CryptoKitties vs. Axie Infinity: Computational Analysis of NFT Game Reddit Discussions

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Abstract. Online trading of non-fungible tokens (NFTs) and online gaming have recently been integrated as NFT-based games. We conducted a comparative study of online discussions of two prominent NFT-based games: CryptoKitties and Axie Infinity. Topic modeling is employed to analyze the large collected data. Key findings are: 1) The games carry functions of education and gamification for blockchain technology adoption. 2) Motivations are mixed between fun and earning money. 3) Players reflect their playful experiences in the community. 4) We discuss connections between the Axie Infinity scholarship program, players with poor financial status, and issues of modern crypto-colonialism. We outline future research directions for NFT games based on our findings.

Keywords: NFT Games · CryptoKitties · Axie Infinity · Topic Model

1 Introduction

Crypto-games are an intersection of blockchain technologies and gaming, which has attracted increasing research attention, due to the way they intersect cryptography, security, economic models, and game development and game culture research, and due to their potential to disrupt traditional models of gaming and traditional models of earning money online. The emergence of NFTs (non-fungible tokens) in blockchain technology has attracted another wave of capital invested and the innovation has inevitably interacted again with the gaming industries. Several NFT based games have been released, with *CryptoKitties* [6] and *Axie Infinity* [28] being two of the most popular current NFT games.

Previous research on NFT games or crypto-games has usually focused on economic potentials [21], opportunities in game industries [9], or required regulations [8]. In contrast, there are still limited player-focused studies. To better understand NFT games from the perspective of their player communities, we analyze players' social media discussion in venues dedicated to the games. In particular, we analyze online discussions from two Reddit subreddits, r/CryptoKitties

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and r/AxieInfinity. We use both subreddits as sources simultaneously to draw insights in a comparative manner, as discussions on the two sources can cover both similar and differing topics and can also complement each other.

Our analysis combines automated quantitative analysis with expert analysis, by applying machine learning based text mining, in particular topic modeling, to a very large amount of online discussion whose exhaustive human reading would be infeasible. The machine learning based topic modeling will extract topics of discussion that represent the data set well, and will model how the prevalence of the topics varies over time and how usage of the topics varies in the different subreddits. Human analysis will then focus on the extracted topics and their trends as well as selected messages where the topics are prominent. To our knowledge, this is the first work investigating NFT games from the perspective of the online player community in a comparative manner. The methods and results of this work can further inspire and benefit future works in blockchain and NFT game research.

This paper is organized as follows. Section 2 provides background on NFT games and the two games in focus, and our research questions. Section 3 describes the data collection, preprocessing, and topic modeling methods we apply. Section 4 describes the results of the data analysis. Section 5 discusses the modeling results and Sect. 6 ends with conclusions, limitation and opportunities.

2 Background

2.1 NFT Games

NFT (non-fungible token) is a blockchain technology built on smart contracts of the Ethereum ecosystem [8]. The major functionality of NFTs is to identify and represent the ownership of a virtual object. As development of blockchain technology and the expansion of its market has continued, NFT games have emerged as the convergence of the technological advances and gaming. Such games incorporate NFTs into the system of rules, mechanisms, and dynamics in order to engage players. For example, objects in games such as characters, items can be turned into in-game NFT assets. NFT games enable players to create values, claim ownership, and emphasize the digital scarcity of crypto assets in a decentralized, virtual game world. Existing games have influenced NFT game development. For example, Pokemon has inspired *Axie Infinity* and *Dungeons and Dragons* [30] has influenced the company *Gripnr*.

However, as pointed out in literature, the elements and activities introduced by the NFT technology such as investment, collection, and transaction have already existed in video games [9,29]. The chance-based nature of crypto assets often lead to the discussion of gaming vs. to gambling [24,26]. Another analysis has further pointed out that limitations of blockchain technology including issues of scalability, maintenance, anonymity, and trustlessness are challenges to its desired economic model [11]. Moreover, lack of sustainability, consumer stickiness, and playability, overly emphasized financial character, and the infancy of the cryptomarket hinder the development of blockchain games [18].

2.2 CryptoKitties

To our knowledge, *CryptoKitties* is the first NFT game. Its major gaming mechanism is built on NFT transactions of virtual cats on the Ethereum blockchain. It is a pet breeding simulator where players breed "kitties" and sell them in the marketplace, where each "kitty" is a unique token.

To start playing, the player has to buy in at least two kitties from the marketplace and pair them as the parents to breed/generate another new next generation kitty. The traits of a newly bred kitty (e.g., color, pattern, etc) are mainly decided by the "Cattributes" inherited from its parents. The players can then choose to keep the kitty or sell it in the market. The price of the kitty is, in principle, decided by the scarcity of its "Cattributes". As the kitty has more "rare traits", the value becomes higher.[1]

Research has pointed out the educational characteristics of *CryptoKitties* as players needed to get familiar with blockchain to play the game (e.g., wallets, transactions, etc.); it has also highlighted the game is "*still a successful example of market gamification*" as it brings gameful experiences into the process of blockchain adoption [25]. Academics have also focused on the connection of *CryptoKitties* and gambling [26], and the values and economy created [27].

2.3 Axie Infinity

Axie Infinity[2] is a Pokemon-inspired, term-based card battle game where players train and breed the "Axies" to fight. The gaming mechanism is base on a card-battle system in which players need to arrange combination of Axies considering their classes and positions in order to win. For example, Axies of the "Bug" class possess advantages over classes such as "Reptile", "Dusk" and "Plant".

Similar to *CryptoKitties*, the Axies are tradable. Players can earn $SLP ("smooth love potion") currency by winning battles. The $SLP is saved in the players' Ronin wallet and can be further traded or exchange for other properties. The $SLP is also needed for mechanisms such as breeding. To avoid hyperinflation, the cost of $SLPs increases according to how many times the Axies have been bred.

The "Scholarship" program is a unique phenomenon of the game. The main reason behind it is the entry barrier of the game: it costs three Axies to start playing and the price of each Axie fluctuates in the market. Therefore, players who cannot afford the expenses turn to the program and join as a "scholar". A team led or invested by "managers" can consist of a range from tens to hundreds "scholars" who are given access to the account but not the underlying wallet. The manager pay the scholars a split of $SLPs (e.g., 50% of the earned $SLPs depending on the deal) afterwards.

To our knowledge, the majority of academic efforts on player studies have been focused on the Philippines. One study focusing on 176 players of *Axie*

[1] There are also other factors can influence the price such as generation and exclusiveness of kitties, please see https://guide.cryptokitties.co/guide/tips/value-of-kitties.

[2] https://whitepaper.axieinfinity.com/gameplay/breeding.

infinity in the Philippines showed that most of the players (79%) have spent 1 to 4 h daily to play, and 39% of them required 1 to 3 months for return-of-investment and 37.5% of them took 4 to 6 months [7]. Another study investigated the psychological effects of *Axie infinity* and pointed out that playing is not easy, it takes a huge investment of time and results in stress and sleep deprivation [10].

2.4 Research Questions

Our research questions are: RQ1 - What have players discussed online? RQ2 - How has the content of discussions changed over time? RQ3 - What are the similarities and differences between the two games in players' discussions? For each question RQ1–RQ3 we further study what the answers reveal about players's experiences and motivations and practices of the games' communities.

3 Method

3.1 Data Collection and Preprocessing

Reddit is one of the largest online discussion forums. The NFT games player communities of CryptoKitties and Axie Infinity both have a strong presence on Reddit. While collecting the data, r/CryptoKitties and r/AxieInfinity had over 13 and 100 thousand members respectively. They are thus taken as the venues to study players' perceptions and experiences. The pushshift API[3] was employed to collect data from Reddit. After collecting the data, stopwords (e.g., "is", "and", etc.), numbers, and punctuation were removed and words were lowercased. We further removed words that only appeared once in the corpus.

3.2 Text Analysis

To analyze the large amount of collected data, we employ topic modeling [3], a text analysis tool where each document is modeled as a mixture of different topics and each topic represents an underlying theme. Unlike hard clustering of documents, topic modeling lets each document arise from multiple topics, which is essential for discussions dealing with multiple themes. Topic modeling represents documents as bags of words, where each document has a distribution over topics and each topic has a distribution over words. The probability of words w occurring in a document d is modeled as a sum over K topics, so that

$$p(w|d) = \sum_{k=1}^{K} p(k|d)p(w|k) \tag{1}$$

where $p(k|d)$ is the prevalence of topic k in the document (probability to choose topic k when generating a word), and $p(w|k)$ is the probability to pick word w

[3] https://github.com/pushshift/api.

from topic k. The probabilities are learned by fitting the topic model to a set of documents, optimizing the ability of the model to represent their content. As a result, topics are found that correspond to underlying themes in the data collection according to what best describes the data, without requiring any pre-specified hypotheses of their content.

In the model training, each Reddit discussion thread (a submission and its follow-up comments) constitutes a document, the analyzed corpus consists of 5061 and 26037 threads from r/CryptoKitties and r/AxieInfinity respectively. The submission time is also collected. To make use of this information, we chose a more advanced topic model called Structural Topic Model (STM, [22]). It is used to model and analyze how the topic prevalence in documents is affected by document-level covariates. STM models the topic prevalences $p(k|d)$ of all K topics in a document d with a vector $\theta_d = [p(1|d), \ldots, p(K|d)]^\top$ which is drawn from a distribution that depends on the covariates, so that

$$\theta_d \sim LogisticNormal_{K-1}(\mathbf{\Gamma}^\top \mathbf{x}_d, \mathbf{\Sigma}) \tag{2}$$

where $\mathbf{x}_d$ is a vector of the document-level covariates, $\mathbf{\Sigma}$ is a covariance matrix, and $\mathbf{\Gamma}$ is a coefficient matrix that governs the integration between topic prevalence and document-level covariates. Here, we take the submission time and the identifier of the source subreddit as document-level covariates.

To determine the number of topics K, semantic coherence is adopted as the model selection criterion [1]. Semantic coherence quantifies how strongly the top most probable words in each topic are co-occurring over the document collection, technically as a sum of their normalized pointwise mutual information values. To select the best model, we train the model with numbers of topics ranging from $K = 5$ to 100, and for each setting, we train 10 models each with a different initialization. The model having the best semantic coherence value was chosen as the final model. In the resulting final model, 73 topics were extracted. Each topic is then further labeled by the authors through examining the its top words and example quotes (i.e., documents with high prevalence of the topic). This labeling process is similar to the "coding" in thematic analysis [4].

4 Results

4.1 Extracted Topics

The 73 extracted topics and their top words are shown in Tables 1 and 2. We arranged the topics into thematic groups and discuss topics of each group below.

Issues, Game Development and Updates. Topics such as **Technical Issues**, **Platform Issues**, and **Account Banned** involve system issues encountered by players. For example, the quote *"Android update Is the Android version working for you? I tried uninstalling/dowloading ..."* from the topic **Platform Issues** demonstrates the player had problems playing on the Android platform.

Table 1. Extracted topics. Pr(%) is average topic probability over documents.

Topic	Pr(%)	Top 8 Words
Team Performance Goals	3.09	mmr can reach team around high think climb
Ownership and Possessing	3.00	get just take back keep hope long anything
Suggestions and Recommendations	2.86	can thank need want also think idea wonder
Asking for Help	2.84	help hello guy please know can someone anyone
Assessing Worth and Time	2.67	much think may lot little maybe since time
Opinion on Goodness	2.62	good like look will try find really seem
Crypto Wallets	2.61	ronin binance metamask fee eth send wallet use
Axie Infinity FAQ Posts	2.60	axie infinity new make question start check sure
Hiring Scholars	2.50	scholar scholarship manager look give split program experience
Team Building	2.43	team good build budget aap comp decent lot
Time and Waiting	2.29	time day now week hour wait ago today
Technical Issues	2.12	issue try problem fix server work anyone happen
Transaction Issues	2.11	show transaction see click say check marketplace happen
Commentary Words	2.10	still now right yes just already guess even
Traits of Kitties	1.96	cat gen kitty fancy trait sire new rare
Advice for Team Play	1.93	tip advice team suggestion stick arena strategy
Transactions of Axies	1.91	axies buy sell cheap floor marketplace can new
CryptoKitties	1.90	kitty cryptokitties new cryptokitty dapper type contract site
Costs on Blockchain	1.85	eth sell buy gas price fee sale high a
Questions Related to Play	1.84	play will can ask friend question answer able
Certainty and Uncertainty	1.76	see really sure know give actually though probably
Battle Arrangements	1.71	plant tank back mid good front backline damage
Ethereum Blockchain	1.66	blockchain token ethereum trade network smart chain platform
Account and Device	1.58	account device use log ban different gift new
Discord Links and Scams	1.56	discord link scam support ask official join message
Conversation and	1.48	people say can even know thing think like
Start Breeding	1.46	one first two mean far set however start
Player-Made Tools or Creations	1.44	add search use part can tool work nice
Adventure and Arena Mode	1.44	level adventure arena energy pvp ruin axies pve
Scholarship Applications	1.41	day play will game can scholarship good sir
Ronin Blockchain	1.38	wallet ronin seed phrase trezor email can address
Earning $SLP	1.36	slp day per earn can daily gain will
Understanding and Sensemaking	1.35	make way understand case etc. come amount sense
Platform Issues	1.35	app code work use mavis mobile phone log
Market Cycle	1.33	price will market now low drop sell hold
Aquatic Cards	1.24	aqua nimo fish koi risky aap double backline
Cryptotechnology and NFTs	1.22	crypto nft project year nfts market tax world
Win-Lose in PvP Mode	1.20	win lose match arena day rate rank bad
Having Fun in Play	1.19	game play fun enjoy like earn gameplay bore
Learning from Videos and Streams	1.17	video watch learn youtube guide start stream check
Update and Release	1.16	will land release update come new battle alpha
Energy Use in Playing	1.12	energy round use opponent count turn time steal
Exclamations	1.11	lol fuck like shit bad even lmao feel

Table 2. Extracted topics. Continued from Table 1.

Topic	Pr (%)	Top 8 Words
Plant Cards	1.08	plant bug serious cactus pumpkin carrot hot bidens
Beast Cards	1.07	beast plant ronin nut rimp get imp dual
Damages and Kills	1.02	kill can damage card combo will use enemy
Investment Plan	1.01	month invest start worth money investment make research
Contests	1.01	amp free name giveaway process pet limit contest
Bird Cards	1.01	bird mech backdoor speed swoop dark hare post
Game Changes	0.98	change season new will now balance last update
Reptile Cards	0.93	reptile termi dusk terminator chomp termis speed tiny
$AXS and Ronin Coins	0.91	axs stake ron token reward will swap farm
Cards and Combos	0.91	card draw cost use combo another can chain
Reddit Discussions	0.87	post comment sub reddit see subreddit remove mod
Breeding Costs and Profits	0.86	breed cost egg part breeder pure can profit
Costs of Play	0.82	money pay can work want spend without will
Defence in FIght	0.77	double poison gravel ant nerf counter anemone nerfed
Attacking Skills in FIght	0.70	damage speed class skill high low part stats
Crit Hits and Chance	0.68	crit crits game random rng morale critical much
Genetics of Offsprings	0.67	gene love image chance will english list parent
Shields and Stuns	0.66	shield attack damage stun axie use effect hit
Metagaming and Ranking	0.60	meta top rank different part competitive see tier
Game Developers	0.55	dev community sky mavis team jihoz developer happen
Account Banned	0.52	ban multi rule get account can risk axies
Long Term Value	0.51	value long term still investment year back profit
Machanism of $SLP	0.51	slp burn will player mint use need supply
Runes and Charms	0.49	origin like animation charm rune fast look now
Skill of Play	0.47	player good skill base everyone can experience will
Jobs and Income	0.34	job earn money people country quit need live
Game Economy	0.33	game economy will much new scheme create earn
Bot Messages	0.31	bot word command thy shakespeare optout shakespeareinsult fordo
Countering Bot Players	0.26	slp bot will reward update just axies dev
Filipino Language	0.22	pro ako may ang lang yung con mine

Topics **Game Developers**, **Game Changes** refer to strategic actions of the game developers as a company and to their ongoing technical game development and updates. One quote from **Game Developers** states *"Should Sky Mavis replace their COO? ... Since it's not a personal attack ... the community should be allowed to discuss this ..."* expressed concern about strategies of the company Sky Mavis which develops *Axie Infinity*. Another quote from **Game Changes** mentions *"How will the upcoming season affect mmr? Hi! I'm still relatively new to the game..."* exemplifies how players' uncertainty arises not only from their own skills but how to plan for and cope with future changes in the game.

Online Player Communities. As Reddit is a platform for several online communities, some topics reflect common language features used in such platforms. **Suggestions and Recommendations**, **Opinion on Goodness**, and **Asking for Help** demonstrate interaction among community members. In this setting the suggestions, recommendations, opinions and help typically are about game strategy and team composition: for example, a quote from **Suggestions and Recommendations** asked "*... can anyone recommend viable axie for a team ...*". Other community interaction topics include **Conversation and Thoughts** and **Exclamations** which refer to users expressing their ideas or feelings online.

Blockchain Technologies and Financial Literacy. Several topics concern aspects of blockchain technologies, both in general and related to the specific games. Topics such as **Ethereum Blockchain**, **Smart Contract**, and **Cryptotechnology and NFTs** deal with general aspects of blockchains. In contrast, topics such as **Ronin Blockchain**, **Earning $SLP**, **$AXS and Ronin Coins**, and **Machanism of $SLP** are *Axie Infinity* related cryptotechnologies. Moreover, there is a group of topics related to financial literacy where players reflect on their personal understanding of cryptomarket, personal financial situations, and even the economies behind the game: topics **Market Cycles**, **Investment Plan**, **Jobs and Income**, **Long-term Investment**, **Game Ecnonomy** are discovered in this group. For example, the quote *"I have a feeling this will boom upwards like ziliqua I mean look at the market cap and price movement ..."* from **Market Cycles** and the quote *"... Is Axie infinity a financial bubble? ... I feel that the risk to my initial investment is worth the passive income. Fees are profit killers ..."* from **Investment Plan** indicate that the players are aware of the uncertain and volatile nature of the cryptomarket.

Game Mechanics and Play Experiences. Breeding is a shared mechanic of the two games. A group of topics related to Breeding are extracted including **Start Breeding**, **Breeding Costs and Profits**, and **Genetics of Offsprings**. Top terms such as "dapper", "type" in **CryptoKitties** as well as "love", "image" in **Genetics of Offsprings** may potentially reflect the aesthetic perceptions of the players.

Another group of topics are mainly related to fighting with teams of the NFT characters. E.g., **Team Performance Goals**, **Team Building**, and **Advice for Team Play** reflect the team fighting mechanics in *Axie Infinity*. Besides, there are also topics related to specific types of cards in *Axie Infinity* such as **Aquatic Cards**, **Plant Cards**, and **Reptile Cards**.

A notable group of topics is about the 'scholarship' program in *Axie Infinity*, especially the **Scholarship Applications** where users post their personal information such as location, how much time per day the person can offer, and in some posts also their reasons for applying for the program. In one post[4], a user emotionally explains that they wish to join a scholarship to financially help their parents, who have had difficulty working due to the covid pandemic.

[4] Such posts can become very personal, we hence do not show the actual quote.

4.2 Topic Correlations

With the STM model, co-occurrencies between use of different topics can be measured by examining the statistical correlation between use (co-occurrence) of different topics across the documents. A positive correlation coefficient of two topics implies they are more likely to be discussed in the same document. The coefficients could be analyzed as a correlation matrix, but the pairwise correlations can also be thought of as a graph of topics where positively correlated topics are connected by an edge; here we follow this latter approach.

Figure 1 shows the subgraph of topics that are positively correlated to either of the topics **Hiring Scholars** and **Scholarship Applications**. All topics in the figure turn out to be positively correlated to **Hiring Scholars**, and topics also associated to **Scholarship Applications** are highlighted by red font color. The topics cover a wide range of discussion, from game play (e.g., **Skill of Play**, **Team Building**) to earning income (e.g., **Earning $SLP**, **Job and Income**).

It is worth noting that the topic **Filipino Language** is one of the few topics that are positively correlated to **Scholarship Applications**. The two other topics that are positively associated to **Scholarship Applications** are **Hiring Scholars** and **Axie Infinity FAQ Posts**.

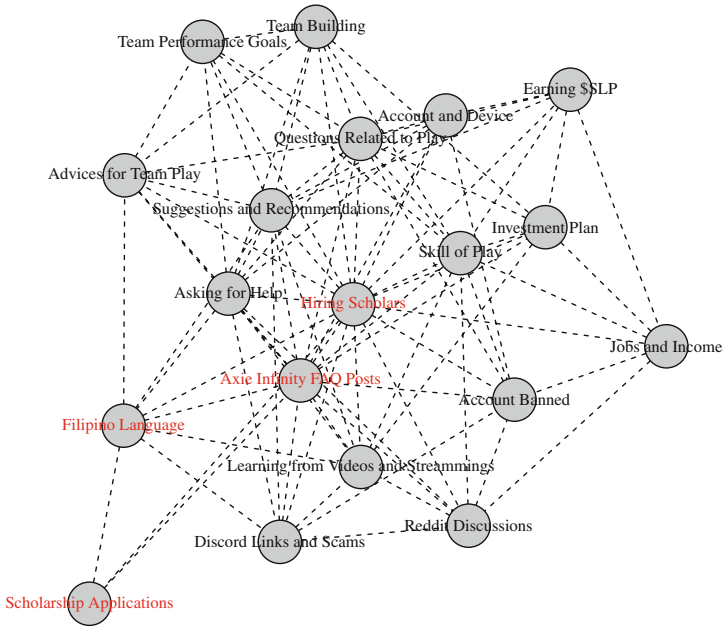

Fig. 1. Subgraph of topics positively correlated either with **Hiring Scholars** or with **Scholarship Applications**. Edges indicate positive correlation of topics. Every topic in the figure turns out to be positively correlated with **Hiring Scholars**, but only some are positively correlated also with **Scholarship Applications**: the latter topics are further highlighted by red font color. (Color figure online)

4.3 Difference of Topic Prevalence Between Games

The STM model can quantify the association of the text source (in this work, r/CryptoKitties or r/AxieInfinity) to the topic prevalence. Technically, STM models this with association coefficients, part of $\mathbf{\Gamma}$ in Eq. (2), where positive values boost topic probability in r/AxieInfinity and decrease it in r/CryptoKitties, and negative values do the opposite. We investigate this focusing on topics related cryptotechnologies and financial literacy. Figure 2 shows the topic association to the two text sources where the horizontal lines indicate 95% credible intervals of the association coefficient. If the credible interval for a topic is on the left-hand side of zero the topic is associated with CryptoKitties; an interval on the right-hand side of zero indicates association to Axie Infinity; and if the interval covers zero the association is not strong for either data source.

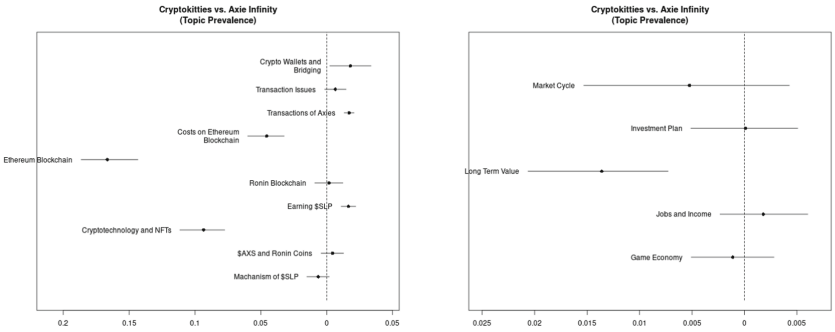

Fig. 2. Influences of source on prevalence of topics. **Left**: Topics related to crypto Technologies. **Right**: Topics related to financial Literacy

Several topics related to cryptotechnologies, namely **Costs on Ethereum Blockchain**, **Cryptotechnology and NFTs**, and **Ethereum Blockchain**, are significantly more prevalent in r/CryptoKitties whereas **Transactions of Axeis** and **Earning $SLPs** are significantly more prevalent in r/AxieInfinity. Other cryptotechnology topics do not have a significant difference of association between text sources. Among topics related to financial literacy, only the topic **Long term value** is significantly more prevalent in r/CryptoKitties, and the other topics do not show strongly different association between the two games.

4.4 Temporal Dynamics of Topic Prevalence

The STM model can facilitate investigating the temporal dynamics of the topics: STM models association between time and the topic prevalences, and allows estimation of the prevalences and their confidence intervals over time in both subreddits. Figures 3 and 4 show the temporal dynamics of selected topics. More concretely, we examine how the modeled prevalences of the topics fluctuate over

time. We focus on nine topics that have shown particularly obvious patterns and reflected prominent topical aspects in analyzed NFT games. The plots show how the prevalence of the topics varies by time (from 2018 to early 2022) within and between two different online communities.

We first investigate compare trends of topics within a subreddit, for two topic groups shown in Fig. 3. The popularities of topics related to crypto technologies among *CryptoKitties* players generally show a growing trend. **Cryptotechnology and NFTs** reached its peak in the beginning of 2022, **Costs on Ethereum Blockchain** started to drop in the middle of 2021, and **Ethereum Blockchain** had two peaks, the first one happened around the end of the first quarter of 2021 and the second one happened around the third quarter of 2021. The popularities of topics related to scholarship programs among *Axie Infinity* players vary. The prevalence of **Scholarship Applications** has two humps whereas the prevalence of **Hiring scholars** has a gradually growing trend.

Next, we investigate compare trends of topics between the subreddits. Fig. 4 shows the topic prevalence of two topics **Investment Plan** and **Transaction Issues** in two different text sources. The topic prevalence of **Investment Plan** has a more strongly varying trend over time in r/AxieInfinity, having low prevalence around July 2019 and high around January 2021, whereas its prevalence is mostly stable in the other subreddit. In contrast, the topic prevalence of **Transaction Issues** shows different patterns over time in both of the two text sources.

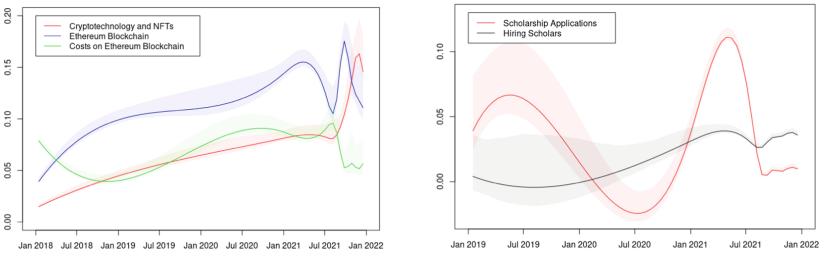

Fig. 3. Left: Topics prevalence related to Crypto-technologies in r/CryptoKitties **Right**: Topics prevalence related to scholars in r/AxieInfinity

5 Discussions

5.1 Shared Functionalities

The discovered topics suggest that both analyzed games have played a similar role when it comes to education and gamification in blockchain technologies adoption. Many of the discovered topics are related to blockchain technologies which indicates that the player communities are somewhat motivated to discuss or consult about the underlying technologies of the games with other players.

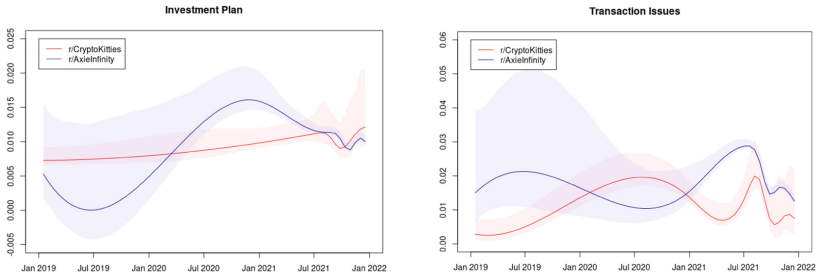

Fig. 4. Topics prevalence over time among different player communities. **Left**: **Investment Plan**. **Right**: **Transaction Issues**

The topic **Learning from Videos and Streams** further indicates that the learning process often requires resources out side of the game and that online video has taken a prominent role in this. These topics yield evidence for similar conclusions as a previous analysis that the players acquire knowledge of cryptocurrency technology but the learning process mainly happens outside of the gameplay [25]. Note that several cryptotechnology related topics have significantly higher prevalence in r/CryptoKitties. There are several potential reasons: firstly, *CryptoKitties* is the first NFT game, therefore its initial player base was still not familiar with the system and a learning process was hence required. Secondly, compared to *CryptoKitties*, *Axie Infinity* has a more complicated design and less chance-based mechanics, this difference may lead discussion to focus on these aspects (e.g., game play) in rather than the core technologies. Nevertheless, our findings still imply that the two games share a similar role in increasing the adoption of blockchain technologies among their players.

We also observe topics related to financial literacy, e.g., **Long-term Investment**, and **Market Cycles**. This is to a degree in line with the finding in a previous research that the players are actually aware of the instability of the market [7]. Moverover, it has also been pointed out that crypto asset owners in general have better level of financial literacy [11]. Hence, we argue that NFT games have gamified educational functionalities that could be expanded to enhance financial literacy.

5.2 Player Experiences

A number topics are specific to experiences of playing the games themselves, such as strategies to win (e.g., **Skills of Play**, **Battle Arrangement**) issues related to the game systems (e.g., **Technical Issues**, **Account and Device**), and some of those topics are specifically related to the blockchain technologies embedded in the games (e.g., **$AXS and Ronin Coins**). Although the analyzed data concerns two NFT games, these topics outline common characteristics of player discussions in research focusing on other non-NFT games (e.g., [16,17]).

There are more specific game-play related topics (e.g., **Adventure and Arena Mode**) that are prominent in r/AxieInfinity than to /r/CryptoKitties.

Especially when it comes to topics related to mechanics in game, there are more abundant discussions in /r/AxieInfinity such as how to arrange the team in a PvP battle (e.g., **Team Performance Goals**, **Win-Lose in PvP Mode**). In contrast, such discussions related to *CryptoKitties* are limited due to its simpler design and comparatively higher chance-based elements. This is a potential cause of relatively higher prevalence of topics related to Cryptotechonologies as shown in Fig. 2. The differences of the player discussions also relate to player agency, in *CryptoKitties* players have less control as the game-play mainly follows the chance-based mechanics whereas in *Axie Infinity* players are granted better level of agency. However, note that there are still fundamental differences in NFT games compared to other video games. For example, the technical problems can result in immediate financial loss and the scarcity of game related crypto assets may lead to a more competitive atmosphere in the player community.

5.3 Play-for-Fun vs. Play-to-Earn

Game balance [14] has been an important notion in game studies. Academic discussions have usually focused on the balance between, e.g., fairness and playfulness. However, due to the unique nature of play-to-earn games the discussions in the two investigated subreddits turn out to be related not to actual gameplay adjustments but rather to how the players-investors believe the economy of the game should work. For example, a player of *Axie Infinity* can be much more interested in daily $SLP earning than the perfection of the owned Axies. This tension between such intrinsic and extrinsic motivation for engaging games was investigated in a previous study showing that Poker online players seem to value both parts of their experience equally [20]. This dual appreciation seems to be widespread among players or NFT related games: for example, a quote of the topic **Having Fun in Play** mentioned "Fun isnt important to this game. How much higher price for the cats, that is important...", another quote alleged "...I'm the opposite, I find adv relaxing. In adv, it'll only take me around 30mins of playing....", and a further quote stressed "...I love playing this game. And earning while playing...".

A caveat is that social media discussion differs from private expert interviews. Reddit is a meeting point where managers try to recruit scholars. This brings a level of social desirability: a potential scholar may be truthful when saying they have fun with the game, but they may also try to seem enthusiastic to impress potential patrons. Thus, even if our results seem to validate previous literature, we cannot be sure whether potential scholars write genuinely. Further research with more immersive techniques could deepen understanding of the phenomenon.

5.4 Scholarship Program and Crypto-Colonialism

Results in Fig. 1 suggest a connection between Axie Infinity scholarship programs and the Filipino language. This is in line with statistics that in 2021 the Philippines had the largest active daily participation and had over 40% of active users of the game [7]. The large size of the phenomenon and its geographic

localization reminds of the "gold farming" industry, a business mainly in China where in-game assets, like gold in World of Warcraft, were accumulated by workers playing as a full-time job. It was argued the business was received with a revamp of racist and colonialist tropes in the western audience, stating for example "*gold farming has led to realworld racism being remapped into cyberspace*" ([12], pp. 20). While exploitation in this industry was documented, aspects of the phenomenon like its size or geographical extent remain obscure. Difficulty reaching workers and stereotypes about the issue prevented a clear picture of the situation, remarked as "*the smallness of the imaginary, its failure to look beyond a vision of the virtual sweatshop and its Third World paraphernalia*" [19].

While avoiding the above pitfall, we must consider literature on dangerous macro and micro level consequences of the rise of cryptocurrency business in the third world. Atiles describes this as crypto-colonialism: *"exploitation of lands and resources by cryptocurrency and blockchain interests, often under the guise of progressive or egalitarian rhetoric to the host communities. The act of coordinated groups of tech-savvy individuals leveraging their wealth, which is often but not always generated by cryptocurrency investments, to settle in and exploit lands and laws favorable towards continued crypto-activities"* ([2] pp. 596).

On the macro level, studies on crypto-colonialism in countries like Venezuela or Puerto Rico argue it reproduces predatory and extractivist practices, undermines local sovereignty, and curtails efforts to overcome class and racial inequalities [5,13,23]. At the micro level, these games allow people in impoverished areas to make a living, but introduce stress in their life. A study advocated that Axie Infinity players need a strong support system to withstand lacking sleep and rest and pressure to reach quotas [7]. Such games may simplify crypto-colonial business for first world enterpreneurs, as it has been alleged that crypto companies have used unfair and deceptive practices to collect data focusing on third-world countries having less legal data protections and cheaper data collection [15]. The deregulated and individualistic nature of the blockchain and the games' unique business model also make it easier for individuals (like Axie managers) to be colonizers, needing understanding the game and its crypto ecosystem, but easily arranging money for a few accounts and outsourcing grinding to the Philippines. Although the phenomenon somewhat parallels gold farming, its new technological affordances yield new colonial practices which could be addressed by further research.

6 Conclusions, Limitations, and Opportunities

Throughout the history of video games, major evolution has often emerged with technology innovation, NFT is no exception. This paper has investigated Reddit discussions of two games in a comparative perspective. With regard to our research questions, for RQ1, a wide range of topics, from gamification, financial literacy to player experiences were extracted and discovered. For RQ2, the temporal dynamics of topics within and between online communities were analyzed in Sect. 4.4. Lastly, for RQ3, the similarities and differences of the online

discussions between the two games were also discovered and discussed; in general, topics related to gamifying blockchain and financial literacy are present in both online communities, on the other hand, r/AxieInfinity contains more player experiences and relevant implications such as discussion on the scholarship program.

To conclude, our key findings can be summarized as follows. 1) Both games show potential in education and gamification for adoption of cryptotechnologies and financial literacy. 2) Player experiences indicate active interest in understanding and mastering game mechanics, strategies and technologies. 3) Player motivation is a varying mix between fun and earning money. 4) The scholarship program aspect has connections to players with poor financial status; we note a connection to modern crypto-colonialism.

Potential biases of social media data (reflecting active commenters, and showing stated opinions rather than private ones) can be examined in future studies. Another limitation is we only take the subreddits as data sources. Other sources such as Discord and Twitter can be considered in future work. This research also highlights directions for future research in NFT games, especially societal impact of phenomena such as the scholarship program requires more attention.

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