the knowledge economy

makes it possible to get credits for learning that happens anywhere
even when you're just doing the things you love

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peerbuds

An open decentralized protocol that tracks everything you have ever learned in units called Gyan and rewards it with tokens called Karma.

Gyan, world's first unit measure of knowledge

World's most secure way to keep a record of every learning transaction - at school, online, with friends or at work. Instantly earn tokens every time you learn, build your reputation, collaborate with peers on the same knowledge story and get project offers from employers that matches your skills.

[TBF - Illustration of Gyan flow]

Karma Tokens, the cryptocurrency empowering every learner

An ecosystem where everyone benefits - the student, teacher and workplaces. Using the awarded Karma tokens every week, students & teachers can study for free, earn money and get access to valuable services.

[TBF - Illustration of Karma flow]

Vision

"A knowledge economy where knowledge workers (students) are recognized and paid for adding value (learning) irrespective of when, where or with whom it happened."

You are one of the ONE BILLION who will earn the true value of learning that happens all life long.

With a governance & economic model that is perpetually self sustainable

<u>Students</u>

- Earn money while studying
- Build global reputation
- Pay forward for your education
- Earn money for collaboration

<u>Teachers</u>

- Instant payments
- Earn money with higher reputation
- Globally recognized content
- Benefit from higher learning students

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1. Abstract

Imagine a world where all your learning is tracked, where both learning and teaching is rewarded, and where learning and earning happen hand in hand.
Peerbuds is a blockchain database that embraces the vision of a knowledge economy, where the exchange of knowledge is driven through cryptocurrency incentivization. Peerbuds understands the problems within the current educational system, and seeks to address the core of it by quantifying how much one has actually learned. By establishing a distributed

account of one's complete knowledge and instantly verifying the authenticity of every learning transaction, we make it possible for people to truly leverage the power of their knowledge. Traditional economies are a zero sum game meaning value is lost by the giver and gained by the receiver. Knowledge economies however will always be a positive sum game. By positive sum, we mean that one individual having a piece of knowledge does not limit the other from having that knowledge. Indeed, everyone benefits from the knowledge exchange. Teaching reinforces mastery from both the perspective of the teacher and the student. Our cryptocurrency reflects the positive sum of that exchange. This exchange of knowledge adds value to the world and any work that even remotely adds value to the knowledge economy must be rewarded.

2. Background

Traditional educational methods have evolved throughout human history. However, many aspects of formalized human learning remain the same. Classrooms or formalized learning groups, textbooks or oratory recitation, tests, and an expert in the target discipline transmitting the knowledge are fundamental components of the transfer of knowledge and have been so, in some capacity, for millennia. In the digital age, only the medium of knowledge transfer has changed. Content is delivered through learning management systems (LMS) such as Google Classroom, Blackboard, and Moodle, to name just a few. While these eLearning platforms digitally mimic the pedagogy of a traditional classroom, they are missing several fundamental components.

Reports abound regarding the connection between advancing one's education and an increase in their earning capacity throughout their lifetime. The more education attained by an individual, the higher their wages[1] and they are less likely to be unemployed.[2] Yet, there are additional intrinsic and extrinsic positives which include healthier lifestyle behaviors[3],

[1] Gould, E. (2016). Looking at the latest wage data by education level. *Economic Policy Institute*. Available at: http://www.epi.org/blog/looking-at-the-latest-wage-data-by-education-level/

[2] U.S. Bureau of Labor Statistics. (2017). More education: Lower unemployment, higher earnings. Available at: https://www.bls.gov/emp/education_pays_handout.pdf

[3] Brunello, Giorgio; Fort, Margherita; Schneeweis, Nicole; Winter-Ebmer, Rudolf (2011) : The causal effect of education on health: What is the role of health behaviors?, Economics Series, Institute for Advanced Studies, No. 280 Available at: https://www.econstor.eu/bitstream/10419/68499/1/73437948X.pdf

volunteerism, and greater civic engagement.[4] Some researchers have stated that increasing the amount of education provides a "social vaccine" that increases life expectancy and reduces the likelihood of disabling conditions.[5] Meanwhile, in terms of worldwide economic indicators, education is a key metric factored into the global competitiveness index.[6] Due to perpetual technological advancements and the increase in the amount of information disseminated through the internet, the who, what, where, when, how, and why of educating the global population is also shifting.

Since education is connected to a country's global economic competitiveness, and the divide between knowledge workers (e.g., analysts, software engineers, scientists, systems thinkers, etc.) and all other forms of employment continues to grow, education has become a worldwide imperative.

2.1. The Fourth Industrial Revolution and The Knowledge Economy

Though the Fourth Industrial Revolution holds the promise of raising global incomes and increasing the quality of life worldwide[7], it is quickly changing the employment landscape. Indeed, the internet of things (IoT), sensors, and embedded digital systems proliferate all areas of business, government, and commerce.[8] We now use some form of internet connected device and its relevant software in every employment sector. At the very least, employees and business owners need to understand how to use the devices relevant to their industry. To keep pace with the demand for innovation and gain global market share, every industry is challenged to find workers who possess a deeply analytical skill set coupled with creative insight and tenacious problem solving capabilities. Additionally, at the individual level, skill sets require ongoing updating to also keep up with the technological shifts.

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[4] College Board. (2017). College Education Linked to Higher Pay, Job Security, Healthier Behaviors and More Civic Involvement: New College Board Report. Available at: https://www.collegeboard.org/releases/2016/college-education-linked-to-hgher-pay-job-security-healthier-behaviors-and-more-civic-involvement

[5] Viner, R.M., et al. (2016). The health benefits of secondary education in adolescents and young adults: An international analysis in 186 low-, middle- and high-income countries from 1990 to 2013. *SSM Population Health*, Volume 3, December 2017, Pages 162-171.

[6] World Economic Forum. (2017). The inclusive growth and development report, 2017. Available at: http://www3.weforum.org/docs/WEF_Forum_IncGrwth_2017.pdf

[7] World Economic Forum. (n.d.). The Fourth Industrial Revolution: what it means, how to respond. Available at: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

[8] Bloem, J., et al. (2014). The Fourth Industrial Revolution: Things to Tighten the Link Between IT and OT. Available at: https://www.fr.sogeti.com/globalassets/global/downloads/reports/vint-research-3-the-fourth-industrial-revolution

Knowledge is a form of currency and the knowledge economy utilizes it to produce additional knowledge, distribute current knowledge, or use the information to improve a product or service. However, unlike economies of scarcity such as those based on oil, gold, or limited distributions of fiat currency, knowledge is abundant. When one gives knowledge to another, it simultaneously increases the recipient's knowledge as well as that of the giver.

Therefore, both walk away from the interaction or transaction with something of value, even if it's simply an understanding as to how others communicate their knowledge. While other economies provide a finite transaction for a good or service, the knowledge economy offers empowerment to all participants which is more likely to last beyond the exchange. Knowledge is also renewable and has, theoretically, an unlimited source. Each human being has the capacity to contribute something new. Individual motivation plays a key factor and this is where education faces one of the greatest challenges.

2.2. Why Modern Education Doesn't Work for Everyone

Motivation and its correlation with behavior is the fundamental predictor of human performance. Various theories of incentivization exist, and behavioral and educational psychologists continue to strive towards specific metrics that help us to assess and predict human behavior. Marketing departments aim to predict and incentivize certain buyers to click on links while machine learning algorithms have laid the foundation for Artificial Intelligence as tool to better predict human behavior.

The goal here is to figure out what humans are going to do so that governments and businesses have the ability to leverage changes in behavior. They strive to incentivize citizens or consumers to perform a certain action. But, incentivization isn't a one size fits all technique and school systems, in particular, vulnerable to this miscalculation.

2.3. Education and Incentivization

A majority of school systems aren't constructed to educate the 21st century human being within the digital era. The brick and mortar based education, particularly within the U.S., is attempting to transition by increasing the number of online degrees available or require some form of digital interaction such as a weekly discussion post via Blackboard or some other learning management system. However, in terms of compulsory education at the kindergarten through 12th grade level, it's evident that the current U.S. system is not adequate. Between the years of 2013 and 2015, the national reading scores in the U.S. were

either stagnant or decreased for 4th and 8th graders.[9] Additionally, math scores for the 4th, 8th, and 12th grades also decreased.[10] Since early education lays the foundation for future success in learning, the stagnation or decrease in test scores is alarming.

In terms of higher education, an average of 33% of first-year college students drop out during their Freshman year.[11] While there are a number of personal reasons that can motivate someone to leave college, and a combination of factors determine whether a student can achieve a high test score, clearly something is malfunctioning within the U.S. education system.

2.4. The Culture of Learning

Cultural incentivization plays a role in knowledge attainment and academic success. Singapore and Japan ranked the highest in the 2015 version of the Programme for International Student Assessment (PISA) science component. Singapore also scored first place in the mathematics and reading sections with Hong Kong also ranking second in both. The only European countries who ranked in the top 5 for any of the tests were Finland (science and math), Ireland (reading), and Estonia (science).[12] Meanwhile, the U.S. lags far behind in science (24th place), mathematics (38th place) and reading (24th place).

But, why does Singapore dominate the international assessment ranking? They have rightly connected education with increased economic prosperity via raising the standard of living.[13] Also, Singapore sets high standards for new teachers entering the field by recruiting the top 5% of graduates from their centralized teacher education system, National Institute of Education.[14] It's also pertinent to keep in mind that the total population of Singapore, 5.6 million[15], is merely a fraction of the U.S. population, 326 million.[16]

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[9] U.S. Department of Education. (2017). Digest of Education Statistics: 2015. Available at: https://nces.ed.gov/programs/digest/d15/

[10] Ibid.

[11] U.S. News & World Report. (n.d.). Freshman Retention Rate: National Universities. Available at: https://www.usnews.com/best-colleges/rankings/national-universities/freshmen-least-most-likely-return

[12] Desilver, D. (2017). U.S. students' academic achievement still lags that of their peers in many countries. *Pew Research*. Available at: http://www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/

[13] Coughlan, D. (2016). Pisa tests: Singapore top in global education rankings. Available at: http://www.bbc.com/news/education-38212070

[14] Ibid.

[15] Singapire Department of Statistics. (2017). Population Trends. http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/population_and_population_structure/population2017.pdf

[16] U.S. Census (2017). Population Clock. Retrieved on October 28, 2017: https://www.census.gov/popclock/

Furthermore, Singapore is far less socially and culturally diverse when compared to the U.S. A majority of Singapore residents are Chinese and Malays, over 87%, while the U.S. attracts immigrants from around the world who speak different languages, thus compounding the complexity of its educational system.

Culturally, the U.S. population is diverse in its view towards the value of increasing one's knowledge. Arguably, the general U.S. enculturation of education is largely focused on becoming the next Steve Jobs, Jeff Bezos, or otherwise leveraging knowledge to become the next billionaire, whether through business, sports, or entertainment. While the school systems work to encourage that learning is a journey rather than a destination, the constant media attention paid to those who "made it big" eclipses the road each successful individual traveled to achieve the current remarkable results.

In contrast, throughout the world, there are 246 million children who do not attend school and only "66% of countries have reached gender parity in access to elementary education." [17] This is yet another example of the importance of creating a culture that not only embraces education but also encourages equitable access to a robust educational system.

Summarily, the variations in internal and external incentive for staying in school throughout the protracted education process largely depends on both microcosmic and macrocosmic influences including the family's regard for lifelong learning, which reinforces self discipline, and society's approach to learning, which requires individualized feedback mechanisms to guide the learner from novice to expert. But, this does not wholly solve the disconnect between the knowledge economy and the often closed world of the system of higher education. And it isn't just problematic in the U.S.

2.5. The Disconnect Between Learning and Earning

Due to the recurring statements from researchers that external incentivization can degrade internal motivation for learning [18], there is an imbalance in the system of learning. Human beings do require a certain amount of "learning is earning" throughout the learning process. And to ignore this essential human psychology while demanding that individuals find their own personal motivation and enjoyment of the learning process stands in opposition to a system that requires students to take classes whether or not they enjoy them.

[17] Bleiker, C. (2017). UNESCO: 264 million children don't go to school. Available at: http://p.dw.com/p/2mO4C
[18] Gneezy, U., Meier, S., and Rey-Biel, P. (2011). When and Why Incentives (Don't) Work to Modify Behavior. *Journal of Economic Perspectives*, Volume 25, Number 4, pgs. 191-210. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.298.6658&rep=rep1&type=pdf

Given the increasing costs of attending college, it is prudent for students to ask, "What will be my return on this investment?" Student debt in the U.S. is at an all time high with the average monthly payment being $351.[19] In the U.S. and throughout Europe, the young, educated, and numerous population of Millennials still struggle to find work.[20] [21] Meanwhile, a majority of the higher paying jobs fall under the "knowledge worker" mantle within the medical, technical, and enterprise realms, [22] [23] [24] many of which require education beyond a Bachelor's degree.

There's a disconnect happening between the "choose your passion" and what the market demands in terms of securing employment after graduation. Additionally, there still exists a long delay between the academic journey and when the student can begin to earn a living within the knowledge economy. Though learning for learning's sake is laudable, at the end of a terminal degree the student needs employment to feed, clothe, and house themselves. The rise of massive online open courses (MOOCs) is an attempt to mitigate the problem. But, is it a solution?

2.6. MOOCs: Where Digital Education Falters

Variations of distance education have been in existence since the late 19th century. Beginning with correspondence courses, where educational materials were transmitted between teacher and student via the postal service, the digital era has adapted and transformed this concept.

The term massive online open courses (MOOCs) was established by Stephen Downes and George Siemens in 2008.[25] Their objective was to include "technology and

[19] Student Loan Hero. (2017). A Look at the Shocking Student Loan Debt Statistics for 2017. Available: https://studentloanhero.com/student-loan-debt-statistics/

[20] Petroff, A. (2017). Europe's lost generation: Young, educated, and unemployed. Available at: http://money.cnn.com/2017/04/13/news/economy/europe-youth-unemployment-france/index.html

[21] Delorenzo, L. (2016). Millennial unemployment rate more than double national average. Available at: http://www.ballstatedaily.com/article/2016/10/news-millennial-unemployment

[22] Connley, C. (2017). The 25 highest paying jobs in America. Available at: https://www.cnbc.com/2017/09/19/the-25-highest-paying-jobs-in-america.html

[23] U.S. News & World Report. (2017). Best Paying Jobs: 2017. Available at: https://money.usnews.com/careers/best-jobs/rankings/best-paying-jobs

[24] Campus Explorer. (2017). Top 25 In Demand Jobs and Fastest Growing Occupations. Available at: https://www.campusexplorer.com/college-advice-tips/76DB6BDB/Top-25-In-Demand-Jobs-and-Fastest-Growing-Occupations/

[25] Mcgill. (n.d.). A Brief History of MOOCs. Available at: https://www.mcgill.ca/maut/current-issues/moocs/history

connection-making" while moving "learning theories into the digital age."[26] Rather than the artificially imposed connections one is required to make between the input of information and the expected output via traditional institutions, Siemens theory rests on several key principles:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known.
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.[27]

Coursera, Udemy, Udacity, and edX quickly adopted the MOOC model beginning in 2011 and now have 58 million users throughout the world.[28] One quarter of new MOOC users have been added due to regional MOOCs such as China's XuetangX and Latin America's MiriadaX.[29] In terms of number of registered users, Coursera ranks first at 23 million while edX takes second place with 10 million users, and XuetangX takes the third top spot with 6 million users. But, despite the increase in the number of courses and the addition of non-English MOOCs, enrollment is slowing down,[30] while the growth of self-paced eLearning products, in general, is -6.4%.[31]

2.7. Monetization Slows MOOC Growth

Initially, MOOCs offered courses and terminal certificates without a fee. However, over the last five years, all U.S. based MOOCs have included courses which leverage a fee if the

[26] Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. Available at: http://www.elearnspace.org/Articles/connectivism.htm
[27] Ibid.
[28] Marsh, N. (2017). MOOC users reach 58 million globally. Available at: https://thepienews.com/news/edu-tech/mooc-users-reach-58-million-globally/
[29] Shah, D. (2016). By the Numbers: MOOCS in 2016. Available at: https://www.class-central.com/report/mooc-stats-2016/
[30] Ibid.
[31] Metari. (2017). International eLearning Market Research. Available at: http://www.ambientinsight.com/Reports/eLearning.aspx#section1

student wishes to obtain a verified certificate for completing a series of courses. Additionally, Coursera and EDx have partnered with Ivy League and other institutions of higher education to offer terminal degrees in certain disciplines. For example, the University of Illinois Urbana-Champaign is a Coursera partner who offers a Master's Degree in Computer Science in Data Science and allows certain Coursera based courses as one of the accepted prerequisites for program admission. At the time of this writing, the cost to complete the program is $19,200.[32]

While it's reasonable to begin charging small fees for verified certificates, after all MOOCs require at least a small staff for technological maintenance and instructional design for their courses, it's notable that their registered user base isn't growing as quickly as before. The expected drop in eLearning revenues worldwide, $13.5 billion through the year 2021, also provides evidence that the MOOC model isn't meeting the needs of its learners.

2.8. MOOC Attrition Rate is High

Another issue MOOCs face is the astronomically high dropout rate which hovers somewhere between 85% and 95%.[33] While some have voiced a solution to increasing MOOC completion rates is to make sure students "have some skin in the game" through fee based courses, the attrition rates at traditional institutions and the slowdown of registered users contradict this claim.[34] Several reasons for the massive attrition rate have come to light including:

- No real intention for the student to complete the course of study.
- Lack of time available.
- Course difficulty level.
- Lack of support.
- Unrealistic self expectations regarding the course(s).
- Peer review protocol.[35]

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[32] Coursera.org. (2017). Master of Computer Science in Data Science. Available at: https://www.coursera.org/degrees/masters-in-computer-data-science

[33] Lynch, M. (2016). Reducing MOOC Dropout Rates. Available at: http://www.theedadvocate.org/reducing-mooc-dropout-rates/

[34] Lang, D., Chan, H.S., Pask-Aube, C., and Swift, K. (2009). Does the Level of Tuition Fees Affect Student Retention and Graduation? Available at: https://www.researchgate.net/publication/263735066_DOES_THE_LEVEL_OF_TUITION_FEES_AFFECT_STUDENT_RETENTION_AND_GRADUATION

[35] Onah, Daniel F. O., Sinclair, Jane and Boyatt, Russell. (2014). Dropout rates of massive open online courses : behavioural patterns. *In: 6th International Conference on Education and New Learning Technologies*, Barcelona, Spain, 7-9 Jul 2014. Published in: EDULEARN14 Proceedings pp. 5825-5834.

A majority of the MOOCs are designed as information or knowledge transmission with feedback limited to auto scoring of multiple choice questions or a peer review of coursework. Yet, learners need feedback that is specific to their level of understanding. Peers who are taking the course might have some insight as to why an answer is correct, but their pedagogical experience is definitively lacking.

The process of learning requires direct interaction with the subject matter expert, in this case the instructor, and recent research supports this. In a study conducted by Kate, et al., interaction with the instructor was shown to have a direct effect on student retention rate and the likelihood of student retention increased as the amount of instructor-student interaction increased.[36]

2.9. Feedback, Incentivization, and Peer Learning

Though MOOCs have the flexibility of continuously adding new courses which reflect the demand within the knowledge economy, they lack dynamic feedback protocols that are timely, thorough, and tailored to the individual learner. Understanding why an answer was incorrect reinforces essential concepts. Formulating questions and having them answered by the instructor directly also furthers metacognition as, through this question and answer process, the learner becomes aware of what they know, what they do not know, and what they need to know in order to move forward in their learning efforts.

Indeed, learning is both a group and individual system. Other students may bring questions to light that others have not considered. A dialogue between learners and the teacher extends the meaningfulness of the topic through discussion regarding personal or practical experiences and how they relate to the new knowledge. Certainly, finding others who share an interest is a form of cultural incentivization, thus providing additional internal motivation to complete the learning path. External incentivization cannot be ignored.

Though traditional universities offer the promise that students who complete terminal degrees are more likely to earn a higher salary, such promises are delayed through the set of lengthy course requirements that span several years. In the meantime, unless the students are already working in their industry of choice, the knowledge economy is quickly surging forward. This translates into students exiting college still behind the knowledge economy curve as technology has already progressed. Many learners drop out of school due to

[36] Hone, K.S. and El Said, G.R. (2016). Exploring the factors affecting MOOC retention: A survey study. *Computers & Education*, Volume 98, pgs. 157-168. Available at: http://www.sciencedirect.com/science/article/pii/S0360131516300793

financial concerns or, in the case of MOOCs, the certifications aren't highly regarded by employers. While the MOOC platforms do offer courses that have greater accessibility in terms of registration and quickly beginning the learning path, there is still a financial outlay that hasn't proven to be the "skin in the game" incentive needed to decrease attrition rates.

Summarily, for eLearning to succeed, it must offer a combination of internal and external incentivization, robust feedback protocols that reinforce a learner's unique internal learning matrix, and a sense of community which brings people together through shared interests. As such, we've created the PeerBuds Knowledge Economy blockchain solution that combines shared learning, external and internal incentivization for both teacher and student, as well as meaningful feedback protocols.

3. Peerbuds Solution: Knowledge Economy

The knowledge economy makes it possible to earn credits for learning that happens anywhere, even when you're just doing things that you love.

We believe that knowledge has become the primary indicator of a society's growth and its potential. It must thus be the resource that drives the modern currency. Once we have a protocol to objectively measure and verify an individual's knowledge and its contribution to the global knowledge pool, we can create an economy that rewards its people based on the value they add to our evolving human knowledge.

Peerbuds is an open decentralized protocol that tracks everything you have ever learned in units called Gyan and rewards it with tokens called Karma.

Our objective is to:

- Keep an unbiased track of continuous learning activities. The future of learning is unbounded where learning will happen not just inside classrooms and at specific intervals. Peerbuds helps build your learning ledger throughout your life.
- Create free platforms for learning by building the first workable pay it forward model for education. Since teaching actions are quantified and recorded immutably and in a globally accepted standard on the blockchain, its value can now be exchanged for your learning goals.

- Create a global standard for tracking an individual's knowledge throughout their learning journey. Peerbuds is creating a global ecosystem of online and offline partners that will plug into the blockchain to record the learning activities of their peers and create incentive and reward programs around their Gyan score.

In the decades ahead, teachers will evolve to become mentors who will embark on a mission of co-learning with their students, a path in which learning and teaching happen at the same time and for both participants.

3.1. Learning is Earning - The Idea Validation

The Institute for the Future (IFTF), in partnership with the ACT Foundation, developed the "Learning is Earning" road map as an essential concept of the knowledge economy. We believe that PeerBuds embodies this function at the highest level. Specifically, our platform is designed to revamp an already evolving educational ecosystem. As the primary educational paradigm shifts to one of co-learning, PeerBuds wants to ensure that alongside this co-learning, all our users are also being awarded for the learning that takes place.

Another concept from the IFTF and ACT roadmap, which is critical to our platform, is the concept of working learners. One of the key deficiencies in traditional educational models is the teaching and learning methods used throughout K-12 and postsecondary institutions. Attempting to apply a one size fits all learning protocol does not meet the needs for a growing majority of the world's population.

However, in a knowledge economy, it is necessary for members of society to experience continuous learning. The current generation of students embody this concept as they are working learners who seek diverse learning and working experiences through various stages of their lives.[37] The future of learning is in perpetual evolution through the study of educational psychology. Continuous research is leading to the creation of new pathways to success, positive changes in life satisfaction and, ultimately, a revamped economy.

4. Peerbuds Protocol

The peerbuds protocol is a set of APIs that provide all the functions required to create unique identities for people on the blockchain, creating teaching smart contracts and

[37] IFTF.org. (2017). Learning is Earning in the National Learning Economy. Available at: http://www.iftf.org/learningisearning/

interacting with them all along the teaching process. It also provides functions to build communities and continuous feedback loops. Finally, the protocol includes various micro-services like rewards management, reputation management, identity management, security etc.

4.1. Peerbuds API

To integrate the peerbuds protocol, any existing web platform needs to implements the following basic functions from our API stack:

4.1.1. User wallet registration

As part of their existing registration process, platforms need to capture the public ID of any existing Ethereum wallet of their users. Platforms can also opt to generate new wallets for their users on sign-up and the protocol will link a new network public ID with the user's account.
Platforms might also want to save the encrypted passphrase of their users' wallet accounts and link it to the hash of their existing password so that users don't have to separately log into their wallets every time they perform a blockchain transaction.

4.1.2. Create teaching contracts

Whenever a new class or any process that involves learning is created on the platform, it needs to create a new smart contract with the required details. Some additional details platforms will need to capture in this flow include the estimated Gyan value of this class and assessment rules.
An important point to note is teaching contracts require the class details to be immutable. To avoid discrepancy with data on the blockchain and within their centralized databases, platforms must implement a versioning system when changes are made to a particular class.

4.1.3. Student participation

When students sign-up for a class, platforms will use this function to execute the corresponding smart contract of the class with the public ID of the student.
Another important step of this flow is burning Karma tokens from the student's wallet. The protocol function will automatically check for enough Karma balance in the user's wallet and

move the decided value to a null wallet. However, platforms need to use the Karma-Gyan function to show the amount of Karma to be burned before participants sign-up.

4.1.4. Account Profiles

Platform must use the profiles function to fetch and display a user's learning journey, teaching journey and Karma rewards in a particular or multiple topics. This information must be publicly visible without having users to log into the platform. To reduce network load, platforms can keep a local copy of this information in their databases which will need to be refreshed before they expire on before it as the platform desires.

4.1.5. Upvote contract, Review contract

These set of functions are to be used by the platform to create an upvote smart contract for any class by a non-participating user or to create a review smart contract by a participating student.
The protocol automatically calculates current voting power in each case based on user action and assigns it to the contract. Platforms can save this calculated value locally from the response.

4.1.6. Contract Profiles

The profiles function for a teaching contract or an upvote contract or a review contract fetch the aggregated details about all the interactions with the contract which must be shown on the contract page and list pages.

4.1.7. Assessment

When a class is considered complete, platforms must implement the assessment function to record grades for all students of the class by the teacher and record teaching grades for the teacher from all students. Only after this assessment function is executed will the contracts execute their Gyan transfers to both teacher and student wallets.

4.1.8. Other functions

There are several other functions that can be implemented by the participating platforms to provide a seamless and intuitive flow to their students and teachers.

4.1.9. Protocol Services

There are several microservices running behind these functions and are responsible for specific response parameters in these functions. Platforms are agnostic to the execution of these services.

4.2. Peerbuds Web Platform

As part of first implementation of peerbuds protocol, we have built a web platform at peerbuds.com which is similar to a MOOCs platform with additional features and incorporates the peerbuds protocol for its teachers and students to build their knowledge ledger.

The web platform incorporates the following features for the purpose of creating an incentivized 'Learning is Earning' environment:

Experiences: Experiential learning in the physical world with a feedback mechanism or review system which allows learners to review their learning experience. In order to leave a review the student must attend at least one live session, whether online or in person, with the teacher.

Communities: Groups of members who have shared interests and wish to discuss what they've learned or wish to learn via the peerbuds protocol. Also has a Quora style question and answer feed where participants can earn Gyan and get rewards by asking the right questions or by answering the most popular questions.

Classes: Completely online teaching with at least one live session between the teacher and students.

Peers: User profiles with complete details on a user's learning and teaching journey and their Karma rewards. Also has an option to join peer-session smart contracts listed by a teacher.

Console: Personal dashboard for students and teachers to manage their teaching and learning journeys, manage wallet balances, create new content and a lot more.

Inbox: Real time chat rooms for participants of a class or for private messaging amongst platform users.

4.3. Token Mechanics

4.3.1. Gyan - The Unit of Knowledge

'Gyan' is the standard unit for knowledge and a unit of Gyan is equal to an hour of learning in any particular subject. You can earn Gyan from a formal institution like a school or your workplace. You can even earn Gyan from individuals or informal groups like a community center or an app.

Every Gyan that has ever been earned becomes a permanent part of a growing public record of a collective learning and working. Although Gyan is not a tradeable cryptocurrency, it is still an ERC-20 token on the ethereum blockchain.

Every user account (student or teacher) has 2 types of Gyan balances:

1. Floating Gyan
2. Fixed Gyan

The Gyan value of every content gets decided by the teacher based on their assumption of how much knowledge is being shared and the time students will spend on learning. The total Gyan value a teacher decides to put on any new content cannot be greater than the total fixed Gyan balance of the teacher. When the class has been taught and its assessment completed, either online or offline, some or all of this Gyan is earned by both the learner and the teacher.

This new Gyan gained by the teacher and the student gets added to the floating Gyan balance under each of their accounts. At the end of the week, this floating Gyan balance gets moved to their fixed Gyan balance. This splitting into floating and fixed Gyan is to make sure the amount of Gyan earned every week remains transient for 7 days and its true value can be applied back to the ecosystem only in the weeks to come. This floating Gyan is also a factor to deciding the user's rank within the ecosystem at the end of the week and decides his stake in rewards.

The amount of fixed Gyan in any account can never go down; it can only increase. Gyan is also a user's stake on the platform. The higher the amount of Gyan they have, the higher the power of their vote for content and price curation.

4.3.2. Karma - The Financial Instrument

Karma is a cryptocurrency (ERC-20 token) that learners need to burn every time they participate in a course. To offset this burning, a fixed number of new tokens are minted every week and awarded to all accounts based on their floating Gyan ranking of the said week. If students run out of Karma, they can add more to their wallets by buying them from any participating exchange. Another way of adding Karma to their wallet is by teaching something and getting ranked higher that week for more rewards.

Within peerbuds, Karma's value is linked to the weekly increase of Gyan. If more Gyan is earned by learners in a week, the demand for Karma is higher and so is its value. Also the value of Karma will increase if the knowledge content in the ecosystem is of better quality. Thus, the creators are being incentivized for creating high quality courses to increase the demand for Karma and thus increase the value of currency they hold.

Karma is the world's first currency that is valued on collective knowledge gain in the world. As long as the collective knowledge of humans increase, the value of Karma will sustain.

The demand for Karma will be driven by the fact that its required by students before any learning can be tracked.

The freshly minted Karma every week is distributed to users based on Proof of Work which in our case is proof of learning through floating Gyan balance.

In the peerbuds protocol, the PoW distribution is based on subjective proof of work which is better than fully objective proof of work algorithms like mining where one has to find prime numbers. This does not have any positive outside impact. A subjective proof of work like Learning or Teaching or finding solutions through questions and working on projects is more valuable to the society.

The applications of a currency implementing subjective proof of work are far wider than any objective proof of work system because they can be applied to build a community around any concept that has a sufficiently defined purpose. When individuals join a community they buy into a particular set of beliefs and can vote to reinforce the community values or purpose.

The value each currency achieves depends upon the demand for influence within a particular community and how large the market believes each community can get. Unlike prior systems,

subjective proof of work enables a community to collectively fund the development of whatever it finds valuable and enables the monetization of previously non monetizable time.

4.3.3. Relationship between Gyan and Karma

When a user looks at any class he gets to see the 'Gyan' value he can earn from that class and the amount of 'Karma' needed to be burned for it. The amount of 'Karma' to be burned per class will be decided by the protocol based on the rate of collective Gyan increase in the ecosystem over past week. The target of this decision is to make sure almost the same amount of Karma is burned every week as is being minted fresh for rewards distribution. This is done by first calculating the total Gyan earned every week over the past few weeks and extrapolating it for the current week. Since the number of new Karma to be minted is fixed, the result now is simply a function of measuring how many Karma per Gyan is to be burned to reach the fixed number.

$$\text{For every unit of Gyan, burn } \frac{\text{new Karma to be minted}}{\text{estimated Gyan earning this week}} \text{ Karma}$$

If the total Gyan earning on the platform goes up, the number of Karma's that get burned goes down. This is because more Gyan increase means more knowledge exchange or higher quality knowledge exchange on the platform which would mean a higher demand of Karma amongst learners and hence higher value per unit of Karma. So, learners can access more content with the same amount of Karma if the amount of Gyan increase on the platform goes up. This is a way of incentivizing learners to invite more people on the platform and bring up the level of knowledge exchange.

4.3.4. Distributing Karma Rewards

There are two ways people can get involved with a cryptocurrency community: they can buy in, or they can work in. In both cases users are adding value to the currency, however, the vast majority of people have more free time than they do spare cash. Imagine the goal of bootstrapping a currency in a poor community with no actual cash but plenty of time.

If people can earn money by working for one another then they will bootstrap value through mutual exchange facilitated by a fair accounting/currency system. Distributing a currency to as many people as possible in a manner that is generally perceived as fair is a challenging task.

The tasks that can be entirely evaluated by an objective computer algorithm are limited in nature and generally speaking have limited positive external benefits. In the case of Bitcoin-style mining, it can result in the production of specialized hardware and cause people to invest time developing more efficient algorithms. It may even help find prime numbers, but none of these things provide meaningful value to society or the currency holding community at large.

More importantly, economies of scale and market forces will end up excluding everyone but experts from participating in this kind of distribution. Ultimately, computation-based mining is just another way of buying in because it requires money to pay the electric bill or the development of hardware necessary to do the work.

In order to give everyone an equal opportunity to get involved and earn the currency people must be given an opportunity to work. The challenge is how to judge the relative quality and quantity of work that individuals provide and to do so in a way that efficiently allocates rewards to millions of users. This requires the introduction of a scalable voting process. In particular it requires that authority to allocate funds must be as distributed and decentralized as possible.

The first step in rewarding millions of users is to commit to distributing a fixed amount of currency regardless of how much work is actually done or how users vote. This changes the question from being “Should we pay?” to “Whom should we pay?” and signals to the market that money is being distributed and is being auctioned off to whoever “bids” the most work. This is similar to Bitcoin committing to award 50 BTC to whoever finds the most difficult hashes. Like Bitcoin, all work must be done prior-to payout and nothing should be paid speculatively on the promise to do work in the future.

The next step is to reward everyone who does anything even remotely positive through the platform. This is accomplished by ranking all work done and proportional value distribution. The more competitive the market becomes, the more difficult it becomes to earn the same payout.

All work done within the peerbuds protocol is calculated by the floating Gyan balance in every peer’s ledger that week. So peers are ranked every week based on their floating Gyan value and are eligible to receive the proportional Karma rewards.

4.3.5. Why are both Gyan and Karma needed?

Karma is our answer to the implementation challenges of a knowledge economy. For any sustainable economy there has to be a resource in limited supply and consistent demand which makes it valuable. This value of the resource can then be used to incentivize the community for their work in the economy. The higher the gap between the supply and demand of this resource, the more its value to the community. Since knowledge is renewable and theoretically unlimited in supply, one can never create a sustainable supply-demand gap. Also, in a learning transaction, no party loses knowledge, rather both gain out of it. So its clear 'Gyan' - the measure of knowledge cannot be the currency with any economic value.
Gyan is measure of one's knowledge which is being acquired from multiple sources in a continuous manner. The Gyan value of every peer never decreases and it only goes up as one continues on his learning journey. This creates an unlimited supply of Gyan and if it were to be used in exchange of services and products, there would be no limit on the amount of consumption against your existing Gyan value.

To introduce a fair limit on the amount of consumption power acquired against the value of Gyan anyone holds, an ERC-20 Token Karma is used. The amount of Karma one earns is proportional to the amount of incremental Gyan received every week and this token can be exchanged for various other purposes including getting more Gyan.

At the time of signing up for any learning, a peer has to burn his Karma tokens as decided the protocol based on weekly knowledge gain. When asking questions within a community, a peer has to burn his Karma tokens calculated based on the Gyan value he wishes to attach to that question.

4.3.6. How to earn Gyan?

There are several ways for teachers and students to earn Gyan. The most important ones are:

- If they teach or participate in a class whether online or offline
- Ask questions or answer them within a community

a. Participate or teach in a class

When a teacher creates a teaching contract, they put a Gyan value on that class. At the end of the class, all students within the class are assessed by the teacher and

based on this assessment, all or a portion of this Gyan value is earned by students. A sum of all the Gyan earned by their students is also earned by the teacher as teaching itself as a form of mastering an art.

b. Participate in a community

When users post questions within a community they can attach a Gyan value to it which will act as a bounty for other users to answer that question. In doing so, the user also has to burn a relative amount of Karma from his wallet. The technical interpretation of this is creating a question smart contract. This contract gets executed either when another user answers the question.

When a question is answered, its attached Gyan value is added to 'Floating Gyan' balance only after an answer is accepted or 24 hours, whichever is earlier. After 24 hours, if there are more than one answers to that question and none marked correct, the one with the highest upvote receives all of the Gyan. If there are multiple answers with the same upvotes or all with no upvotes, then all respondents earn equal share of the questions Gyan value.

As a community oriented protocol, we want to promote asking public questions that would be of interest to the wider community. Basic or personal questions are encouraged to be asked within personal communication tools such as private video and chat. For this reason, the model incentivizes asking questions that are more likely to be upvoted by the curators and most likely to receive a correct answer.

Every time an answer is marked correct, or after its acceptance time expires, if there is at least one non-flagged answer to a question, the Gyan value attached to the question gets added to both the answering user's account and the original poster's account. A question can have only one answer marked correct by the user asking it.

If the original poster flags every single answer to their question, none of the peers who gave those answers would gain the Gyan value and neither would the original poster gain any Gyan value from it. Once a question has been posted, it cannot be deleted.

4.3.7. How to earn Karma?

Earning Karma through the peerbuds protocol is only through weekly rewards. Users within the ecosystem are rewarded with Karma for any proof of work that adds value to the ecosystem. The following actions are rewarded with Karma:

1. Increase in Gyan balance over last week because of teaching, learning, asking or answering questions.
2. Upvotes on classes, comments, replies, questions or answers.
3. Curation of Gyan value of teaching contracts from others users.

Based on their increase in Gyan and the popularity score of their upvoted content every week, users are ranked on content reward and curation reward distribution scales respectively. From within a fixed pool of Karma rewards created every week, the exact distribution pattern in each of these scales is based on a highly elliptical curve shown below.

[TBF - Curve distribution]
This means that 90% of total Karma rewards are given to top 10% of rankers.

4.4. Assessment Model

A core part of creating and executing smart contracts is the assessment model. As part of subjective proof of work model adopted by peerbuds protocol, all learning that gets recorded on the blockchain needs to be quantified in the most justified manner. While a teaching contract created by the teacher could be valued at a certain amount of Gyan, in reality the amount of knowledge gained effectively by every student from the class would be very different. This difference between the amount of data that was passed on by the teacher and the amount of information gained by the student is commonly known as the entropy of that particular transaction.

The factors affecting the information gained by a student are several. From a student's past learning history to their grasping ability to their attention span while learning this class, a wide range of factors come into play. The field of psychometrics deals with trying to definitely calculate the amount of information or knowledge gained by a student. While a lot of research has gone into this field and several models built around trying to measure the actual knowledge gain of an individual, none of the models cover all possible aspects of this

complex transaction and even yet, are not ready to be rolled out to real life use cases in a production environment.

The peerbuds protocol was built to be able to incorporate some of all of these psychometric tests if and when they reach production readiness at scale. However, as of today, to be able to quantify the entropy of every learning transaction, the protocol applied the next best available models in society today. When creating a teaching contract, teachers can decide to implement from one of these models.

4.4.1. Teacher Assessment

One of the most important models of assessing the amount of knowledge gained in a class by students is teacher assessment. There are various ways teachers currently assess students within a class like assignments, projects, tests. Even within these modes of assessment, the actual implementation can range from formative, summative, diagnostic, objective, subjective, informal, formal, internal or external. The peerbuds protocol is agnostic to the actual mode and medium of assessment implemented by a teacher.

While creating a teaching contract, teachers have to clearly list down the rules of assessment, meaning how the cumulative result of these assessments affect the value of Gyan earned by the students. As an example, if a teacher decides to adopt the grade format for assessment results, they'll have to list down how each possible grade links to the percentage of Gyan earned by a student. Or if the teacher decides to adopt the percentage format for assessment results, those directly relate to the percentage of Gyan earned by a student.

At the end of the class, a teacher only has to record the result of their assessment for each student and the contract will execute the listed rules to calculate the exact amount of Gyan earned by each of their students.

While creating contracts, teachers can also decide to allocate a percentage of Gyan value to non education assessment like attendance or commitment by students or even participation within the community. During final assessment at the end of the class, data for these areas of performance will have to supplied by the platform to calculate the final Gyan earned by students. This feature enables students a guarantee of a certain minimum quantity of Gyan free from any human evaluation and based solely on their actions tracked by a platform.

4.4.2. Peer Assessment

Peer assessment is another important model used by teachers to assess the amount of knowledge gained by each student. The peerbuds protocol allows for teachers to select this assessment model as part of creating a contract and when its time to complete a course, all students are required to assess their peers based on the grade format decided by their teacher.

4.4.3. Third Party Assessment

With teacher and peer assessments, there is always a risk of collusion and bias especially in hyper local teaching setups where the class sizes are small and the teacher and students all know each other well. Even in other scenarios, like MOOCs courses there are challenges like unavailability of resources or ability to perform unbiased assessment or even the problem of certain employers not valuing teacher assessed or peer assessed learning.

To offset these challenges, the peerbuds protocol also allows teachers to set up their teaching contracts with third party assessment and then selecting the grade format along with its rules. When the class is complete, the request to input the assessment result for each student is sent to the concerned third party assessor and that decides the final value of Gyan earned by each student. The process of performing the actual assessment by third party is not within the purview of the protocol, only the final results will be taken into consideration for recording on the blockchain.

As the ecosystem grows, any third party assessment company or group or individual can join to be a part of the ecosystem. They will need to register a unique identity on the blockchain and implement the assessment function of the API within their processes to be able to input results and get reminders for their due assessments.

4.5. Rewards Model

4.5.1. Karma Rewards Pool

Total newly minted Karma token every week is 961,538. Rewards distribution will take place every Monday at 3pm and the total rewards pool gets divided into the following smaller pools:

- 65% (625,000) tokens reserved for knowledge pool

- 15% (144,231) tokens reserved for curator pool
- 20% (192,307) tokens reserved for block producer pool

4.5.2. Knowledge Rewards (65%)

This is the biggest reward pool and every direct teaching and learning recorded on the peerbuds protocol is rewarded from this pool. Teaching is the most important and the biggest value add for the ecosystem and it must be rewarded handsomely. As previously explained, teachers always earn more Gyan than their students and this gap increases as there are more students in every class. So at the end of every week when gyan earners are ranked, most of the top rankers will most likely be teachers.

With this observation, an elliptical distribution curve is applied to the ranking scale and about 90% of the rewards are given to the top 10% of the rankers. This makes sure that while most of the rewards are given to teachers for their value add, students also get some rewards as part of the long tail of the curve.

One of the primary reasons for doing this is the fact that when the value of Karma increases over time, teachers will have earned enough value from rewards in return for their teaching that they would have no real need to charge any other FIAT currency from their students.

4.5.3. Curation Rewards (15%)

Every action within the protocol that generates value for its users needs to be rewarded. Discovering good quality classes and getting the correct gyan from those classes is of high value to every student in the world. So, every user curating high quality classes and making sure it has the right gyan attached to it are rewarded for their efforts. This will encourage more and more people to curate classes and their gyan value.

4.5.3.1. Non Participant Review (35%)

Non participant curation is done in the form of Upvotes. The value of each vote is weighed by the fixed gyan balance of that user. The higher the gyan, the higher his/her vote will count towards the final popularity of any content.

Peers can upvote or downvote on individual contracts created peerbuds protocol including classes, questions, answers, comments and replies. Each vote is weighed based on the following factors:

- Order of vote: Early votes when the content is still new will have more value.

- Discovery threshold: Votes made in the first 30 mins will have their value delegated to the teacher on a pro-rata basis. This means a vote made on 15th minute after content was posted will give 50% potential rewards to the teacher and 50% potential rewards to the curator.
- Curator's Gyan Value: The value of each vote is weighed by the fixed gyan balance of that user.
- Each user's voting power will go down after every successful vote in a sharp curve and will slowly increase over a period of time. The decrease in power will be instantaneous but the increase will be slow. If a peer votes too often without waiting for the cool off period, his voting power will drop down to 0. After every 24 hours, the voting power will be reset to 100%.

  [TBF - Voting diagram here]

4.5.3.2. Participant Review (35%)

Participant curation includes the teacher and students reviewing each other. All teachers and students getting reviews over the week are ranked based on their received reviews and payouts made to them at the end of the week. User flow in terms of participant curation is as follows:

- Teacher gives stars (up to 5 stars) to each student with a textual review.
- Students give stars to the teacher (up to 5 stars) with a textual review.
- Students and students earn Karma rewards from the participant review pool based on their ranking that week.
- Teachers ranking is based on their aggregate star rating from all students over the week.
- Both of teachers and students become eligible for payouts only if they have both voted for each other.

4.5.3.3. Review of Contract Value (30%)

Users can make a counter quote on every contract's listed Gyan value. The teacher would see a histogram of all suggested counter quotes and can decide to alter the value of his contract once every week. If the teacher changes the price of his content, all users who put in a counter quote will be rewarded based on their counter quotes proximity to the new Gyan value of that content. The value of their quote eligible for rewards distribution will be based on the following factors:

- Curator's Gyan value.

- Discovery threshold: Votes made in the first 30 mins will have their value delegated to the creator on a pro-rata basis. This means a vote made on 15th minute after content was posted will give 50% potential rewards to the creator and 50% potential rewards to the curator.
- How far off the user ranks in terms of his quote's proximity to the contract's new gyan value.

4.5.4. Rewards Payout

Rewards are paid out to teachers & curators at the end of every week based on their floating gyan balance, value of their vote and the popularity score of each content. Rewards are distributed in a high elliptic curve pattern where the top 10% of the popular contents receive almost 90% of the rewards while the rest is distributed to the long tail (the rest 90% of the content).

Reward payouts for curation are delayed by a Gyan-weighted average of 24 hours from the time each vote was cast. Once a payout is made to the user, the votes are reset to 0. If votes are received after the payout, the process is restarted.

One of the primary goals of the Peerbuds reward system is to produce the best discussions on the internet. Each and every year 80% of the market capitalization of Peerbuds is distributed to users submitting, voting on, and discussing teaching contracts. At the current size of Bitcoin this could be as much as 14 million dollars per day being given to top teachers and curators. The actual distribution will depend upon the voting patterns of users, but we suspect that the vast majority of the rewards will be distributed to the most popular content.

Peerbuds weighs payouts proportional to n^2 the amount of Gyan voting for a post. In other words, post x would receive a payout proportional to: votes[x]^2 / sum(votes[0...n]^2). Zipf's Law is one of those empirical rules that characterize a surprising range of real-world phenomena remarkably well. It says that if we order some large collection by size or popularity, the second element in the collection will be about half the measure of the first one, the third one will be about one-third the measure of the first one, and so on. In general, the kth-ranked item will measure about 1/k of the first one.

Taking popularity as a rough measure of value, then the value of each individual item is given by Zipf's Law. That is, if we have a million items, then the most popular 100 will contribute a third of the total value, the next 10,000 another third, and the remaining 989,900 the final third. The value of the collection of n items is proportional to log(n).

The impact of this voting and payout distribution is to offer large bounties for good content while still rewarding smaller players for their long-tail contribution. The economic effect of this is similar to a lottery where people overestimate their probability of getting votes and thus do more work than the expected value of their reward and thereby maximize the total amount of work performed in service of the community.

The fact that everyone “wins something” plays on the same psychology that casinos use to keep people gambling. In other words, small rewards help reinforce the idea that it is possible to earn bigger rewards.

4.6. Block Producers

Peerbuds block producers are basically microservices running as part of protocol responsible for collecting and recording all token and smart contract transactions on the ethereum blockchain.

The peerbuds protocol is built on top the ethereum blockchain and every Karma or Gyan transaction, every teaching and question smart contract created as part of ecosystem becomes a transaction on the ethereum blockchain. However, there is a monetary cost involved in recording transactions on ethereum in terms of Gas value to be paid in ethers. Also, because of how blockchain works, transactions created by users take time to be picked up by an ethereum block producer and be included in a block to be put on the chain.

This is done through an asynchronous process of microservices within the protocol that record every transaction once they are received from any of our API functions and queue them to be recorded on ethereum. The response of our APIs does not wait for a confirmation of having recorded the transaction on ethereum but contains a promise with an address of the transaction which can later be queried to get its status.

If there are sequential API transactions that depend on the successful execution of the preceding method, our block producer microservices implement sequential queuing of requests and roll back in case of failures. The block producer micro-service can also take in http hooks as part of the transaction request which will be called once the transactions is successfully placed on ethereum.

To cover the cost of running these microservices and the cost of Gas spent on recording the transactions on ethereum, a total of 20% of the Karma rewards every week are reserved for

these block producers which are currently owned by Peerbuds Inc. As the ecosystem bootstraps, the dollar value of Gas spent on recording these transactions on ethereum will be much higher than the corresponding value of Karma rewards received as tokens. This difference in dollars will be borne by Peerbuds as part of their long term investment into the value of Karma tokens as a sustainable currency for the world.

4.7. Token Flow

The peerbuds protocol is built around two unique ERC-20 tokens one of which [Karma] is a tradeable cryptocurrency. At the core of the protocol is the understanding that Gyan tokens are unlimited in supply and are earned by users for any work done that increases the value of the ecosystem; while Karma tokens are always rewarded to users based on the amount of work they put in.

Here is an example of how the flow of tokens would work in the ecosystem with three users, Alice, Bob and Chris.

4.7.1. Case Study: A typical week of the knowledge economy

4.7.1.1. Day One - Since the beginning

Let us suppose we have 3 peers Alice, Bob and Chris. Alice is a teacher who has been sharing her knowledge with students for the last 2 years. Since Alice first joined Peerbuds Knowledge Economy, Alice has learnt and taught several topics to other peers and currently has a Gyan score of 1000.

Alice	1000 / +0 GYN	100 KKC

4.7.1.2. Day Two - New Users join the platform

Alice now plans to take an online workshop on 'Photography for Beginners' and decides that students who take this workshop will increase their Gyan by 100.

Bob and Chris have just joined the Peerbuds knowledge economy and have a current Gyan score of 0 (default value) and 10 Karma [ERC 20 Token - KKC] in their wallet.

Alice	1000 / +0 GYN	100 KKC
Bob New	0 / +0 GYN	10 KKC
Chris New	0 / +0 GYN	10 KKC

4.7.1.3. Day Three - Students participate and burn Karma

They decide to sign up for Alice's workshop - 'Photography for Beginners' hoping to learn and increase their Gyan score by 100. For doing so, they will need to burn some of their Karma as decided by current value of Karma (say 10 KKC).

Alice	1000 / +0 GYN	100 KKC
Bob	0 / +0 GYN	0 KKC
Chris	0 / +0 GYN	0 KKC

4.7.1.4. Day Four, Five, Six - Students learn and earn Gyan

Over the next 3 days, Alice, Bob and Chris take part in live sessions, watch recorded videos, work on projects and contribute to discussions as part of the Workshop.

On finishing the workshop, Alice is asked to assess Bob and Chris for their efforts and the learning outcome. Say Bob gets 90% of the Gyan score (+90 Gyan) and Chris gets 60% of the Gyan score (+60 Gyan).

Bob and Chris also get to rate Alice for her efforts in teaching the workshop by giving her 4 / 5 stars and 5 / 5 stars respectively. Since Alice earned 9 stars from her students and was successful in sharing 150 Gyan worth of knowledge, she herself increases her Gyan score by 90 + 60 + 90 = +240 Gyan.

Alice	1000 / +240 GYN	100 KKC
Bob	0 / +90 GYN	0 KKC
Chris	0 / +60 GYN	0 KKC

4.7.1.5. Day Seven - Karma Rewards

After 3 days of efforts from all Peers, a total of 390 GYN was added to the economy. Alice earned most of this GYN while Bob and Chris earned GYN for their assessment.

Coming Monday at 3pm, the Peerbuds economy ranks all the GYN earners of the last week. Alice ranks 1st while Bob ranks 2nd and Chris 3rd. Say from the rewards pool, total of 25 new KKC is to be distributed today and every Peer who got ranked is eligible to receive a portion of this bounty. Based on an highly elliptical curve distribution, Alice gets +15 KKC in her account, Bob gets +7 KKC and Chris gets +3 KKC.

Alice	1240 / +0 GYN	115 KKC
Bob	90 / +0 GYN	7 KKC
Chris	60 / +0 GYN	3 KKC

4.7.1.6. Conclusion

So after a week, Alice has earned GYN and increased her KKC wallet balance by teaching a workshop. Bob and Chris have also earned GYN and got rewarded back with some KKC. All of this without spending any real money while getting global recognition for their efforts.

Bob can now choose to teach his new skill to other Peers by hosting a workshop worth 90 GYN and increase his GYN score and KKC wallet balance even more. This KKC balance can then be burned for more FREE learning in the economy.

Chris can choose to buy some more KKC (say $1 / KKC) from the marketplace and burn it for taking an intermediate level photography experience and increase his GYN score even more before beginning to start teaching.

[TBF - Illustration for full token flow]

4.8. Technical Specifications

4.8.1. Protocol Architecture

The Peerbuds protocol is being built on the most modern and scalable technologies. Our engineering team is comprised of people who have built highly available and scalable cloud platforms from scratch before. The motto of the team is: Provide for a functional experience that is intuitive and intelligent.

Peerbuds uses the Ethereum blockchain and all transactions with the blockchain are handled by a Geth server running as part of the architecture. The framework being used to build our APIs is Truffle. Commands from the API server are sent to the Geth node which then executes the respective smart contracts for individual accounts. The Geth node maintains ether wallet of each individual account on the platform.

We have constructed an architecture that supports high availability and scalability. The architecture is microservices ready from the beginning. Modularity is at the core of our architecture design. The data, compute, view and search layers are separated from each other and exposed as services to other layers. The MVP extensively utilizes Amazon Web Services including Load Balancing, Routing, Compute, Storage, Analytics, Logging and CDN.

Below is a snapshot of Peerbuds platform architecture which shows broad level understanding of various layers and their interactions.

[TBF - Protocol architecture diagram]

4.8.2. Application Interface

One source APIs exposed via RESTful services for our partners to integrate the protocol within their applications. Partly in production.

4.8.3. Compute Layer

Peerbuds runs on NodeJs on the backend for all our core logic which acts as both the data access server and an API server with services exposed for the front-end. NodeJs servers work in a cluster to intermediate and execute all service requests from the search, database and user interface layers. The result of these request is passed to the block-producer layer to be recorded on the blockchain.

4.8.4. Block Producer Layer

Microservices that implement request queuing and sequentially executing the right smart contracts and transactions on the blockchain based on the incoming request.

4.8.5. Data Layer

Peerbuds uses an innovative and highly stable document based database called Neo4j. Neo4j is a graph database that works extremely well with network based products which is ideal for peerbuds. Interactions, states and values in peerbuds are stored as a complex relation of nodes and relationships. These relations also very easily expose developing exchange patterns between multiple nodes on the platform thus improving intelligent user experience. Completed and deployed to production.

4.8.6. Search Layer

The Peerbuds community is based on being able to trade its knowledge with peers who need help. We realize a critical factor in enabling this is providing a highly quick and extensive search experience to our partners. Because of this, Peerbuds uses elastic search across all its teaching contracts to support quick search-as-you-type functionality and did-you-mean functionality. Metadata from all the teaching contracts is indexed to enable an extensive search experience.

4.8.7. Peerbuds Platform

4.8.7.1. Design Philosophy

The beta platform is designed using Material Design philosophy. Our goal is to ensure that user experience is easily accessible and of world class caliber. The team at Peerbuds is

extremely passionate about beautifully designed products that are both visually appealing while creating a positive impact.

We follow a highly minimalistic approach with focus on the most relevant content at the right places. The product is designed around a 'Dynamic UI' approach where the most relevant information shows up at the right place at the right time. The risk of taking this approach is a UI that is too volatile and hurts user experience in terms of relatability to particular screens. Our design team has painstakingly worked on every dynamic UI element to make sure we control the volatility.

4.8.7.2. Frontend

Peerbuds platform uses Angular 5 to serve its user interface and views. It consumes functions and services exposed by the protocol in a secure manner using RESTful standards. Peerbuds platform is built in a way where it can be an example for our early partners to demonstrate and use and benefits of adopting the knowledge economy.

Below are some of the screenshots from currently live peerbuds.com platform.

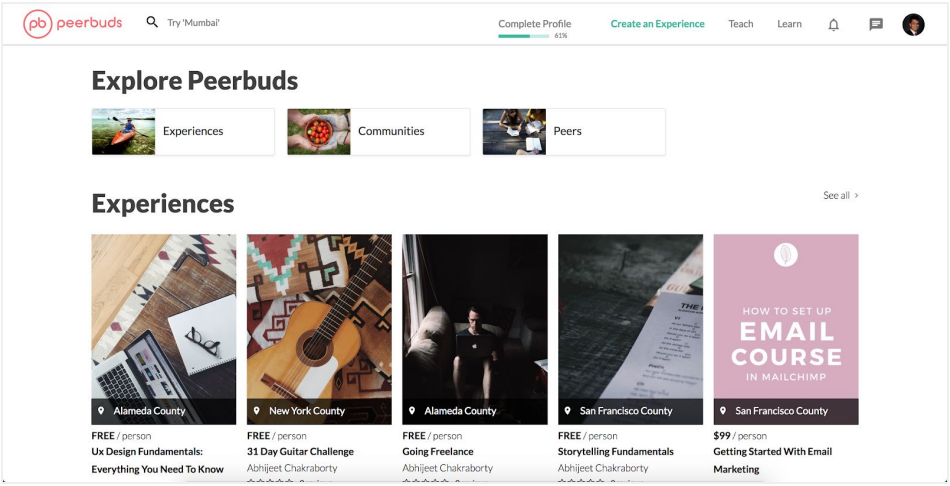


Image 1: Platform home page to explore all teaching contracts

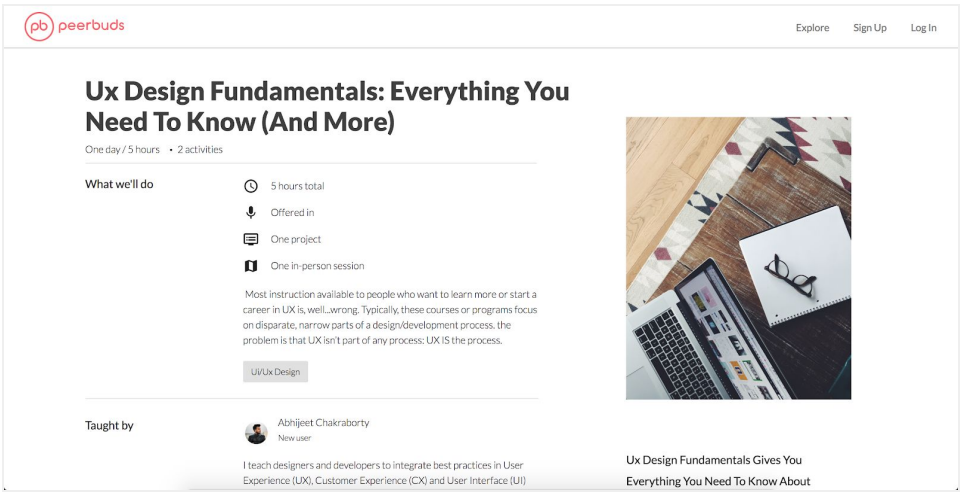


Image 2: A teaching contract page for Experiences

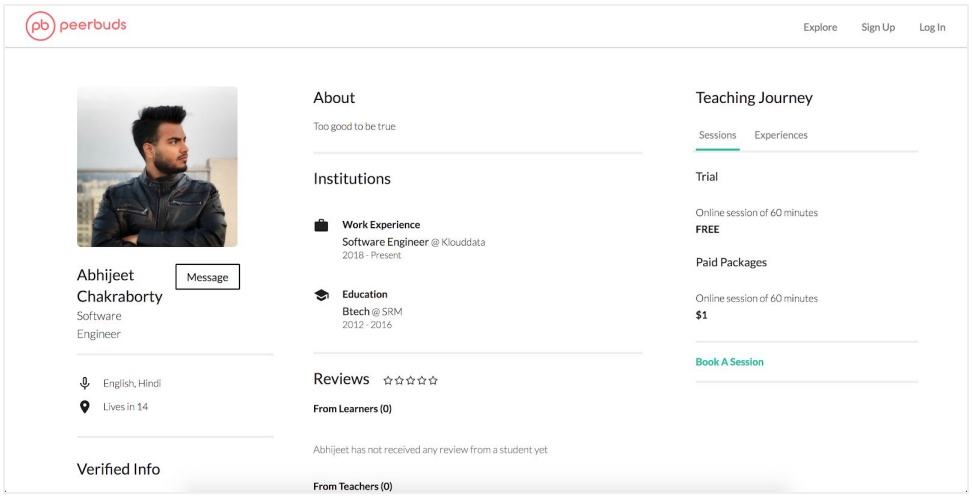


Image 3: Profile page of a peer who teaches and also learns

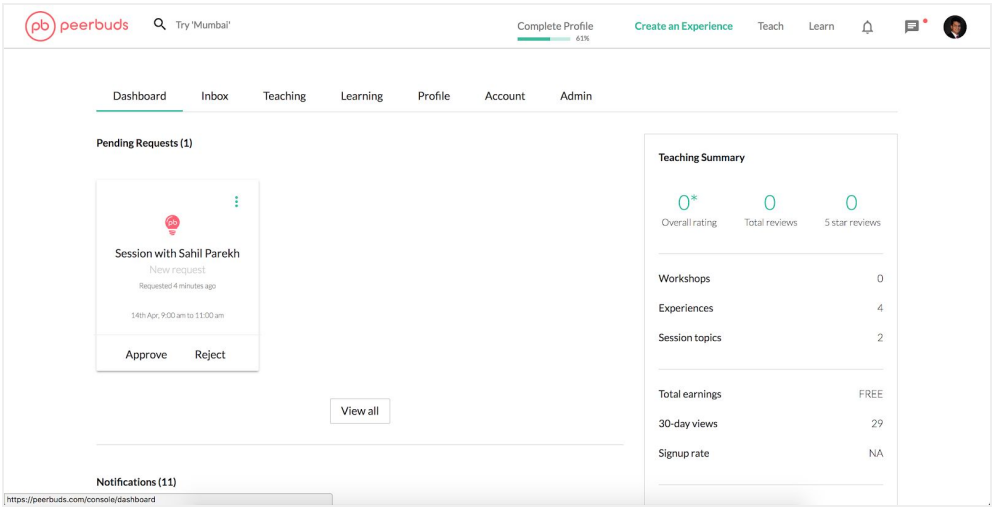


Image 4: Teaching and Learning dashboard

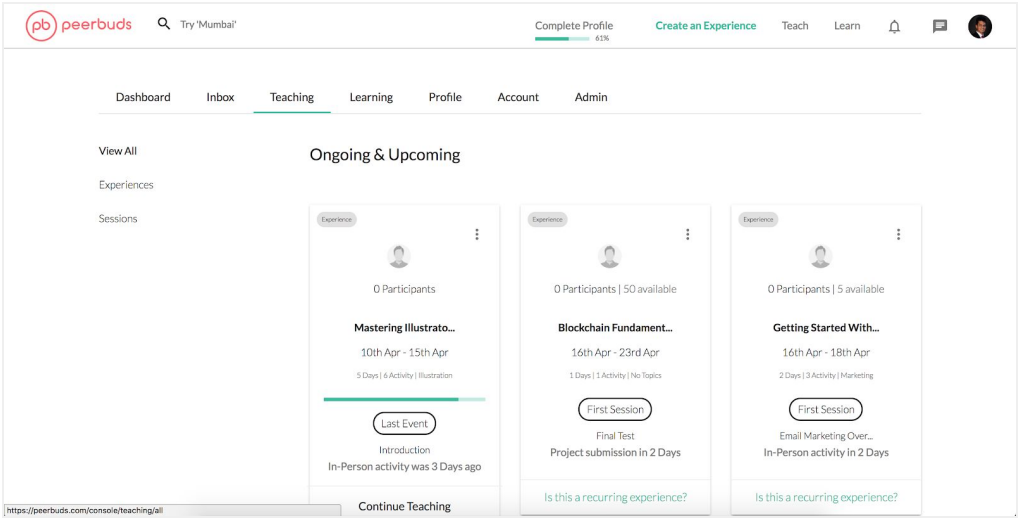


Image 5: Console for a teacher's entire teaching journey

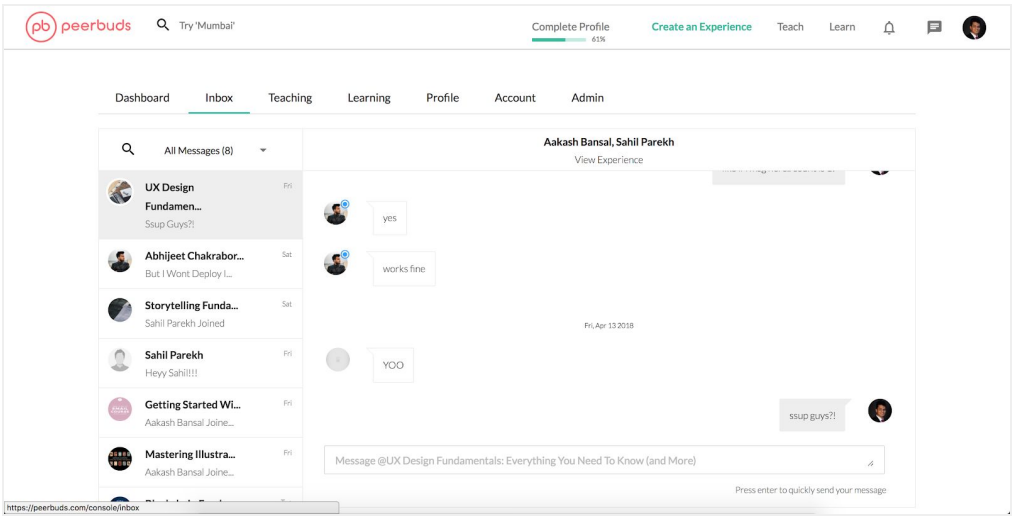


Image 6: Real time chat between all students, and teachers of a contract

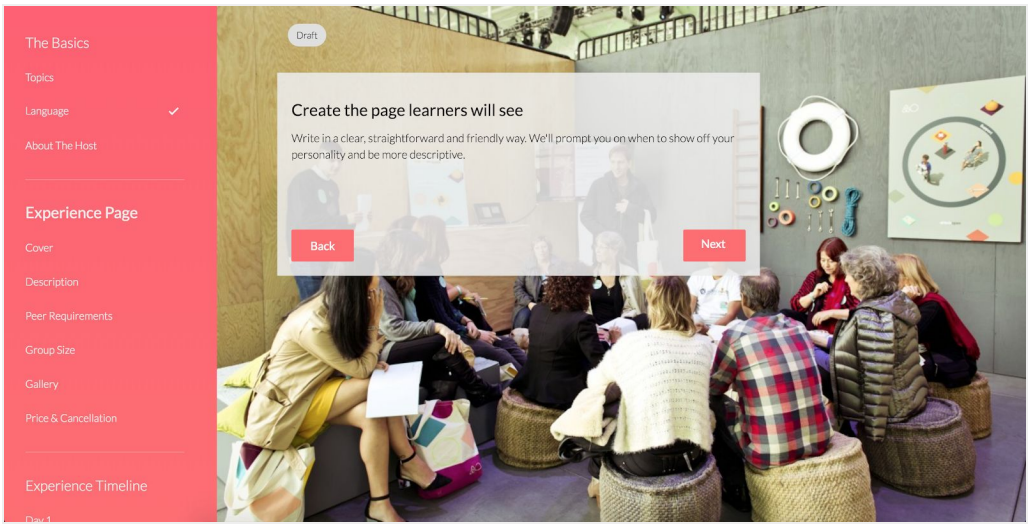


Image 7: Create a new teaching contract easily

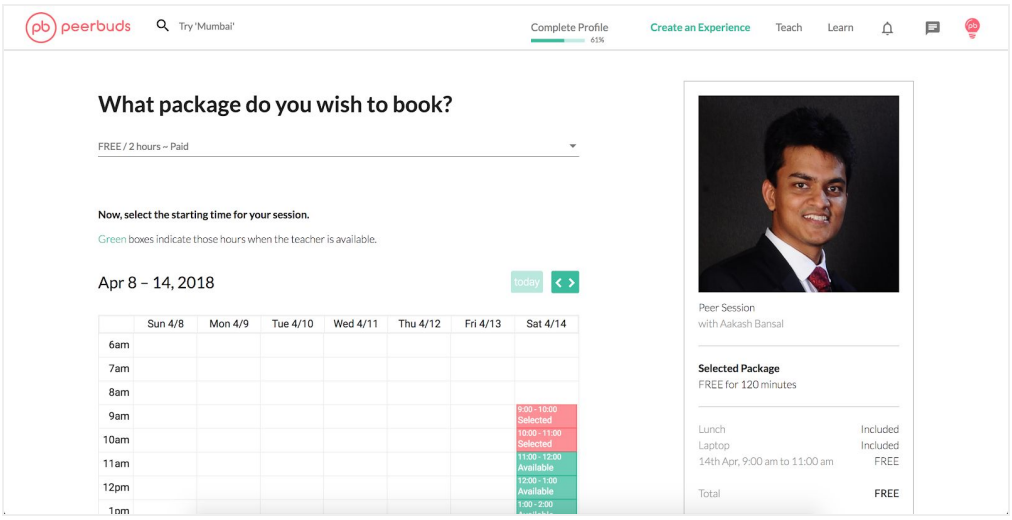


Image 8: Schedule a live video session with any available teacher

5. Competitive Analysis

The peerbuds protocol adds value to all existing education platforms or learning management systems. It gives them the ability to implement blockchain based knowledge management, incentivization and community building within their existing products.

We have found a few companies starting up right now that plan to build an education platform on the blockchain with some level of token rewards for the student. Most of them them either completely lack a product yet or its market validation. Only Tutellus seemed to have a well defined model that is similar to the the peerbuds protocol.

All of the new blockchain based startups have built their models around a MOOC style learning platform and tokenized incentives for learning on the platform. They directly compete with existing MOOCs majors like coursera, udacity and udemy amongst others. None of them have a model to build an ever increasing lifetime score of every person's knowledge like Gyan.

Below is a list of all the companies starting up and their pros and cons.

	Peerbuds	Tutellus	Bitdegree	Bitschool	NTOK	Skillchain

Platform or Framework?	Open Framework	MOOC Platform	MOOC Platform	MOOC Platform	Tutoring Platform	Registry Platform
Available for Online or Offline learning?	Both	Online	Online	Online	Online	Both
Creates a lifetime measure of all knowledge?	Yes	No	No	No	No	No
Adds value to existing platforms & schools?	Yes	No	No	No	No	No
Earning from community collaboration?	Yes	Yes	No	No	No	No
Does the student earn money?	Yes	Yes	Yes	Yes	Yes	No
Existing tested Product?	Yes	Yes	Yes	No	No	No
Implements the principles of knowledge economy?	Yes	No	No	No	No	No
Value	**8**	**3**	**2**	**1**	**1**	**1**

Only peerbuds has an open decentralized framework for companies and individuals to collectively build their students' knowledge history, give credits for learning and incentivize collaboration.

6. Business Model

6.1. The Market

Peerbuds targets the entire knowledge market including eLearning, online tutoring, offline learning at both formal and informal institutions. The total size of this market as of 2017 is ___ with a CAGR of _____.

[TBF - Illustration of various parts of knowledge market - online / offline, content, product]

[TBF - Illustration of the size of market by different countries of the world]

[TBF - Sector wise sizing and CAGR for the knowledge market]

Peerbuds protocol will be launched initially in the US and Indian markets because of their market size in terms of transaction value and transaction size respectively.

6.2. Peerbuds Organization

Peerbuds Inc. is a privately owned company registered with the state of Delaware in USA. The organization as of 1Q 2018 has offices at Fremont in California and Mumbai and Bangalore in India. Our US office focuses primarily on business development, community building and our global marketing efforts whereas our India offices focus primarily on product development, strategy and innovation. Apart from this, we work with several outsourced partners spread all over the world including Poland, UK and France for collaborating on different parts of the business.

As we move towards the ICO our team is expanding steadily to keep up on our promised service standards to our early partners. Keeping in line with our business strategy for the first 2 years, our hiring plan focuses more on our product, business development and community building teams.

Here is a brief representation of our hiring plan.

[TBF - Employee headcount]

6.3. Sales & Marketing

We understand the scope of what we plan to achieve is huge simply because of how widespread and regional our target market is. With this challenge clearly laid out in front of us, we have identified several key pivots around which our short term marketing and sales efforts will revolve. There is a clear intention to keep our targets short term as we plan to engage in hyper feedbacks from our potential customers and quickly adjust strategies for sustainable results. A core flavour of our marketing pivots is community and awareness building. We believe the most effective way of reaching out to this diverse market is by building a highly loyal community that can swear by the value and utility of Gyan and Karma tokens.

a. Focused targeting with campus ambassadors around the globe
b. Develop relationships with faculty
c. Populate platform with peerbuds sponsored content
d. Start clubs/host learning focused events to associate the brand with value within community
e. Speak on behalf of peerbuds @ blockchain events.
f. Collaborative workspaces at peerbuds offices
g. Events with prominent influencers in our target markets
h. Video content developing social following & email marketing
i. Strategic partnerships
j. Video campaigns

6.4. Revenue Model

Once the ecosystem bootstraps, almost all of the revenue for Peerbuds will come from 20% Karma token rewards reserved for Peerbuds owned block producers.

A portion of value of these tokens will go as cost towards paying Ether while recording transactions on the blockchain.

Another major cost for the company will be developing, running and maintaining the protocol code along with its governance policies. Although the code base for the protocol will be made open source prior to our ICO, the company and its engineers will have to contribute majority of the resources in upkeeping the project till the open source community for this project matures.

[TBF - Illustration on the revenue streams and the cost streams]

7. Roadmap

Over the last 2 years, the ideation, development and deployment of the peerbuds protocol has been uninterrupted. We started off as a tutoring platform back in 2016 with thousands of users and a robust ecosystem of tutors and students.

But the core vision; of changing the status-quo in education and making it easier for students to learn things they love doing and get credits for them in areas current education system

discards; was always the same and our core team began ideating on solving the problem with blockchain around mid 2017.

From then to now, we built from scratch a completely new framework on top of ethereum blockchain and a beta MOOC style platform to demonstrate the APIs benefits.

Here are the major group of services to be put into production during the following months:

- Services for individual users
- Services for companies and partners
- Services for Employers

7.1. Services for Users

- Wallet interoperability and management
- Implementation of internal operations with Gyan and Karma tokens
- Tokenization of all functions and services offered by the peerbuds platform
- Recommendation and suggestion engines based on Gyan score and topic preferences.

As part of initial implementation, we realize that user's will need to be able to earn Gyan from their learning transactions for the protocol to become operational. So that is the first priority as part of the protocol and it is expected to be ready and rolled out to production by May 2018.

7.2. Service for Companies & Partners

- Setting up services for API access management based on private and public keys, oAuth and Single Sign On.
- Architecture and build of services for companies and organizations to be able to create courses on behalf of their teachers. Control the visibility of information on teacher profiles.
- Build associated products like analytics, community metrics, big data, feedback and recommendation engines.
- Extend teaching contracts to cover all possible workplace learning opportunities.

7.3. Services for Employers

- Build products for discovering candidates based on desired knowledge levels and topic expertise.
- Implement smart contracts for job offerings and track income from work positions liked to specific learning paths.
- Optimize token economics applying deep learning techniques and protocol utilization trends.

Looking at this process chronologically:

[TBF - Roadmap illustration]

March 2016 - Peerbuds tutoring platform went live
May 2017 - New peerbuds protocol conceptualized with Karma and Gyan tokens
Jan 2018 - All new peerbuds.com platform went live with focus on interactive learning and community based learning.
May 2018 - Peerbuds protocol goes live with first set of functions like wallet registration, teaching contracts, student participation and assessment. Karma and Gyan are now active tokens. Private beta with early partners goes live. Onboard upto 10 mid sized communities or institutions with direct protocol integration. Marketing push for individual teachers and students to use peerbuds platform.
September 2018 - New functions in peerbuds protocol like account profiles, contract profiles, reviews and upvotes. Pre-ICO goes live. More protocol integration options based on validation from private beta partners.
December 2018 - Launch publicly available APIs and SDKs for partners to implement peerbuds protocol in their learning management systems. Main token sale event goes live. First Karma rewards given out to individual users and early partners after token sale ends.
May 2019 - New functions in peerbuds protocol like employer registration, candidate discovery, job offers and income tracking. Transition protocol from bootstrap mode to live mode. Launch internal Karma marketplace for peers to buy and sell their Karma tokens easily. List Karma tokens on most major crypto exchanges.
December 2019 - Aggressive business development for partner integrations globally. Strong security standards and audits for strict SLAs with partners. Deep learning products to recognize learning patterns and build highly effective learning path suggestions.
May 2020 - Optimize token economics based on deep learning analysis of usage trends.

8. ICO Plan

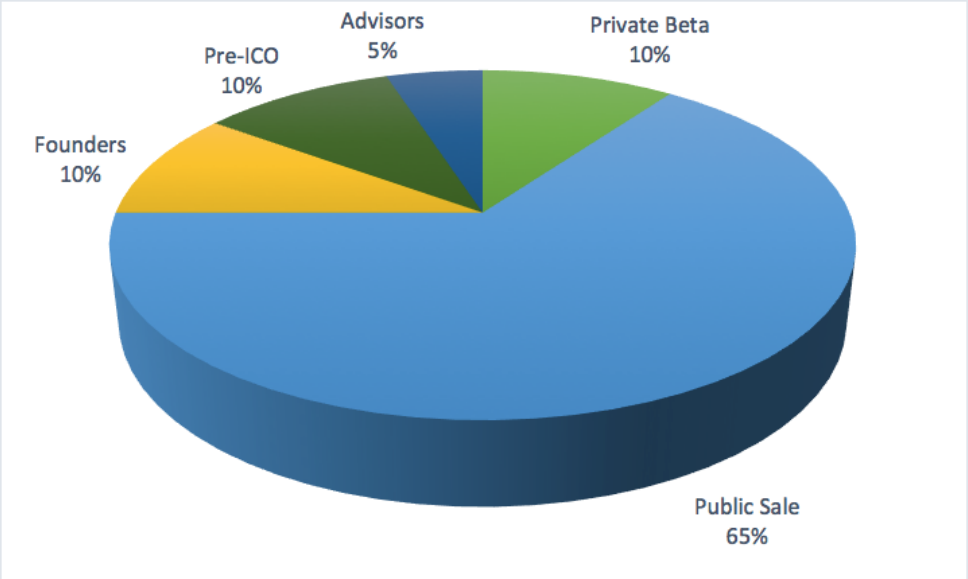
8.1. Rationale

Peerbuds is going to fund the initial bootstrap process during which all the Karma burned by students will go out of a scholarship pool created by peerbuds. Also, the cost of recording transactions on Ethereum in terms of gas is being borne by peerbuds owned block producers until such time that the dollar value of Karma earned back as rewards does not cover the dollar cost of ether spent every week.

To generate fund for this investment in bootstrapping the ecosystem and to cover the cost of developing the entire protocol, running the servers to maintain our SLAs with partners and to pay for the upgrades and future development within the product, Peerbuds Inc. plans to do a private and public token sale of Karma. The proceeds from this sale will go directly towards developing the ecosystem and strengthening its market penetration.

8.2. Total distribution

The total number of Karma tokens released as part of private beta, pre-ICO and ICO events will collectively be **1 Billion (1,000,000,000)**. Here is the split of Karma tokens released during each of these events:



8.2.1. Private Beta / Bootstrap

1st May to 31st Aug 2018
A scholarship pool of **100 Million (100,000,000)** Karma tokens will be created as part of the private beta with early partners. These Karma tokens will be burned on behalf of each participating student during this period. Students will not have to worry about buying new Karma tokens before they participate in classes but they will still be eligible for Karma rewards based on their Gyan rank.

At the end of the bootstrap period, if there are still Karma tokens pending within the scholarship pool, they will continue to be burned instead of student wallet Karma till such time that the scholarship pool balance reaches 0. Alternatively, if the balance reaches 0 before the end of scholarship period, an additional 10 Million Karma tokens will be added to the pool by peerbuds Inc. from its share of ICO tokens. This refill of Karma tokens will continue till the bootstrap period ends.

During the bootstrap period, no weekly Karma reward cycle will take place for rewards distribution. The first reward cycle will start at the end of first week following the last date of main ICO event. Only on this first reward cycle, all existing Gyan earners will be ranked for their total current Gyan value and not just for the preceding week and rewards distributed accordingly. From the following week, rewards cycle will stabilise to the governance rules and schedule described previously.

All private beta users will be rewarded with Karma discounted at 50% on the first rewards cycle. This means all beta users will receive 2x Karma tokens for every 1x Karma reward they were eligible for as part of rewards. This is to incentivise the early partners for their effort in bootstrapping the ecosystem.

8.2.2. Pre-ICO

1st Sep to 23rd Nov 2018
A total of 100 Million (100,000,000) Karma tokens will be available for sale as part of the pre-ICO.

Schedule:

- 1st Sep 9am PST to 21st Sep 9pm PST
    - 25 Million (25,000,000) Karma hard cap
    - 40% Bonus

- 22nd Sep 9am PST to 12th Oct 9pm PST
    - 25 Million (25,000,000) Karma hard cap
    - 30% Bonus
- 13th Oct 9am PST to 2nd Nov 9pm PST
    - 25 Million (25,000,000) Karma hard cap
    - 20% Bonus
- 3rd Nov 9am PST to 23rd Nov 9pm PST
    - 25 Million (25,000,000) Karma hard cap
    - 10% Bonus

8.2.3. ICO

1s Dec to 31st Dec 2018
A total of 800 Million (800,000,000) Karma tokens will be distributed as part of the ICO. Of this a total of

Distribution:

- 650 Million (600,000,000) or 75% for public sale
- 100 Million (100,000,000) or 12.5% for founders
- 50 Million (50,000,000) or 6.25% for advisors and team

Schedule for public sale:

- 1st Dec 9am PST to 7th Dec 9pm PST
    - 5% Bonus
- 22nd Sep 9am PST to 12th Oct 9pm PST
    - 2% Bonus
- 13th Oct 9am PST to 2nd Nov 9pm PST
    - No bonus
- 3rd Nov 9am PST to 23rd Nov 9pm PST
    - No bonus

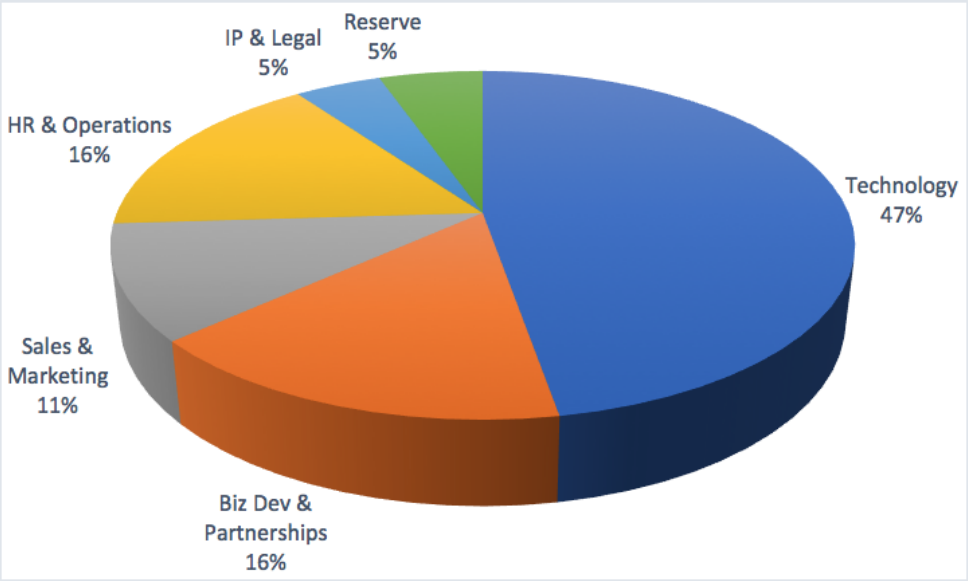
8.2.4. Weekly Inflation

In total there can only be 1 Billion (plus 65 Million if all bonuses are added) Karma tokens in circulation at the end of the ICO.
Karma tokens are inflated at 5% every year, meaning 5% of the year's starting value of Karma is to be added to the economy over a period of 52 weeks once every Monday at 3pm.

However, this inflation is inherently offset by the protocol by having students burn their Karma when they sign up for any class. This action is deflationary and the amount of Karma burned by students is dynamically adjusted by the protocol to limit it to 5% every year.

8.3. Fund Use

Here is a representation of how ICO generated funds would be used by the platform.



9. Core Team

9.1. Co-founders

Sahil Parekh - CEO, co-founder
I am one of the founders and CEO of Peerbuds.

Aakash Bansal - CTO, co-founder & main developer
Technology evangelist with a strong business acumen. With a masters degree in Electronics, strong business experience and over 15 years of hobbyist, freelance and open source coding, I started as the youngest project manager at AT&T Labs. In 3 years I co-founded 4 businesses and successfully exited 2. Along with building & managing over 12 products, I co-manage a family run school of 500 students in Mumbai, India.

9.2. Engineering

Abhijeet Chakraborty - Lead full stack developer
Software engineer, who's always on a quest to learn new things and make something new.
Can solve problems, regardless of technology.

9.3. Marketing / Growth

Emmanuel Gigante - Community manager

Community Manager advocate in Relationship Management Specialties: Marketing funnels, customer retention , acquisition, social advertising,Lean content.

9.4. Advisors

[TBF - Advisors]

9.5. Partnerships

Unitek College, Fremont CA

Unitek College is a privately held vocational school dedicated to helping you gain the skills needed to advance your career or begin a brand new career.

Blockchain at Berkeley

We're a student-run organization at UC Berkeley dedicated to serving the Berkeley and greater East Bay crypto and blockchain communities. Our members include Berkeley students, alumni, community members, and blockchain enthusiasts from all educational and industrial backgrounds.

APPENDICES

Appendix I - The Gyan Token

[TBF - Explain how Gyan is not a crypto-currency. Why is it needed in the ecosystem and the value it adds. Also list down the governance model of Gyan.]

Appendix II - Token Economics in Details

In this section we will provide a deeper look at some aspects of the model, detailing the economical and mathematical foundations behind it.

II.1. Karma distribution model based on floating Gyan

II.2. Earning model for Students

II.3. Earning model for Teachers

II.4. Value of Karma to burn for every Gyan

II.5. Initial distribution of Karma and Gyan