Bringing Web 3.0 and DAO into Democratic Class: A study of Pedagogy in Higher Education

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Abstract. Blockchain technology introduces a paradigm shift into higher education, presenting opportunities for innovative transformations in human organization and democratic operations. Education-based Decentralized Autonomous Organizations (DAOs) on Web 3.0 are anticipated to instigate change across the spectrum, from classroom pedagogy to broader educational systems. Our research concentrates on the micro-level exploration of the merger between the decentralization principles of educational DAOs and traditional democratic classrooms. In the course of our experimental study, we analyze an experimental postgraduate course that uses a governing token to stimulate decision-making processes, empowering students with a participatory role that mirrors DAO operations. The implementation of popular DAO tools is discussed with the goal of crafting a classroom environment reflecting the decentralized decision-making structures intrinsic to DAOs. While we underscore the potential of decentralized teaching methodologies to enhance democratic education, we particularly focus on students as the primary facilitators of collective decision-making. According to our investigation, students showed a greater understanding and positivity towards decentralization than expected, suggesting that a suitable environment could boost positive behavior in class. Furthermore, in an architecturally decentralized class, a properly operational tokenomics could enhance classroom liberty, particularly for elite students, who might exert significant influence due to tokenomics and reward mechanisms.

Keywords: DAO · Democratic education · Blockchain for education

1 Introduction

In recent years, blockchain technology has emerged as a transformative force across various sectors, with higher education being no exception. The core value of blockchain technology resides in its inherent decentralization and transparency, which fosters a more democratic, equitable, and accountable system. By eliminating the need for central authorities, it empowers individuals and communities, reduces the potential for corruption, and promotes greater inclusivity and cooperation across diverse stakeholders. This decentralized nature of blockchain, alongside its inherent security, reliability, and data integrity, presents numerous benefits to higher educational institutions.

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The capabilities of blockchain not only signal a technological revolution but also instigate a reshaping of the organizational structures and operational methods in human societies. This shift is epitomized by Decentralized Autonomous Organizations (DAOs). Higher education is not immune to this metamorphosis. Both micro and macro aspects of higher education will be significantly influenced by these emergent organizational structures and instructional paradigms. Our research is committed to investigating from a micro perspective, particularly classroom teaching, the fusion of DAO's core principles with distinct educational philosophies. We have observed that democratic education innately aligns with the decentralization espoused by DAOs and blockchain's core values. This amalgamation extends beyond a mere adoption of blockchain and internet technologies, aiding in our exploration of innovative educational models, as evidenced in the intricacies and operational modes of Ed3's core values.

To accomplish this objective, it is essential to delineate the fundamental concepts of decentralization. Further, by implementing exploratory classroom experiments and empirical research, we aim to determine the extent to which this integration realizes the application of decentralization and the current limitations and challenges it encounters. In our research, we examine a postgraduate course where a governing token is deployed to facilitate decision-making processes. This token is utilized in a voting mechanism for class debates, effectively offering students an active role in shaping the course's trajectory, thus simulating the operations of a DAO. Employing popular DAO tools such as Snapshot, Charmverse, and Metamask, we aim to create a classroom environment that mirrors the decentralized decision-making structures found in DAOs. To evaluate the effectiveness and degree of acceptance of this DAO-style governance, a comprehensive questionnaire is administered to the students upon the completion of the course. The aim is to assess the impact on students' diverse tiers of understanding, desire, and implementation regarding decentralization within democratic educational environments. Simultaneously, we intend to provisionally gauge the role of the amalgamation of DAO practices, principles, and democratic classrooms in this setting.

2 DAOs and Ed3

The advantages of applications derived from blockchain technology and other Web 3.0-based installations in higher education, can be fundamentally outlined via two perspectives: the progression of educational technology and the transformation of the organizational structure of the educational system.

Addressing the former perspective, a multitude of applications emerge that can be regarded as value-neutral tools, possessing the potential for seamless implementation within traditional educational settings. The tamper-proof characteristic of blockchain technology makes it an ideal tool for securing and validating qualifications, thereby enhancing trust and transparency in credential verification processes [1]. Institutions such as MIT have already initiated the process of issuing virtual academic credentials, thereby attesting to the efficacy and potential of blockchain in higher education [2].)

Beyond the aforementioned perspectives, a plethora of applications, intrinsically linked to the core values of blockchain technology, are prominently emerging in contemporary times. For instance, blockchain can facilitate the democratization of education

by providing universal access to open educational resources [3]. The unalterable nature of this technology enables secure sharing of resources on a public network, promoting lifelong learning while concurrently reducing costs. A remarkable operation within this domain is the Decentralized Autonomous Organization (DAO) for education, which aligns with our focal theme. DAOs are digital entities constructed and functioning on smart-contract-based platforms. The governance aspect of DAOs has attracted considerable attention in academic research, as they are believed to offer a democratic platform that is accessible to individuals who align with their principles or stated objectives [4]. On a broader scale, DAOs for education serve the concept known as Education 3.0 (Ed3) [5].

Philosophically, Ed3 embodies a highly democratized and market-oriented form of education, where decisions regarding the distribution of capital resources, human resources, and knowledge resources are made by diverse stakeholders. These stakeholders include teachers, students, and others, such as investors in education. The composability of education would be enhanced, the construction of the curriculum and module combinations would create greater individuation of education for every individual student.

Technologically, the decision-making process within Ed3 is tokenized, employing smart contracts on blockchains, such as Ethereum. Building upon this foundational organizational structure and utilizing other autonomous decentralized software applications, traditional educational governance, typically controlled by an elite few, is supplanted. Consequently, the governance of education is driven by market forces and collective decision-making, paving the way for a more equitable and democratized educational landscape. Various organizations working with this model are DAOs for education [6].

The preceding surge in the crypto technology bull market was primarily focused on Decentralized Finance (DeFi), and within this framework, it remains debatable whether DAOs have transitioned into a phase of robust development. DAOs fundamentally emphasize production and construction, rather than finance. Present challenges associated with DAOs for education include excessive financialization (such as the "learning to earn" DeFi game); inadequate product implementation; and noticeable remnants of Education 2.0 (Ed2) (as characterized by Atish Mistry as "centralized platforms distributing education, such as Udemy, Skillshare, and Outschool").Nevertheless, these hurdles do not preclude us from investigating and scrutinizing existing, valuable operational models that bear resemblance to, or are related to DAOs that resonate with the principles of Education 3.0 (Ed3). In accordance with the insights provided by Scott Meyer and Vriti Saraf, four distinct characteristics of DAOs for education merit attention [6]:

1. DAOs for education operate on protocols that align with the blockchain, thereby automating a substantial portion of their operations.
2. DAOs for education encompass collective ownership, learning communities, social clubs, content curation, and asset creation. This contrasts with traditional cooperatives, which primarily concentrate on collective ownership of tangible products or assets, such as housing or specific goods.
3. While cooperatives typically adhere to a one-person-one-vote paradigm, DAOs for education possess the flexibility to innovate governance structures via an array of tokenomics and voting protocols.

4. DAOs for education establish stratified incentive structures using tokenomics that cater to an array of personal interests, such as earning, learning, producing, promoting, and networking, all consolidated within a singular platform.

Crypto, Culture & Society, DeveloperDAO, VectorDAO, MetricsDAO, ScribeDAO, Daokrayaki, among others, could be regarded as DAOs for education, in addition to fulfilling various functions such as knowledge sharing, training, job markets, project funding, and social engagement. Essentially, they constitute social communities that operate on platforms such as Discord and Twitter. United under specific shared values, these communities engage in knowledge sharing, provide job opportunities through a cryptocurrency-based bounty system, raise funds, and sponsor projects aligned with their guiding philosophy.

Given the burgeoning demand for developers in the Web 3.0 industry, the most influential learning DAOs are those tailored for developers. Hackathons are frequently organized globally by nearly all DAOs reliant on information technology. In this sphere, the influence of traditional higher education is difficult to discern. These DAOs offer a more liberal, democratic environment that directly connects learners to the industry. While it is challenging to discern the necessity of traditional educational institutions such as schools or universities within the framework of Ed3, practitioners based within these establishments may facilitate their integration through a process of transformation. Local teacher organizations, research communities, and student clubs all possess the potential to alter the functioning of education through DAOs.

In future, numerous macro and micro DAOs may exist within the educational spectrum, each possessing distinctive decision-making needs. Nevertheless, up until now, most decentralization endeavors in Ed3 have concentrated on educational management and resource allocation within education, while placing minimal emphasis on classroom teaching and pedagogy. This is an area where decision-making and choice also play a pivotal role in determining what knowledge needs to be learned, how knowledge is constructed in the classroom, and how the learning is evaluated. The operation of DAO may also play a useful role in this realm. The reason Ed3 proponents and practitioners seldom focus on this area is because physical classrooms are often omitted from their narratives. However, a shift towards the integration of traditional teaching systems with Ed3 could hold significant value. Given suitable conditions, the technological platforms and operational methods intrinsic to DAOs could instigate meaningful changes within traditional classrooms.

The integration of DAOs into classroom practice holds significant implications. Based on our prior discussions, there are two primary avenues for the implementation of blockchain in education:1. Employing it as a neutral tool; 2. Instigating an evolution of education, thereby overturning the old order dominated by the traditional education system. The first approach does not tap into the inherent value of blockchain, whereas the integration of blockchain and web 3.0 technology should ideally enact transformative changes in education. The second approach, while it more fully embraces the potential of blockchain, might be perceived as premature, radical, and too confined to specific areas of learning. Consequently, its acceptance within broader society remains a challenge.

A middle ground may assist those entrenched in the traditional education system to consider employing DAOs as a force for educational reform, capturing the humanistic

values intrinsic to blockchain technology. By adopting a balanced approach, the core principles of decentralization, transparency, and autonomy embodied by blockchain can be used to enhance educational practice and governance, without negating the existing strengths of traditional educational systems.

3 What is Decentralization?

An educational movement committed to decentralizing the traditional education system is not new. Known as "democratic education" or "freedom-based education", the model is one in which students maintain autonomy over their learning content, method, and schedule. This concept has its roots in a diverse range of historical and philosophical traditions, such as the ancient Greek philosophers, Romantic thinkers like Rousseau and Froebel, the libertarian-anarchist tradition, the 19th century, American transcendentalist movement, and the free-school movement of the 20th century. Significant examples of the latter involve the Summerhill School, led by A. S. Neill, and the extensive establishment of free schools across the United States during the countercultural revolution of the 1960s and 1970s [13]. The democratic classroom stands as a significant sector within the educational spectrum that employs this freedom-based education paradigm.

In acknowledging that both democratic classrooms and DAOs operate under the paradigm of decentralization, there are three salient issues that require elucidation:

1. The essence of decentralization within the context of democratic classrooms.
2. The characteristics of decentralization inherent to DAOs.
3. The compatibility between these two forms of decentralization, along with the criteria for examining this compatibility.

Addressing these issues will enhance our comprehension of the decentralization paradigm as it applies in these two distinct, yet potentially complementary, contexts. Before embarking on the comparison, it is imperative to clarify the analytical framework of the concept of decentralization. According to Vitalik Buterin [14], there exist three dimensions of (de)centralization: Architectural (de)centralization, Political (de)centralization, and Logical (de)centralization. While these definitions have been designed for the realm of information technology, Buterin's instances of decentralization extend well beyond the computer world. Thus, we find it necessary to generalize these dimensions:

1. Architectural (de)centralization—How many "accounts" control the system?
2. Political (de)centralization—How many individual or organizational minds exert control over the system?
3. Logical (de)centralization—Do all users adhere to a standard operational design imposed by the creator of the system?

An instance cited by Buterin involves direct democracy, which he categorizes as politically decentralized, architecturally centralized, and logically centralized. The descriptor "politically decentralized" indicates a lack of control by a single individual or organization. "Architecturally centralized" implies that all decision makers operate within a single chamber or under a single "account", if this account fails or becomes canceled, the

entire system collapses. "Logically centralized" refers to a system where all participants adhere to the rules set by the original creator of the system, hence maintaining a singular mode of operation.

In reference to blockchain technology, Buterin classifies it as politically and architecturally decentralized yet logically centralized. This characterization reflects the operational nature of the blockchain which, while being determined by multiple accounts (or computers) and controlled by diverse individuals or organizations, still requires all participants to conform to the protocols established by the system's originator. Prior to delving into the discourse surrounding the political (de)centralization attributes of democratic classrooms and DAOs for education, we aim briefly to assess the aspect of logical (de)centralization in this context. We posit that all classrooms under consideration would be logically decentralized, as the pedagogical approach within these classrooms remains stable, regardless of whether they exhibit political decentralization and architectural decentralization.

4 The Essence of Decentralization Within the Context of Democratic Classrooms

Democratic education demonstrates a broad spectrum of applications, spanning from micro-level classroom democracy to the idealized macro-level school-wide democracy. As per the aspirations of democratic education activists and theorists, there is even a call for transforming an entire nation's education system to align with democratic principles. This ambition parallels those pioneering Ed3 and the utilization of DAOs in education. However, the realization of democratic education encounters numerous theoretical and practical challenges, which limits its widespread implementation. Most manifestations of democratic education are restricted to micro-level classroom practices; hence, this study will focus primarily on decentralized pedagogy within democratic classrooms.

We shall draw from two instances to exemplify the feasibility of decentralization within democratic classrooms. The first case, "Teaching Assistant Training Program" (TATP), has been established by the Centre for Teaching Support & Innovation (CTSI) at the University of Toronto. Since 2002, this initiative has aimed at fostering democratic learning within classrooms for Teaching Assistants and Course Instructors at the Roberts Library. Additional teaching and learning workshops targeting TAs and instructors have been facilitated at both the UT Scarborough campus and UT Mississauga campus. The underlying aim of this TA training program is to cultivate democratic teaching and learning practices among TAs and students. It is designed to further facilitate the process of peer teaching and peer learning among students [15].

As illustrated in the report [15], the implementation of democratic classes within this project is confined to facilitating open discussions and peer learning, aiming to enhance the democratic competencies of TAs and students. Such competencies encompass understanding diversity, appreciating ambiguity and complexity, challenging assumptions, attentive and respectful listening, acknowledging persistent differences, fostering intellectual flexibility, recognizing connections, respecting experiences, embodying democratic habits, creating collective knowledge, effective communication, collaborative learning, widening comprehension and empathy, and the synthesis, integration, and

transformation of ideas and actions. These skills represent the positive freedom essential for practicing democracy in constructing knowledge, a prerequisite for political decentralization.

However, these competencies should not be misconstrued as fully democratic; they align more accurately with critical thinking, particularly when class topics bear minimal relevance to politics. We can call this critical pedagogy rather than fully decentralized pedagogy such as "banking method" by Brazilian educator Paulo Freire [16]. It may be observed that when students are granted increased tangible political power within the classroom, the exercise of their action of positive freedom tends to diminish [15].

A fully realized democratic classroom should incorporate elements that engender and represent negative freedom. This implies the necessity for a relatively formalized collective decision-making process, such as voting, within the classroom. Moreover, students should consider this process with great care, given that the outcomes of such votes could directly influence their educational experiences. Consequently, Case 2 merits closer examination.

The case 2 to be considered is Ira Shor's "Utopia Course" at the City University of New York, serving working students. The relaxed external environment affords an opportunity for Shor to experiment with democratic education in a higher education setting. Unlike the Teaching TATP, Shor seeks to fully embody the philosophy of democratic education by transforming the classroom into a politically decentralized space, as opposed to merely decentralizing diverse thoughts. To this end, Shor not only utilizes discussions, but also provides students with test and assignment options that cater to their unique learning preferences. He also allows students "protest rights", practices contract grading or self-grading, permits students to address the teacher by their first name, and encourages students to co-construct knowledge [17].

It can be argued that Ira Shor's class represents a genuinely politically decentralized entity, despite the inherent authority that his status as a teacher might confer. Shor makes considerable efforts to minimize this element of centralization, by altering the seating arrangement between him and the students, by allowing students to address him by his first name, and by adopting a Socratic approach to questioning rather than a didactic teaching style. Nonetheless, it is challenging to eliminate the naturally centralized political characteristics of the traditional classroom in a practical implementation of classes akin to Shor's.

In summary, it is reasonable to assert that traditional democratic classrooms hold the potential to achieve political decentralization, though they fail to fulfill the requirements for architectural decentralization, largely due to their similarities with direct democracy. If the school decides to terminate the course, or if the instructor elects to discontinue the course, it would invariably cease. This underscores the inherent weakness of architectural centralization; if the "account" or the sole operating deployment of the work is compromised, or falls under the control of a malicious individual, the recovery of the system becomes significantly challenging. The same issue could arise with centralized educational platforms.

5 Different Democratic Classes with Regard to the Context of Decentralization

We now turn our attention to assessing the degree of decentralization exhibited by DAOs, specifically those intended for education. DAOs for education are architecturally and politically decentralized. This is presumed to be advantageous for these DAOs, given that the political landscape within cyberspace differs markedly from that of the physical world. But it is an oversimplification to conclude that classes of DAOs are more decentralized or better than democratic classes.

Discussing the divergence between the DAOs' realm and the physical educational world, it is noteworthy that DAOs are marked by a high degree of tribalism, partly in consequence of its anarchistic nature. Unlike citizens confined to physical locations under governmental regulations, inhabitants active in cyberspace are unrestricted by a tangible space that limits their access to various cyber domains—a mere click of a mouse allows for fluid transitions. Given this convenience of unrestricted movement, cyber residents are not obliged to harmonize with others who may not share their values, moral stances, or political ideologies. This circumstance eventually leads to the formation of internet tribes. The core members of these tribes likely have visited numerous communities before deciding to associate with one. Consequently, democracy within these tribes may be taken more seriously because cyberspace offers alternatives to "fighting" within a democratic system. These alternatives include leaving, to choose another tribe more aligned with their interests, or forking the community into separate entities unless compelling reasons exist to maintain the unity and growth of the community.

Thus, a class governed by a DAO for education may not necessarily demand stringent democratic engagement. Different teaching channels or websites are akin to small tribes, with the teacher, as the space's owner, likely adhering to traditional pedagogical practices in their interaction with students. Given the vast amount of content available online, the necessity to implement composability of content "within" their class may seem redundant. Reflecting on the definition of E3 as outlined in preceding sections of this paper, the composability it advocates may be best applied "outside the class". This discrepancy between the actual practices of DAOs for Ed3 and democratic classrooms could be considered their primary incongruity. However, the channels for communication between these two remain open.

The crucial question here is whether the organic nature of a Shor-style democratic class retains its significance in light of Ed3, and whether the introduction of architectural decentralization might enhance democratic education. In our opinion, the answer is "affirmative". Most of today's so-called DAOs for education appear to inadequately integrate the class system with tokenomics. The lack of innovative deployment of Web3 technology in pedagogy could explain why the "learn to earn" scheme often devolves into a financial narrative or merely generates memberships with little intrinsic value. In such a situation, when an individual earns tokens through 'learning,' which is often defined by simple processes of recording and testing, the primary incentive to proceed seems to be the potential for selling these tokens. It could be argued that the design philosophy of this system is fundamentally flawed because it undermines the core purpose of learning, which is to approach the truth and gain knowledge, skills and understanding. A democratic educator might refine this statement by emphasizing that the journey

towards acquiring knowledge is equally deserving of consideration by the learner. This focus allows learners to understand the 'why' and 'what' of learning rather than just the 'what,' fostering a more holistic and purposeful learning experience.

Hence, it would be significant to imbue these DAO tokens with more functionality. When introducing innovation to education, three levels are of concern: the classroom level, the institutional level, and the more macro societal level. Likewise, for promoting Ed3, we may consider the class level, the DAO level, and a broader macro level. Implementing a tokenization operation at the classroom level (assuming that classes exist in Ed3) could be a feasible method for learners, who are likely minor stakeholders, to engage with the democratization of education and knowledge. This process could potentially forge strong connections with democratization efforts at other educational levels. Consequently, the economic value of these tokens would be reinforced by these more fundamental values.

Table 1. Decentralization statuses pertaining to the five distinct class types.

	critical thinking education	political decentralized education	architectural decentralized education	logically decentralized pedagogy
TATP Style Class	Y	N in organization level; N in class level	N	N
Shor Style Class	Y	N in organization level; Y in class level	N	N
General DAOs for Edu3	Y	Y in organization level; N in class level	Y	N
Edu3&Shor Style Class(ESSC)	Y	Y in organization level; Y in class level	Y	N
ESSC negative	Y	N in organization level; Y in class level	Y	N

To explore the fusion of Ed3 and democratic education, we propose a pedagogical model (Ed3&Shor Style Class, ESSC for short) that introduces tokenization into the democratic classroom, thereby transforming all procedures requiring collective decision-making. This includes the selection of lecture content, students' preferences for examination content, and voting to express support for discussion standpoints. The process of token distribution would be linked to the academic behavior and engagement of the students, as observed through their bounty applications and participation in classroom discussions, etc. With this mechanism, a sub-circuit of tokenomics would be established within the class. We maintain an open setting towards a more macro-level tokenomics in higher levels, potentially encapsulating this one and encouraging the development of more diversified and flexible rules within this ecosystem. An ESSC with negative attributes would constitute an isolated class, devoid of the context of decentralization at the school level or any broader macro level.

6 A Web3 and Democratic Class Simulating ESSC Negative

To suitably align with the constraints posed by the Chinese education system and the theme of the course, we have designed a class that simulates the ESSC negative while incorporating several distinct features. Here are the principal deviations from the ESSC negative model in our design:

1. Our governing token for the class will be deployed on the Ethereum blockchain's testnet, as opposed to the mainnet. This approach is motivated by several considerations: first, launching such a project on Ethereum would be prohibitively expensive, and we lack the necessary budget; second, there is no perceptible difference for students in terms of client-side operations; third, there is no compelling need for tokenomics with real economic value at the class level; and finally, it helps circumvent any potential risks stemming from school-level prohibitions.
2. In view of the cultural influences and prevalent class participation habits among Chinese students, the teacher's authority in our class will not be as significantly reduced as in Shor's class model.

The courses implementing our design are titled "Introduction to Dialectics of Nature" and are available to graduate students at Suzhou University of Science and Technology. These courses introduce foundational aspects of knowledge and knowledge production—concepts that can also be described as philosophical characteristics of science and its evolution—along with related philosophical topics on science and technology development. Given that the construction of knowledge within our course also signifies a form of knowledge production, the exercise of democracy in constructing knowledge within our course shows the mirror relationship between pedagogy and learning content. To outline our design, we will elucidate the Web 3.0 tools employed, tokenomics and the classroom governance involved.

Tools

Metamask is a browser extension that allows users to interact with decentralized applications (DApps) on the Ethereum blockchain. It serves as a digital wallet, enabling users to securely store, manage, and transfer Ethereum and other ERC-20 tokens. Metamask provides a user-friendly interface, making it easier for individuals to access and engage with the world of decentralized finance (DeFi) and blockchain-based applications.

Charmverse is a platform that integrates blockchain technology, specifically tokens and NFTs (Non-Fungible Tokens), into a community forum. We use it for delivering bounties.

Snapshot is a governance tool used by decentralized communities and projects. It allows token holders to vote on proposals, participate in decision-making processes, and shape the future direction of a project. Snapshot uses blockchain technology to ensure transparency, immutability, and security in voting processes.

Tokenomics

We will issue a batch of tokens, minted simultaneously and held by the classroom manager (a somewhat centralized approach). However, this approach is adopted for ease of management. As this study is limited to classroom management research and does not delve into the economic aspects of education.

The functions of these tokens are threefold: 1) to be used for voting governance; 2) to be issued as rewards for tasks (bounties); 3) to serve as a reference for tracking routine performance. The distribution of these tokens follows three methods: 1) as bounties; 2) to students participating in the voting; 3) to students participating in classroom management work (if there is a teaching assistant, this step is omitted). In the initial round of token distribution, class monitors from each group were delegated to distribute the tokens. However, due to unsatisfactory results, the distribution of tokens was transferred to the hands of the teaching assistants. Through the application of this tokenomics system, students can acquire greater governance over the class by actively participating. This process not only increases their agency but also enhances the likelihood of their preferences influencing the final examination content and subsequently improving their usual grades. The system thus fosters an environment where student engagement directly impacts their academic outcomes.

Classroom Governance

Online part:

1. Implemented on Charmverse, the main activities include forum discussions and bounties. Ways of earning bounties include: 1) Registration for topic discussion and debates (bounties are awarded after debating or other class speeches), 2) Distributed knowledge collection (bounties are confirmed after verification). Token distribution principles: In addition to acquiring bounties, everyone participating in the voting can receive a certain number of tokens. The bounties are significantly higher than the rewards for regular activities. Required tools: Metamask wallet, Charmverse (DAO governance tool)
2. Voting, implemented on Snapshot. The main work is off-chain voting. Voting subjects include: 1) Classroom topic resolution selection, 2) Selection of classroom lecture content, 3) Voting on classroom assessment topics (survey on classroom assessment content preferences). Required tools: Metamask wallet, Snapshot

Offline Part

The offline part includes special topic discussion and debate (in class), lecture, exams, etc.

Presentation Section: Each resolution has 3–4 rounds, each round is represented by a pro and con party from a group, presenting their stance and evidence, each presentation should be between 3 and 5 min.

Debate Section: Each resolution has one debate, proposed by a group with recommended pro and con debaters. The total time for debate is 15 min. The debate is conducted by taking turns, with an "answer then question" approach. Each representative has a total of 7.5 min, and each round of speaking time should not exceed 2 min. To encourage

participation, students who join the debate without prior registration can receive a 50% additional bounty. The encourages students to facilitate the entire debate.

The lecture topics are designed to offer a variety of choices. There are 20 potential lectures that correspond to the course theme, exceeding the number of course hours. From these, students will select eight topics. The first six topics form a cohesive series centered around scientific methodology and the history of philosophy in science and technology. The remaining 14 lectures are more varied, encompassing philosophical discussions on cognitive science, blockchain, the metaverse, artificial intelligence, and other related themes.

7 The Examination of Decentralization Within the Simulated ESSC Negative

The implementation of a decentralized democratic classroom presents multiple challenges, involving students, teachers and institutions. This study will concentrate on the most crucial subjective viewpoint - the students', since they are the primary agents engaging in collective decision-making, a significant outcome for such a class. Our analysis will utilize the fundamental framework proposed by Morrison [13], focusing on the positive freedom exhibited by students in the classroom, given the pre-existing conditions of freedom in a democratic environment. Contrary to traditional democratic classrooms, our simulated ESSC negative model integrates web 3.0 technology and its associated political mechanisms, resulting in several notable advantages: 1. The anonymity provided in such a setting encourages a more robust exercise of freedom of speech and other forms of liberty; 2. The tokenomics model incentivizes active participation in class with the prospect of earning rewards.

We anticipate findings that extend beyond a simplistic answer such as "students lack behaviors indicative of positive freedom", given the innovative feature of decentralization introduced in this study. In order to accomplish this goal, we employ two types of assessment to scrutinize students' understanding, desires, and implementation levels concerning decentralization. The first is a comprehensive post-course survey covering diverse aspects of the students' experiences about decentralization. The second involves evaluating students' classroom performance through a combination of subjective evaluations by teachers and data on classroom participation.

Furthermore, we have established two control groups comprising two lecture courses at Campus A (with a total of 360 students) and two at Campus B (totaling 376 students). These groups employ similar teaching methodologies and content but differ in the curricular scheduling. Referred to as Group A and Group B, respectively, the former has its lecture content, except for the introduction and pedagogical courses, determined by student voting on Snapshot. Conversely, in Group B, the instructor determines the course's first half, with decision-making authority delegated to students for the remainder. Given the close alignment of classroom debates with previously covered content, the two groups also differ in the progress and continuity of debate topics. This arrangement aims to examine whether content continuity influences student engagement.

We disseminated the electronic questionnaire via social media, garnering 163 responses from Group A and 116 from Group B. The questionnaire consisted of 33 questions, 13 of which were directly related to students' understanding, desire, and implementation of various types of decentralization (table1). We classified the strength of these associations into three levels: weak, medium, and strong, and inferred students' positivity towards different types of decentralization (understanding, desire, implementation) based on their responses. The data for Groups A and B can be found in Fig. 1.

We classified decentralization according to Table 1 discussed earlier and defined critical thinking as a type of decentralization. While critical thinking does not fall into the categories of decentralization defined by Vitalik Buterin, it is associated with a diversity of values and a high degree of acceptance of rational thinking processes. We thus believe it can serve as a parameter expressing positive freedom. Additionally, to avoid excessively technical questions in the survey, all our questions employed common-sense language and therefore, might not precisely correlate with a specific type of decentralization. Consequently, some questions might relate to multiple types of decentralization simultaneously, but with varying degrees of correlation.

We notice that there is no significant difference between Group A and Group B. This suggests a strong commonality among students from both groups in their self-perception of understanding, desire, and implementation concerning various types of decentralization. According to the data, students seem to have a relatively higher understanding and acceptance of political decentralization and its value of this class. There is a comparatively lower desire for critical thinking and political decentralization, yet a certain interest and inclination towards architectural decentralization are demonstrated. Nevertheless, the level of implementation for all types of decentralization appears relatively low. Upon examining the lecture content selection and debate voting conditions of the control group, several noteworthy points emerge (Fig. 2):

1. Group B's voting rate for lecture content selection is lower than Group A's.
2. The voting rate and standard deviation of vote distribution for lecture content selection in Group A shows a trend of initial decline followed by a return to previous levels.
3. Even after opening up lecture content selection in the second half of the course, Group B still continued to select the next chapter in accordance with the original teaching order (Scientific Methodology and History of Science and Technology), demonstrating a rational exercise of positive freedom in choice. A relative rationality in choice was also observed in the third and fourth rounds of content selection in Group B. The selected lecture content on these two occasions were "The Rise of Modern Science (including a bit of Medieval Science content)" and "Dialectics of Nature after Socrates." Despite the teacher suggesting that students could select certain content if they wished to learn more about the related knowledge, there was no obligation for the students to heed the teacher's advice.

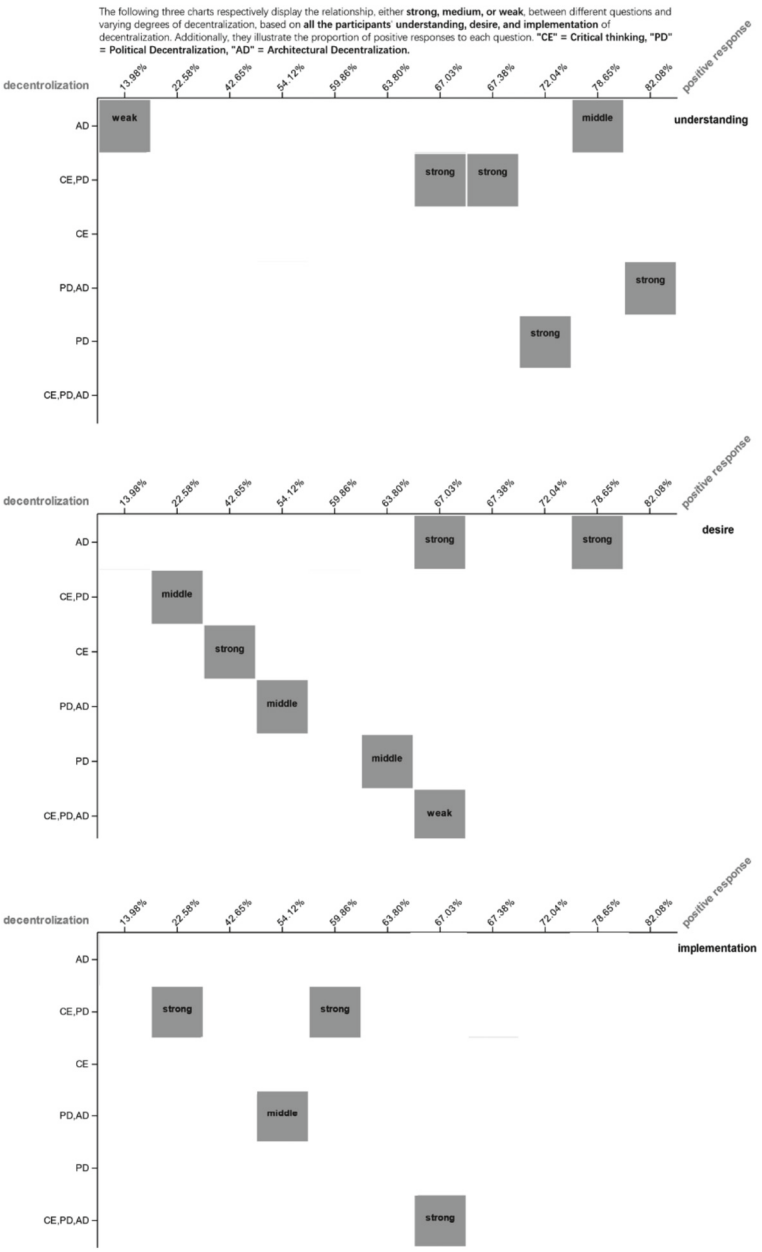

Fig. 1 Comparative analysis of three dimensions across diverse decentralization collections for all the students.

8 Discussion

Issue: Our observations suggest that, in contrast to a minority of proactive participants or 'elite students,' the majority of students exhibit a stronger inclination towards the implementation of negative freedom than positive freedom. This propensity remains robust despite the challenges posed by the deployment of blockchain technology and network instability. The classroom's sole objective for positive freedom is to cultivate students' capacity to contemplate various attributes of knowledge and technology in philosophy, yet this intent appears less appealing to many. Evidenced by lower voting rates for differing debate stances compared to lecture content selections, it seems that the requirements for positive freedom in this classroom setting may be overlooked or misconstrued as merely offering negative freedoms. Consequently, students tend to express limited interest in ballots demanding rational effort, favoring decisions that can be made impulsively.

Response: Upon reviewing the choices regarding lecture content made by Group A, as well as the responses to the survey questions—'Did you conduct a prior investigation into the content of the elective lectures?' (57.06% answered 'yes') and 'Did the content of the lecture you chose differ from your expectations?' (73.39% answered 'yes')—we infer that the majority of students display scant interest in performing exhaustive research on their selected lectures prior to the class. Given the advanced specialization of the course, students often struggle to predict whether a course will align with their learning objectives, armed with only limited information and basic internet searches. In fact, a substantial number of students remain uncertain about their expectations of the course, given their relative unfamiliarity with philosophy. Hence, when interpreting the aforementioned issue, we must caution against simplistic evaluations of this phenomenon. Nevertheless, we do not negate the possible misuse of negative freedom by students, which would bechallenging to quantify.

Furthermore, during the teaching process, we have discerned several anomalies, suggesting potential countermeasures within the classroom to curb the misuse of negative freedom. Notably, in Group A's Rounds 2, 3, and 4—which demonstrated relatively low voting rates (38.33%, 36.67%, 29.44%, respectively)—the standard deviations were also lower (17.94, 12.42, 14.66, respectively), indicating a more concentrated voting pattern when participation rates were diminished. These three rounds of lectures exhibited an evident continuity, with the instructor drawing attention to the logical links between current, preceding, and subsequent content. Students were advised that should they find this continuous content appealing, they would need to opt for it via voting. We posit that attentive and engaged students represent the relative elite of the classroom, and we have noted that the choices of these elite students tend to be more consolidated and frequently align with the instructor's recommendations. If the tokenomics is in their favor, then the practice of selection may lead in a reasonable direction.

This observation contrasts with the seemingly rational decision made by students in Group B. It appears that these students are influenced more significantly by the "hidden curriculum" and may be motivated either by its inherent rational components or by the curriculum's centralizing role. However, the precise driving factor remains uncertain, warranting further research in the future.

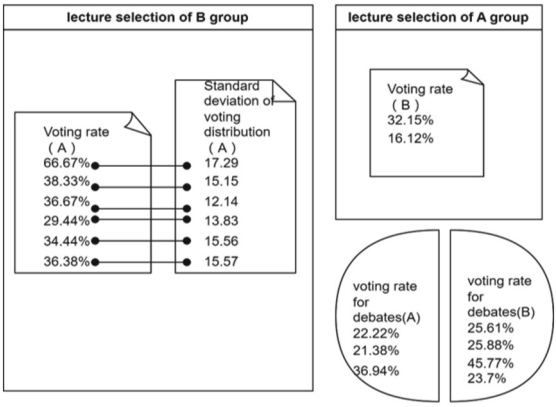

Fig. 2 Comparative analysis of voting rate and standard deviation of voting distribution across various rounds of debates for groups A and B.

9 Conclusions

As anticipated, there were several challenges encountered in effectively implementing our pedagogical design, which melds DAO and democratic education. However, unexpectedly, students' understanding of and aspiration towards decentralization exceeded our expectations and were more positive and accurate. Given suitable external conditions, we have good reason to anticipate a rise in positive classroom behaviour. Another notable potential discovery is that within an architecturally decentralized class, an appropriate operation of tokenomics could foster a rational, positive, and autonomous enactment of classroom liberty. Furthermore, a plausible hypothesis for this scenario is related to the potential power derived from architectural decentralization, particularly as wielded by elite students. These students, due to tokenomics and reward mechanisms, could exert considerable influence within the class.

As the spectrum of DAO applications expands from micro to macro levels, our thinking should evolve correspondingly. The power of tokenomics will become more substantial and complex, thereby bringing the issue of DAO governance to the fore. Once this occurs, the novel research domain of DAOs for education warrants exploration.

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