewards for individuals. This process would promote healthy competition between students, and also better prime them to earn better rewards through building more fruitful career paths for themselves (Macrinici et al., 2018; Lei & Zhao, 2007; Husin et al., 2021).

Proposed system: a custom-made cryptocurrency

Blockchain transactions are often payments for goods and services, or originate from financial exchanges by cryptocurrency traders and investors. While different blockchains and the cryptocurrencies that are transacted on them are often financial in nature, other cryptocurrencies can be made on pre-existing blockchains. Such a cryptocurrency could also be used as a unit in a token or point system, a said amount of which could be awarded to students striving in various academic and non-academic pursuits. Different denominations and quantities of tokens could be allocated by weightage for every exam, assignment and quiz. The same would be done for various extracurricular activities, including

but not limited to student clubs, social service, sports, research publications, and personal projects. Once a student worked hard on his academics and earned the maximum number of tokens allocated for those activities, he would be participating in extracurriculars and cocurricular to further boost his score. Similarly, academically weak students who would be more involved in non-academic activities would have to work harder on their studies to earn the tokens allocated for grades, after reaching the limit allocated for their pursuits. Having to perform both these types of activities would ensure that students are performing well on their coursework, as well as building soft skills and other qualities that can only be learnt outside the classroom, for wholistic development (Grech & Camilleri, 2017; Patnaik et al., 2016; Maican, 2009).

A custom cryptocurrency can be created on the Ethereum blockchain following the standardized ERC-20 token format. The cryptocurrency would be launched by publishing a smart contract containing the descriptors of our token along with the EIP-20 Interface which would be implemented for our tokens to run and get transacted on the Ethereum blockchain network (Bursztyn & Jensen, 2014; Dave et al., 2019; Oka, 2021). As the main Ethereum network is the production blockchain where financial transactions of huge quantities occur, we will be building our smart contract and deploying the same on a test net, used for development purposes. The smart contract be pushed to the network and the token will be generated after spending some test ether, which will be obtained from a faucet which drips test net ether for developers and testers. We will be using the Ropsten network, which is a proof-of-work network and bears the most resemblance to the actual Ethereum blockchain.

The modules of this system would be as follows:

- Remix: A solidity IDE to compile and deploy our token or smart contract
- ERC-20 Interface: This defines a set of requisite token identifiers, constants, and functions which any token running on the ETH blockchain would need to have.
- Ropsten Test Network: Test network where our token would be deployed
- ETH Faucet: To request test ether tokens to publish our contract onto the blockchain
- Metamask Total Supply Wallet: This is the wallet which will hold all of the tokens of our cryptocurrency when the smart contract is deployed.
- Faculty Wallet: This would be the wallet for the faculty to hold and store their tokens to award to students on completion of their designated activities and pursuits.
- Student Wallet: Every student of the institution would have his/her own wallet where they would receive the appropriate amount of tokens as credit for their achievements.
- Etherscan blockchain explorer: This is used to track all token transactions and view balances of the student's wallets on the blockchain network. Either the wallet address, or the transaction hash can be used as input.

A hypothetical testing scenario

Table 1
Hypothetical token balances for 3 types of students

Achievement Criteria	Max Token Allowance	Tokens/Credits		
Academics		Student 1	Student 2	Student 3
Cycle Test 1 (out of 15)	15	14.7	7.5	10.5
Cycle Test 2 (out of 20)	20	19.6	10	14
Cycle Test 3 (out of 20)	20	19.6	10	14
Semester Exam (out of 50)	50	49	25	35
Extracurriculars, Co-curriculars				
Work at NGO	50	0	50	25
College Team, Tournament	40	0	45	20
Research Paper Publication	40	30	0	20
Workshop	30	0	0	15
Internship	50	40	0	25
College Club Participation	30	10	25	15
Total Balance	345	**182.9**	**172.5**	**193.5**
Perception		Academic, Studious	Outgoing, Strong Extracurriculars	Holistically Developed

The tokens granted to the three students above are allocated hypothetically. The perception derived from the different score components for each criterion would supposedly be based upon the skillset developed on the basis of the diversity of the activities pursued. The tokens granted to each student for extracurricular and co-curricular components would be determined by the college administration or the faculty, based on factors like:

- Duration of activity
- Designation held, or level of achievement
- Level of Participation: Local, District, National, International
- Organization or Company Reputation

Technical advantages over traditional systems

The traditional university management software systems primarily utilize web servers, running web frameworks like Node.js, Express, Java, or Django along with an SQL database to store all the university's information. One instant benefit of these systems would be that these are languages and frameworks that have been in use for a considerable period of time. This makes it easier for university administrators or developers to install, troubleshoot, and maintain such systems. But by virtue of their centralized nature, these systems are often vulnerable to cyber-attacks, malware, and hardware or system failure (Mishra et al., 2021; Alnafrah & Mouselli, 2021). In any of these unfortunate events, the data records stored on these systems could be damaged, and also irrecoverably lost. The blockchain, on the other hand, is completely decentralized, providing smart

contracts and cryptocurrencies excellent failsafe features. Since every node on the network would have a copy of the ledger data linking it to the rest of the nodes, once the data of a student's token balance is on there, it will never be erased. It can also not be tampered with or modified due to the 51% rule and the security features of the blockchain.

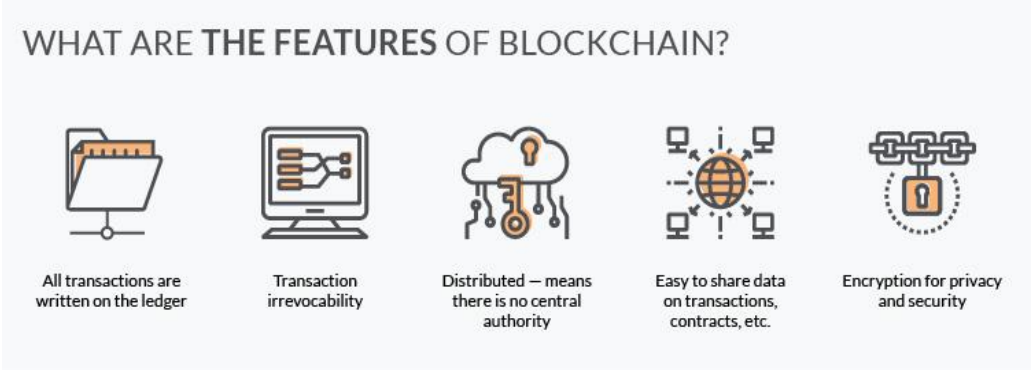


Figure 2. Features of blockchain technology

Implementation and experimental results

Displayed below are the outcomes of the following:

- Token identifiers and mandatory EIP20 properties
- Smart Contract Deployment
- Transferring of a per-faculty limit of tokens by the administrator/total supply account
- Transfer of tokens to Students 1, 2, 3 as per the abovementioned hypothetical scenarios

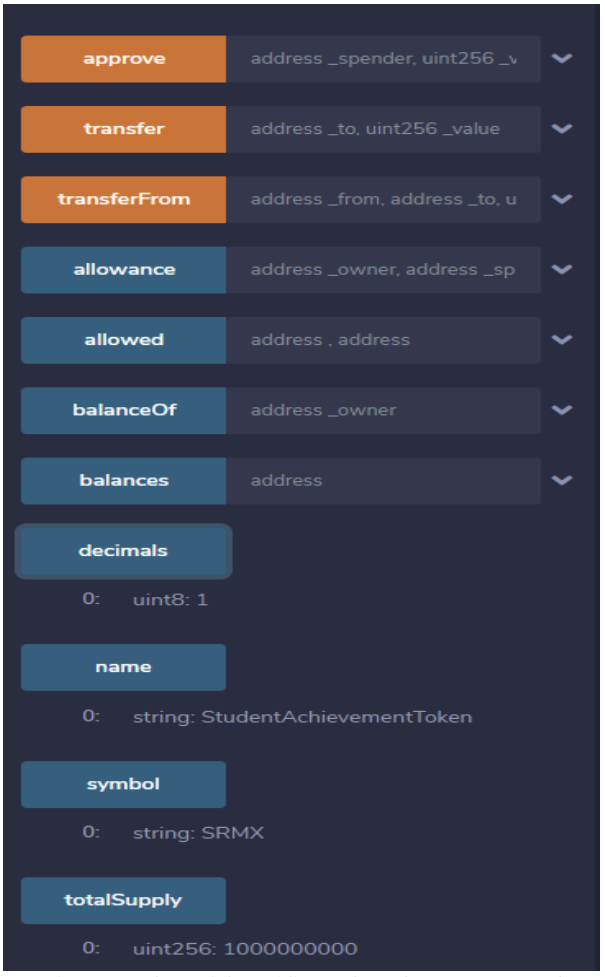


Figure 3. EIP20 functions, token identifiers for the SRMX token, total circulating tokens in existence

The figure above lists the property descriptors which make our ERC-20 token unique and give it the properties needed to be uniquely identified amongst the other tokens which run on the Ethereum blockchain. The abbreviated symbol for our token is taken as SRMX, and the complete title is set as StudentAchievementToken. An initial supply of 100 million SRMX tokens has been generated.

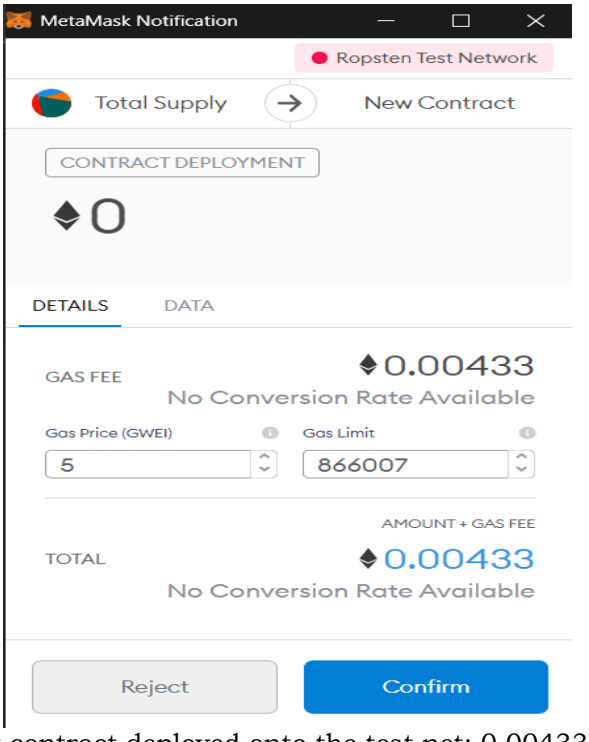


Figure 4. Smart contract deployed onto the test net; 0.00433 ETH spent for deployment

The smart contract or source code containing the details of our token and the mandatory functions that are needed for it to be transacted on the blockchain need to be deployed onto the Ethereum network. For this, 0.00433 ETH tokens are spent as a transaction fee for the deployment on the Ropsten test network.

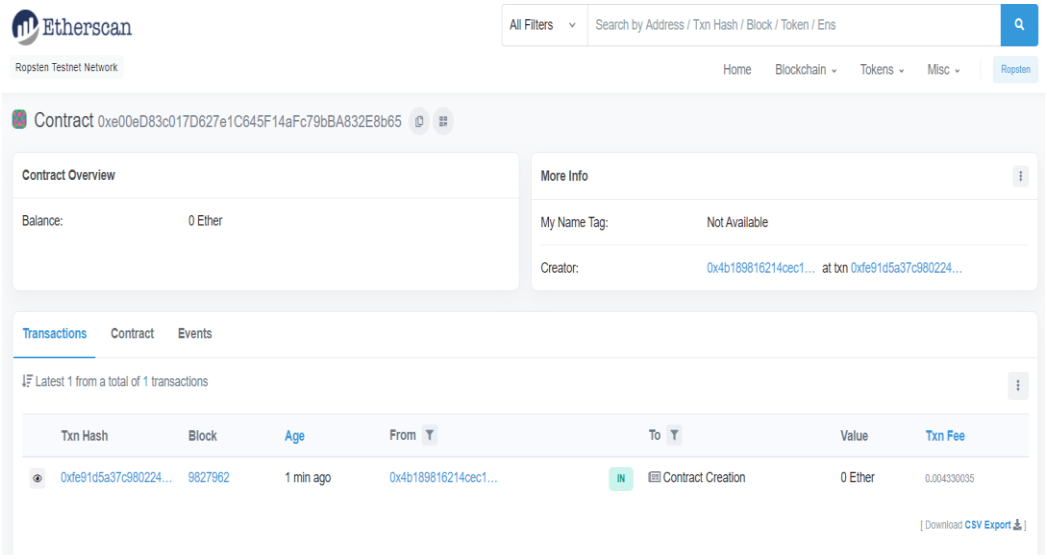


Figure 5. Contract visible on ETH blockchain explorer at address 0xe00eD83c017D627e1C645F14aFc79bBA832E8b65

Etherscan is a blockchain explorer, essentially a website which enables us to track and view transactions, smart contract addresses, and wallet balances for different tokens on the Ethereum blockchain. Our contract is the source code of our SRMX token, and resides on the address shown above. The transactions carried out via this contract, through SRMX tokens, are shown in Etherscan.

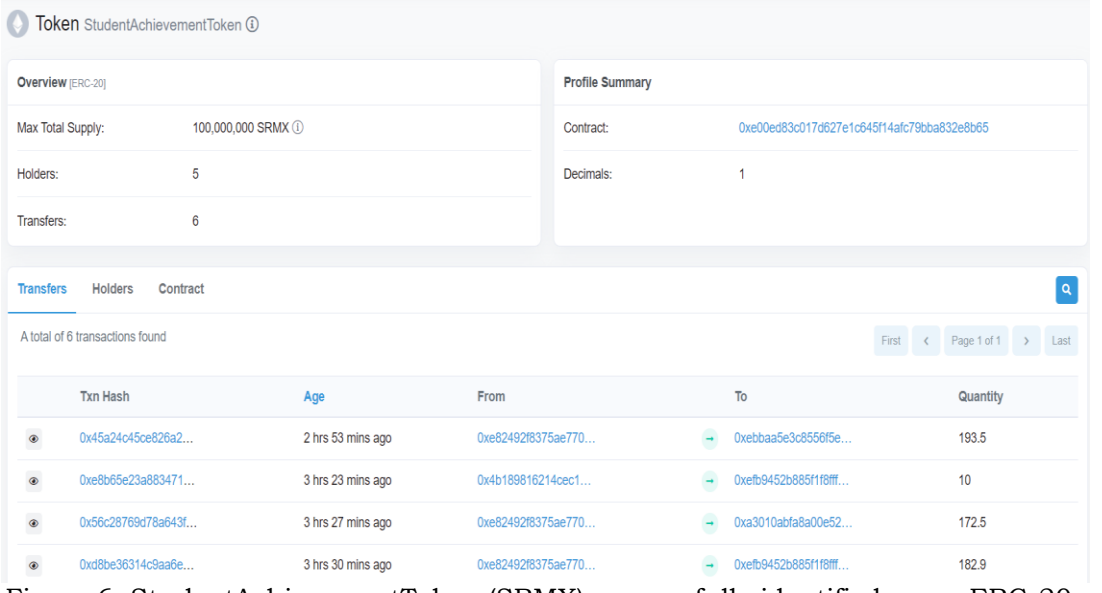


Figure 6. StudentAchievementToken (SRMX) successfully identified as an ERC-20 token, the total supply of 100 million tokens

Depicted in the figure above are the transactions which have occurred, listed as exchanges of SRMX tokens between the wallets that have been created to store

both the StudentAchievementToken, as well as the ETH tokens which as used as gas for paying transaction fees.

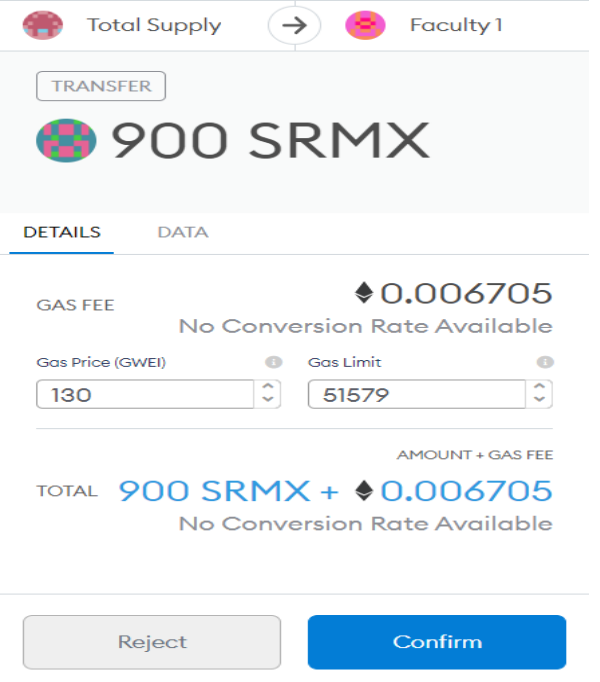


Figure 7. Allocating(sample) SRMX tokens to a faculty account (900 SRMX + 0.006705 ETH txn fee)

The figure shown above shows Metamask, which is the browser-based wallet which stores cryptocurrency tokens. It is the same wallet which the total supply of our tokens was granted to, and the same wallet has been used to create different accounts for demonstration purposes of 3 students and 1 faculty account. The totally supply wallet was also integrated with Remix during deployment of the smart contract so that ETH tokens could be spent as gas for contract creation (Casino et al., 2019; Imran, 2019; Volet, 1991).

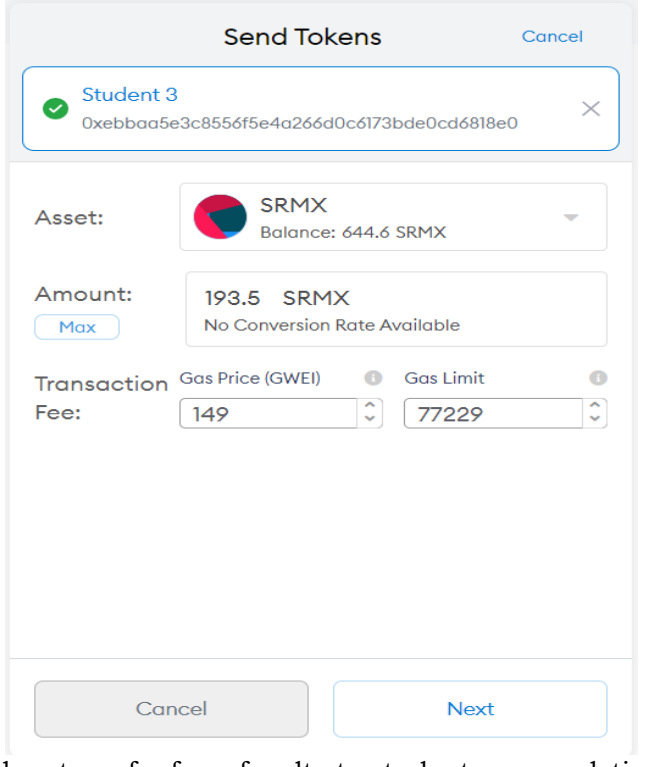


Figure 8. Token transfer from faculty to student on completion of activity

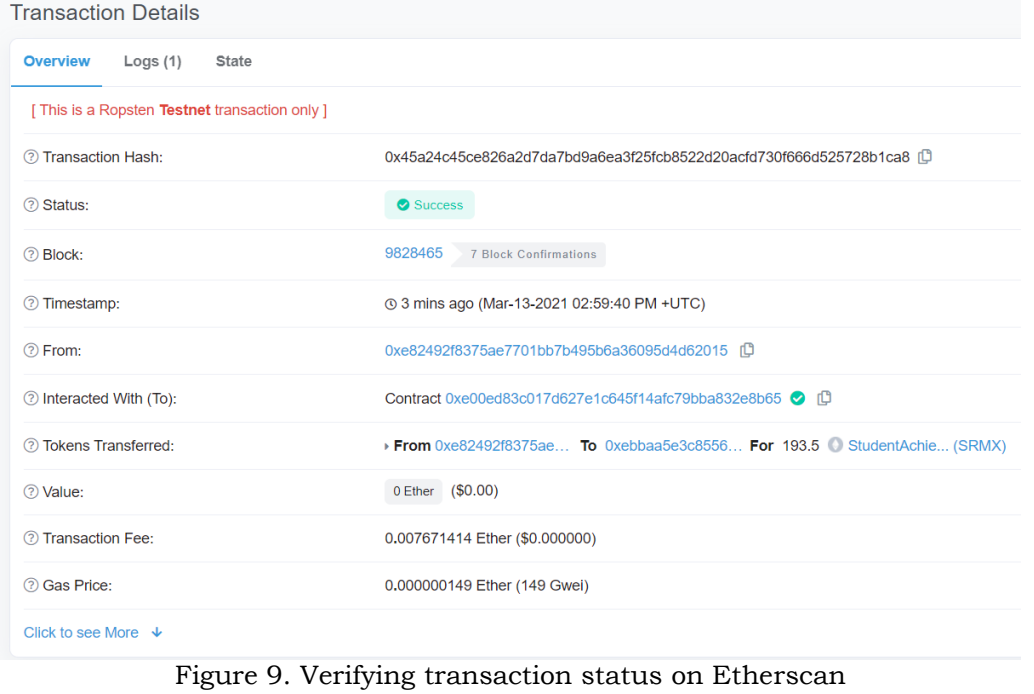
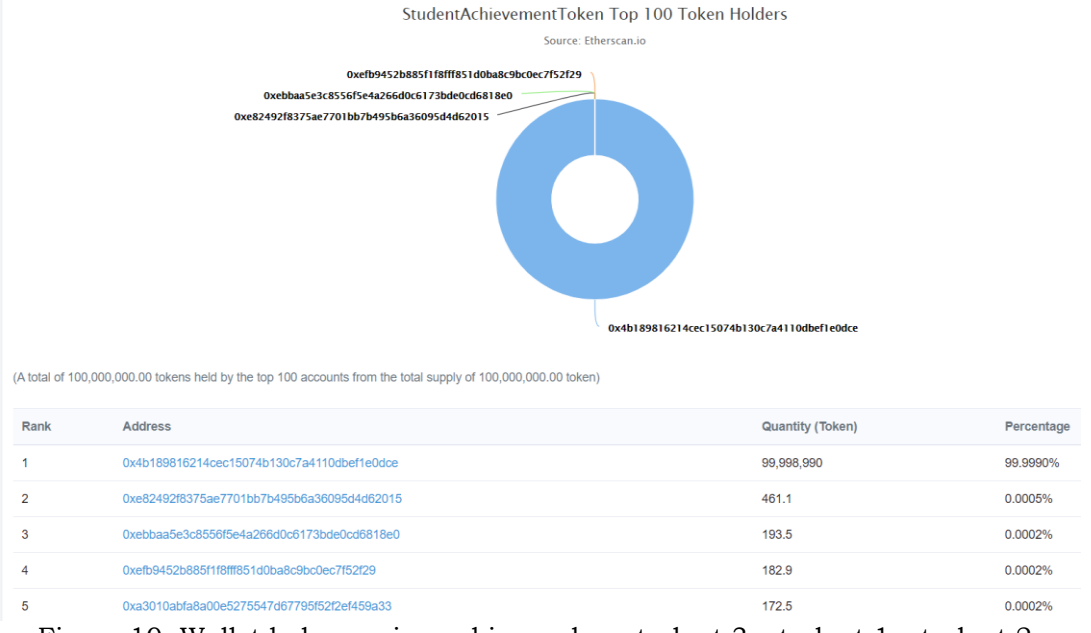


Figure 9. Verifying transaction status on Etherscan

Every transaction or granting of tokens from the college administrator or the total supply holder to the faculty's wallet and also from the faculty to the student's wallet can be tracked in Etherscan as shown above. The value, gas, as well as the wallet hash values for the sender and receiver can be identified.



(A total of 100,000,000.00 tokens held by the top 100 accounts from the total supply of 100,000,000.00 token)

Rank	Address	Quantity (Token)	Percentage
1	0x4b189816214cec15074b130c7a4110dbef1e0dce	99,998,990	99.9990%
2	0xe82492f8375ae7701bb7b495b6a36095d4d62015	461.1	0.0005%
3	0xebbaa5e3c8556f5e4a266d0c6173bde0cd6818e0	193.5	0.0002%
4	0xefb9452b885f1f8fff851d0ba8c9bc0ec7f52f29	182.9	0.0002%
5	0xa3010abfa8a00e5275547d67795f52f2ef459a33	172.5	0.0002%

Figure 10. Wallet balances in ranking order: student 3, student 1, student 2 (exclude faculty wallet and total supply)

The holders of our token, with their respective balances and the percentages with respect to the total circulating supply are shown in the figure above. This serves both the purpose of displaying the account balances of all our token holders, as well as ranking the token holders in order of their balances. In the context of our project to quantify student performance and achievements, the faculty and total supply wallet balances would be taken out of consideration. The remaining balances here include the quantities of tokens sent to different students' wallets based on their performance to assign them their corresponding rankings, which would be used as required.

SRMX wallet addresses

Total Supply Wallet: 0x4b189816214CeC15074B130C7A4110dbEF1e0dCE
Faculty 1: 0xE82492f8375aE7701BB7B495b6a36095d4d62015
Student 1: 0xeFB9452B885f1F8fff851D0bA8c9bc0EC7F52F29
Student 2: 0xa3010aBfa8A00e5275547d67795F52f2EF459A33
Student 3: 0xEBBaA5E3c8556f5E4a266D0C6173bDe0cD6818E0

From the above chart which represents the ranks of the student wallets, it can be seen that Student 3 (193.5 SRMX), who was perceived as holistically developed due to pursuing a diverse set of activities, has a higher rank as compared to Student 1 (182.9 SRMX) and Student 2 (172.5 SRMX).

Conclusion

Grades and percentages are a fair indicator of a student's potential and dedication to his/her career. But they often fail to quantify other activities that the individual would have pursued during the course of his/her college journey. Creating a ranking and reward system based on the currency-like nature of a custom-made cryptocurrency token using the technology of Ethereum's blockchain can really innovate and shed new light on a method of measurement of such activities. Student 3's higher ranking based on the SRMX token balance due to overall development and diversity of activities and achievements is evident here. This shows how such innovation can lead to new avenues for both motivation for students as well as block chain development, especially in the field of education.

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