A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

INNOVATION IN DIGITAL HEALTH- HOW TO INCREASE THE USER ADOPTION OF PLAY TO EARN DIGITAL HEALTH APPLICATIONS

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17/05/2024

Abstract

This paper addresses the challenge of low adoption rates of Play-to-Earn (P2E) digital health applications, pursuing three objectives: assessing the opportunities of gamified financing for enhanced user adoption, analyzing user motivations to adapt to existing P2E health apps, and proposing management strategies to increase adoption rates for the P2E app Dotmoovs. The paper applies a literature review, a survey-based analysis of users' experiences and a discrete choice experiment. Results indicate that while economic incentives can enhance adoption, understanding user motivations and integrating engaging gamification strategies are crucial. Recommendations for improved adoption include refining engagement strategies, simplifying cryptocurrency integration, and aligning app functionalities with user needs.

Keywords

Healthcare, Digital Health, P2E, GameFi, Cryptocurrency

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

Introduction

Modern society is facing health challenges like high blood pressure, obesity, and physical inactivity, primarily due to lifestyle changes. In the U.S. alone, chronic diseases linked to poor health behaviors account for about three-quarters of health expenses, while minor behavioral adjustments could significantly enhance well-being (Johnson et al., 2016). Thus, changing health behaviors is key to reducing preventable diseases (Maqbool et al., 2018).

Digital health, defined as using technology to improve health (Kostkova, 2015), has become popular for promoting health behavior changes. Especially gamification of digital health apps has proven effective by meeting users' needs for satisfaction, although challenges like low adoption rates remain due to insufficient user motivation (Woldaregay et al., 2018). The shift towards Decentralized Finance (DeFi) provides opportunities for tackling these challenges. DeFi uses blockchain for accessible and transparent financial services to manage risks and improve system resilience (Schär, 2021). Integrating game finance (GameFi) and Play-to-Earn (P2E) models in healthcare could transform health behavior change by motivating and financially rewarding users (Proelss et al., 2023).

This paper follows three objectives. Firstly, it will conduct a systematic literature review to identify how gamified financing and risk-sharing mechanisms might enhance the adoption of P2E-based digital health apps (objective one). Secondly, it will apply the identified factors to analyze and compare the effectiveness of P2E-based digital health apps like Dotmoovs, Stepn, and Sweatcoin, incorporating field research to examine user motivations (objective two). Based on the findings, it will offer informed management recommendations for Dotmoovs to enhance the apps' user adoption rates (objective three).

The literature review suggested that GameFi could significantly increase digital health app adoption by focusing on five key factors but also found potential demographic and motivational mismatches. Field research on three P2E apps showed varied user adoption and engagement, highlighting the need for tailored gamification strategies and a deep understanding of user motivations. The final section proposed recommendations to enhance Dotmoovs' adoption, including refining engagement strategies, simplifying cryptocurrency features, and improving usability and educational content to align the app closely with user needs and preferences.

1. Systematic Literature Review

This systematic literature review examines the role of gamified financing models and risk-sharing mechanisms in promoting the adoption of digital health applications. It addresses two main questions. First, it explores who uses gamified finance and risk-sharing strategies and identifies the factors behind their success. Second, it seeks to determine the factors that contribute to the high engagement and adoption rates of successful digital health applications.

1.1 Methodology

The review followed the PRISMA 2020 guidelines to investigate GameFi and risk-sharing in digital health apps. A protocol was established detailing the research questions, information sources, search strategy, selection criteria, as well as the data extraction and analysis methods.

1.1.1 Data Sources and Search Strategies

In February 2024, a comprehensive search across databases such as Science Direct, Scopus, and Research Gate identified studies relevant to GameFi and digital health app user adoption. The systematic review followed strict inclusion and exclusion criteria to maintain study relevance and quality. Inclusion criteria targeted peer-reviewed articles in English from 2015 onwards, focusing on relevant terms, free access, and exploring user adoption and gamified finance. Exclusion criteria were non-English articles, pre-2015 publications, non-peer-reviewed works, and irrelevant or paid-access articles.

1.1.2 Selection of Studies and Data Extraction Process

The study selection employed a broad range of keywords, namely *digital health, eHealth, GameFi, DeFi, Gamification*, and *P2E.* Titles and abstracts were reviewed by the single researcher who used the abovementioned criteria to determine paper eligibility. The full text of potentially relevant studies was reviewed independently for final inclusion.

1.1.3 Eligibility Criteria and Constitution of the Corpus of Analysis

The article selection process involved three rounds. Initially, titles and abstracts were screened. This was followed by a detailed analysis of the articles, guided by criteria aligned with the research question. In the final round, the reviewer consolidated all findings into a single document and thoroughly assessed each article's eligibility for inclusion in the study. The initial search identified 687 articles, which was reduced to 146 relevant articles after applying exclusion criteria. Of these, 89 were not free of charge and were excluded, leaving 57 articles for detailed assessment (see Appendix 1). Appendix 2 lists all 34 articles finally included in the review, while Appendix 3 provides an overview of their publication years.

1.2 Results

This section details the findings for each of the two research questions separately. The discussion will then focus on the overarching objective, outlining how gamified financing models and risk-sharing mechanisms could enhance the adoption of digital health applications.

1.2.1 Results Research Question One

Research question one explores who uses gamified finance and risk-sharing strategies and the factors behind their success. Although research is limited, two studies included in the review provided insights into the characteristics (Delic, 2023) and motivations (Lee, 2023) of P2E game users. Delic (2023) examined the characteristics that drive engagement in P2E gaming. He found that those engaged in P2E gaming often show higher impulsivity and are more likely to own digital assets like crypto and NFTs, indicating a blend of gaming and financial interests.

On the other hand, Lee (2023) analyzed the key motivational factors that influence player engagement in P2E games. The study identified three primary factors: gaming experience, financial outcomes, and P2E game awareness, with gaming experience being the most significant. Lee's findings emphasized the necessity for developers to prioritize high-quality gaming experiences in addition to financial incentives to foster growth in the P2E market. Proelss et al. (2023) echoed this and advised developers to invest in improving the entertainment value and quality of blockchain games, arguing that the potential earnings from gaming alone might not be sufficient to attract players due to the substantial risks associated with cryptocurrencies. An example of stakeholders and user roles in the P2E game Axie Infinity is provided in Appendix 4. Additionally, Appendix 5 and 6 respectively elaborate on GameFi's success factors as well as the role of risk sharing mechanisms within the GameFi context.

1.2.2 Results Research Question Two

This section examines the factors contributing to high engagement and adoption rates of successful digital health applications, using findings from six studies. Wang and Qi's (2021) study were particularly comprehensive, examining ten factors across individual, social, and app design dimensions affecting mobile health app behavior, as visualized in Appendix 7.

On the individual dimension, the study identified that demographics and motivation significantly influence app usage. Younger individuals more frequently used these apps, whereas adoption among those over 70 was rare. Also, it found that negative self-health assessments deterred app use, while those more aware of their health were likelier to use them (Wang & Qi, 2021). The social dimension also plays a crucial role as social networking enhances app engagement by fostering interest, achievement, and retention. Lee et al. (2017) further supported this, noting that social interactions and media integration are particularly effective in increasing app enjoyment and motivation among users with chronic diseases.

From an app design perspective, functionality, ease of use, perceived usefulness, security, and cost are critical. Wang and Qi (2021) highlighted that personalized features and gamification aspects such as badges, levels, and behavior comparison with other users, enhance attractiveness and user motivation. Lee et al. (2017) found that gamification is effective in increasing user intention to use digital health applications, as it satisfies achievement desires. Specifically, their results suggested that digital health with gamification factor encourages healthy people who lack exercise, increase their interest in healthcare by satisfying their desire to achieve individual interests. Gamification also increased the motivation of study participants classified as unhealthy, yet to a lower degree than the healthy group (Lee et al. 2017).

According to Wang & Qi (2021) ease of use and utility significantly impact user readiness to adopt health apps, with a straightforward interface enhancing user interaction. However, the significant time and effort required can deter acceptance. Potential users are also unlikely to adopt an app unless it is efficient and user-friendly. Zhao et al. (2018) suggested that utility values like entertainment are vital, recommending user involvement in development to address usage difficulties. Mouloudj et al. (2023) recommended strategies to boost users' confidence in their ability to use the apps effectively, thereby increasing self-efficacy and adoption.

Ultimately, Wang and Qi (2021) highlighted security and cost concerns. They noted that concerns over the security and privacy of health data deter users from adopting or continuously using these apps. Additionally, some users are unwilling to pay for mobile health applications. Echoing this, Woldaregay (2018) pointed out that addressing privacy and trust issues clearly is essential for enhancing long-term adoption of digital health technologies.

1.3 Discussion

This systematic review of the research papers addressed two research questions to meet the

overall objective of identifying how gamified financing models and risk-sharing mechanisms could leverage the diffusion and adoption of digital health applications. Initially, the review explored the user base of gamified financing and identified GameFi success factors, followed by an assessment of factors leading to the high engagement and adoption of digital health apps.

The review revealed that GameFi users often own digital assets and are driven by both the enjoyment of gaming and economic gains, yet the importance of game design is often overshadowed by economic incentives. Key elements of GameFi's success include economic incentives, democratization of asset ownership, low entry barriers, high entertainment value, and an engaged community. Additionally, the review identified ten factors influencing digital health app adoption, which Wang & Qi (2021) categorized into individual, social, and app design dimensions. Appendix 8 links these factors with GameFi and risk-sharing insights, highlighting potential leverage points for digital health app adoption.

GameFi could significantly enhance digital health app adoption, primarily through its innovative app design. Characteristics such as economic incentives, accessible asset ownership, and low entry barriers align with users' cost sensitivities in digital health apps. The P2E model, by lowering cost barriers and offering financial incentives, could remove financial barriers and reward users with minimal initial investment. Moreover, GameFi's risk-sharing tools might mitigate security concerns, thus improving trust and engagement. GameFi applications requiring less personal health data could also enhance users' security perceptions, promoting increased adoption. The research also indicates that users value apps that deliver optimal utility. GameFi's financial incentives could enhance this, particularly when enriched with personalization features like progress tracking or tailored development zones, which have been shown to support in digital health app adoption. However, perceived ease of use might be

less advantageous due to potential discrepancies between cryptocurrency-savvy GameFi users and traditional digital health app users focused on health improvements. Conversely, those knowledgeable about cryptocurrencies may not prioritize health improvement.

On the individual dimension, GameFi could enhance the social aspects of digital health apps, as research indicated that social networking boosts app engagement, interest, achievement, and retention. Games like Axie Infinity introduce a social element through interactive user roles, and further integrating social media could enhance user engagement and adoption. Nonetheless, it is important to recognize that the impact of GameFi on digital health app acceptance may be limited at the individual level due to differences in demographics and motivations between GameFi and digital health app users, potentially posing risks in terms of ease of use. Appendix 9 provides a summary of the systematic review's key findings.

1.4 Limitations

In conducting this systematic literature review, the updated PRISMA guidelines were respected. To include a wide range of relevant studies, three electronic databases were thoroughly searched. Yet by only including three databases, potentially relevant papers may have been overlooked due to biases in the selection of databases or biases in the selection of the search terms applied. Additionally, 89 papers were excluded as they were not available free of charge, which potentially neglected relevant papers. Further, this review is subject to language bias, since only papers in English were included.

1.5 Conclusion

The exploration of gamified financing models and risk-sharing mechanisms highlights their potential to significantly increase the adoption of digital health applications. Through a systematic review, this first part delivered insights from 34 articles, identifying potential factors for adoption of P2E apps in the health space. The findings suggest that GameFi's economic

incentives and low barriers to entry align with user preferences, potentially increasing digital health app adoption. However, challenges arise in aligning the interests of traditional health app users with the GameFi audience, indicating a need for developers to adopt targeted strategies that address these differences. Additionally, the importance of integrating social features and high quality gamification elements within apps is emphasized. Yet, to fully leverage GameFi's benefits, developers must navigate the discrepancies in user demographics and preferences carefully. To conclude, while GameFi offers promising opportunities to increase the adoption of digital health applications, successful integration depends on tailored approaches that consider user security, cost sensitivity, social attributes, ease of use, and powerful gamification integration.

2 Field Research

The paper’s first section reviewed digital health app adoption determinants, emphasizing how gamified financing and risk-sharing might further enhance adoption rates. It noted that P2E models support half of the digital health app adoption factors. This section examines these factors in the P2E apps Dotmoovs, Sweatcoin, and Stepn, split into two parts. The first evaluates app alignment with the key adoption drivers, while the second conducts a field study on motivational factors and key design elements in these apps.

2.1 Research Section One

The following research will focus on the five areas where P2E health applications demonstrate potential to boost the adoption of digital health apps. These factors include functionality, perceived usefulness, social attributes, security, and cost. The investigation will examine each factor individually for the three applications, Dotmoovs, Sweatcoin and Stepn.

2.1.1 Functionality and Perceived Usefulness

The literature review revealed that gamification significantly supports user motivation, a key factor in the adoption of digital health apps. P2E applications inherently incorporate

gamification, likely enhancing user engagement. Additionally, perceived usefulness is a determinant in digital health app adoption. In P2E digital health apps, combining gamification with the potential for rewards while improving health could enhance their perceived usefulness. However, realizing these benefits depends on the apps delivering on their promised value.

A sentiment analysis of user reviews from the Apple app store and Google Play store was conducted that assessed perceptions of usefulness and functionality for the three apps regarding *Health Improvement*, *Financial Incentives*, and *Entertainment* value, the key motivators identified in the literature review. Additionally, reviews concerning the overall *Functionality* of the apps were also examined. Reviews were analyzed using the tool Appbot, classifying sentiments as positive, neutral, negative, or mixed. Established keywords for each factor were used to facilitate this process, including *Health Improvement* (healthy OR fit OR fitness OR lifestyle), *Entertainment* (fun OR enjoy OR boring OR entertaining), *Financial Return* (return OR gain OR earn OR reward) and *Functionality* (work OR bug OR functions OR problems).

In the *Financial Return* category, Stepn and Sweatcoin showed contrasting sentiments. Stepn had balanced positive and negative feedback, each at 41%, while Sweatcoin encountered significant dissatisfaction, with 71% negative sentiment due to unmet reward expectations. Dotmoovs, however, stood out with 88% positive reviews, suggesting it effectively met user expectations for rewards. Many users voiced concerns that Sweatcoin no longer offers tangible rewards and that the rewards provided are often just discounts or coupons. In terms of *Health Improvement*, Stepn and Sweatcoin both received generally positive feedback, scoring 69% and 58% in positive sentiment, respectively. However, Stepn faced slightly more criticism, with users skeptical of its health benefits and concerned about data privacy related to NFT sales. Dotmoovs had too few reviews in this area to provide a robust analysis. *Entertainment*

value varied among the apps. Stepn led with 71% positive sentiment, whereas Sweatcoin's less engaging walking activity resulted in only 59% positive reviews. Dotmoovs convinced with 93% positive feedback, attributed to its engaging game design that resonated well with users. *Functionality* received the most critical feedback, where both Stepn and Sweatcoin's reviews showed high negative sentiments at 77% and 90% respectively. The primary reason for this is that users complain about the inaccuracy of step tracking of the apps. Dotmoovs, despite lower quantity of functionality reviews, maintains a more balanced spread across sentiments, with a notable 44% positive feedback.

Due to the varying number of reviews across apps and factors, the period analyzed for Sweatcoin was set at 90 days (January to March 2024), whereas a whole year was taken into account for Stepn and the analysis for Dotmoovs included all reviews until 2022. The sentiments expressed in these reviews give a snapshot of user opinion but must be considered within the context of the number of reviews and the time frame from which they were gathered. In summary, the analysis highlights that users value earning rewards through physical activity, but express frustration when expectations are not met, particularly with Sweatcoin. This underscores the importance of transparent communication about potential earnings. Moreover, the success of gamification depends on engaging and enjoyable game mechanics. Sweatcoin's scheme was often seen as monotonous, impacting user retention, while Stepn and Sweatcoin struggled with step tracking accuracy. In contrast, Dotmoovs, with its AI-based challenges, was perceived as having a more effective and appealing design, suggesting that robust game mechanics and reliable functionality are vital for user satisfaction in gamified health apps. The detailed results of the sentiment analysis are portrayed in Appendix 10.

2.1.2 Social Dimension

The literature review underlined social networking's role in enhancing engagement with mobile

health apps by maintaining user interest and involvement. Thus, P2E-based digital health applications should focus on developing strong community connections that extend beyond the app. Therefore, the apps were analyzed and compared based on their social media performance.

The engagement rate on social media, which calculates the average interactions per follower, is a common metric for analyzing social media performance. This allows for consistent comparisons across different channels, regardless of the total number of followers. The rate is calculated by dividing the total interactions by the number of followers and multiplying by 100% (Corporate Finance Institute, 2024). The analysis initially intended to compare engagement rates across various channels. However, after expert consultation, only Instagram was selected due to its higher posting activity compared to Facebook and X. The engagement rates were calculated using the online tool Phlanx. Results indicated that Stepn showed the highest rate with 0.21%, while Sweatcoin and Dotmoovs with 0.03% and 0.01% showed significantly lower rates. Notably, Instagram engagement rates are typically considered high around 1-2% (Corporate Finance Institute, 2024). Thus, while all three applications show relatively low engagement rates, Stepn stands out with the highest engagement rate.

Building on these findings, a content analysis was conducted to understand why Stepn achieves higher user engagement compared to the others. Since all target similar audiences, this analysis aimed to identify the content types that resonate most effectively with their followers. The content from these three apps over the past three months (January to March 2024) was examined and classified into thematic categories. The results are detailed in Appendix 11. Stepn implemented a diverse content strategy that included educational posts about running, often in collaboration with athletes, humorous content to engage the community, and updates on new app features. This mix informed but also helped to create a sense of belonging among

users, effectively engaging, and binding the Stepn community. Sweatcoin focused mainly on entertainment, using humorous videos and memes about collecting steps to engage followers, and highlighting potential rewards. Their strategy was tailored to align with current trends, aiming to capture attention through relevant content. Dotmoovs adopted a different approach, emphasizing the technical sophistication of their app with posts about features, AI technology, and subscription plans. They also included fitness motivation and educational content, accompanied by occasional nutrition tips to inspire a health-conscious mindset among users.

The content analysis suggests that Stepn's higher engagement rate could be a result of its well-rounded content strategy that spans educational, entertaining, and community-oriented posts. In contrast, Sweatcoin and Dotmoovs, which favored humor and motivational content respectively, did not achieve similar engagement levels. This highlights the potential need for these apps to diversify their content strategies to foster higher interactions on social media.

2.1.3 Security

The literature review underlined that user adoption of digital health apps increases when apps respect the security and privacy of personal data. P2E digital health apps potentially collect less personal, health, and financial data than traditional digital health apps, making them more appealing to privacy-conscious users. Thus, an examination of the privacy policies of four applications was conducted, with a focus on personal, health, and financial data (Appendix 12). The diabetes management app MySugr was included to compare the three P2E apps against a traditional health app. The analysis verified that MySugr gathers the most data, due to its focus on diabetes management which requires a broad range of health data for tailored care.

Among the P2E apps, Dotmoovs collects biometrical data for its game activity, while Stepn and Sweatcoin primarily use GPS tracking. A questionnaire-based study was conducted to determine if the type of data collected influences user willingness to download P2E digital

health apps. Additional topics explored in the study will be detailed in the next chapter, but initial findings related to data protection sensitivity are presented here: Among 67 respondents, 56% stated that the type of data (biometrical or GPS) did not affect their decision to download an app. Only 3% would refrain from downloading apps that collect either type of data, while 22% were hesitant about apps that collect GPS data, compared to 19% who were cautious about apps gathering biometrical data.

This investigation highlights two key findings. Firstly, a comparison of privacy statements between P2E-based digital health apps and MySugr revealed that MySugr collects more user data. Thus, P2E-based digital health apps might indeed be an attractive alternative for those users that are more cautious about the collection of their data. Secondly, the main difference in data collection among Dotmoovs, Stepn, and Sweatcoin is between biometrical and GPS data. Research aimed at determining user preference for either data type showed that the decision to download an app is not influenced by the nature of the data collected.

2.1.4 Cost

The initial literature review noted that some people refrain from adopting digital health apps due to costs, highlighting an opportunity for P2E digital health apps, which are often free and offer a reward incentive. Therefore, the costs associated with using Dotmoovs, Sweatcoin, and Stepn were analyzed to determine which requires the least investment for engagement. The analysis included all associated costs namely initial download cost, in-app purchases, subscription fees, initial investments required, earning mechanism and earnings limitations.

All three apps are free to download. Stepn requires an initial investment in NFT sneakers and cryptocurrency for transactions, with an entry-level NFT costing $49, and users must set up a digital wallet. Sweatcoin has a more accessible model, offering a free version that caps the

number of steps earning currency, with an optional premium subscription that increases this cap and removes ads. Dotmoovs, similar to Stepn, follows the NFT model with optional subscription plans, requiring investments for full functionality and personalized features. Further elaboation on the key findings is available in Appendix 13. Thus, in conclusion, Sweatcoin is the most cost-effective, allowing users to participate in earnings without upfront investments, making it the most accessible application. Dotmoovs and Stepn cater to those more integrated into digital and cryptocurrency spaces, who are willing to make initial investments for potentially higher returns.

2.1.5 Conclusion Research Section One

The findings from this entire section indicate that gamification significantly boosts user engagement, with apps blending health improvements and engaging game mechanics receiving positive feedback. The sentiment analysis showed mixed feelings about financial returns but generally positive views on health benefits. Technical issues like inaccurate step tracking were noted for Stepn and Sweatcoin. Regarding social engagement, Stepn's varied content strategy outperformed others in terms of user engagement, underlining the effectiveness of educational, entertaining, and community-focused posts. Although all apps are free, those requiring initial investments like Stepn and Dotmoovs are less accessible compared to Sweatcoin's more flexible model. A summary of this section’s key findings is available in Appendix 14.

2.2 Research Section Two

This second phase addressed two questions: "What motivates users to engage with P2E digital health apps?" and "Which design features are most valued?". A survey and a discrete choice experiment were conducted to offer insights into user motivations and design preferences.

2.2.1 Methodology

The survey was conducted using the online platform Microsoft Forms, allowing for efficient distribution and collection of responses from participants. The target population for this survey

included everybody with a minimal understanding of digital. The survey did not exclude any population segments, reflecting the unrestricted availability of applications in the Apple app and Google Play store. A total of 67 participants completed the study. The questionnaire consisted of two core sections. Section one comprised of twelve demographic multiple-choice questions, addressing the participants' health status, their experience with digital health applications and cryptocurrencies. The second section included three multiple-choice questions addressing the participants' interest and motivation to download a P2E-based digital health app. To understand which factors people value when choosing such app, the participant was asked to complete a discrete choice experiment. The experiment, consisting of four questions, exposed the participant to choose their preferred option out of two hypothetical digital health applications that were presented. The choice set followed a full factorial design, including three attributes (*Game Activity, Reward Mechanism*, and *Entry Barrier*) with two levels for each attribute. The attributes were developed to reflect key components of P2E-based digital health applications. The two levels in each category were developed to reflect the app design of Dotmoovs, Sweatcoin and Stepn. Appendix 15 portrays the full experiment design. All survey questions, including the attributes and levels of the discrete choice experiment were developed with prior expert consultation. The survey was open for responses between March 15, 2024, until March 22, 2024 and the survey link was distributed via social media networks, professional networks, and email. Participants were informed about the purpose of the survey, its voluntary nature, and the confidentiality of their responses through an informed consent clause at the beginning of the survey. Data from the discrete choice experiment was analyzed using the software Stata, while the qualitative responses were analyzed manually, identifying key themes and patterns.

2.2.2 Study Results

Section one focused on experience with digital health apps and cryptocurrencies, revealing a

demographic dominance in the 18-30 age group (91%) with a slight male majority (58%). 66% (44 participants) have used or are currently using digital health applications, primarily fitness and sports apps (61%). Only 27% of these users have spent money on such apps. The main motivations for using digital health applications were improving physical health (49%) and enhancing mental health (20%), with most users engaging with these apps weekly. A significant 73% noted a positive impact on their physical health, with 65% experiencing a moderately positive effect and 8% a significantly positive effect. Experienced users (66%) expressed a desire for more personalized recommendations (31%), additional features (24%), and lower costs (18%), with 16% seeking easier usability. Preferences among non-users (34%) were similar, with 27% indicating that a recommendation from a healthcare professional would likely increase their usage. Non-users also favored more personalized recommendations and lower costs (23% each), and 20% said that easier app usability would encourage their future use. Participants generally described their physical activity levels as active, with only 7% identifying as physically inactive. The overall health status was viewed positively by 51% of respondents, rating their health as very good or excellent. Cryptocurrency knowledge among participants was limited, as 33% had no understanding and 48% possessed basic knowledge.

Section two of the survey included the discrete choice experiment, investigating user motivation to adapt to a P2E digital health app. The independent variables included 'Game Activity', 'Reward Mechanism', and 'Entry Barrier'. The analysis incorporated a total of 268 observations, reflecting the decisions made by participants across all choice sets presented.

The linear regression results revealed unstandardized coefficients of 0.5003 for 'Game Activity', 0.5000 for 'Reward Mechanism', and 0.5031 for 'Entry Barrier'. The model explained 74.98% of the variance (R-squared = 0.7498) and had an adjusted R-squared of 0.7470,

indicating a precise fit. The significant F-statistic ($F(3, 264) = 263.76$, p-value ~ 0.0000) underscores the model's robustness. An extended analysis with demographic variables showed that 'Age18', 'Age1830', and 'Age3045' had no significant effects (p-values: 0.561, 0.162, 0.079, respectively), and the 'Female' variable also had an insignificant impact ($\beta = -0.002$, $p = 0.929$), suggesting that age and gender did not significantly influence choices. The standard errors adjusted for RespondentID confirmed the strong influence of the primary attributes ($p < 0.001$ for all), emphasizing their significant impact on user choices in the P2E app design. The full regression results are available in Appendix 16.

Following the discrete choice experiment, participants answered final questions on their motivations and barriers for adopting P2E digital health apps. Health improvement was the main motivator for 44% of respondents, followed by financial rewards (30%), and enjoyment (22%). The primary adoption barrier was the effort involved in downloading and setting up the apps (38%). A lack of cryptocurrency knowledge was a barrier for 32%, and 15% did not see these apps as useful for health improvement, while 14% had no interest in using such apps. In terms of data privacy, 56% said the type of data collected by P2E apps does not affect their download decision. Among the rest, 22% preferred apps that collect GPS data, 19% favored those collecting biometrical data, and only 3% would avoid apps collecting any such data. Details on the survey results, including the choices made in the discrete choice experiment, are in Appendix 17, with a summary of key findings in Appendix 18.

2.2.3 Discussion

Research question one explores motivations for adopting P2E-based digital health apps. While no prior studies have specifically investigated the motivational factors for adopting to apps like Dotmoovs, Sweatcoin, or Stepn, the literature suggested that financial rewards are the primary motivator for engaging with P2E games such as Axie Infinity, with entertainment as a strong

secondary factor. For digital health applications, the main motivator is in health status improvement. A survey was conducted to understand what motivates adoption when P2E and digital health contexts merge in a P2E-based digital health app.

The survey found that 44% of participants are primarily motivated to use P2E-based digital health apps for health status improvement, with financial incentives (30%) and enjoyment (22%) following. This aligns with demographic data showing that 66% of respondents have used digital health apps to enhance physical health, yet only 16% have moderate or greater cryptocurrency understanding. The survey also revealed hesitations, as 32% cited a lack of cryptocurrency knowledge and another 32% cited high setup effort and associated costs as barriers to downloading P2E apps. Thus, the results of the study indicate that familiarity with digital health apps rather than cryptocurrency drives health-focused motivation. The appeal of financial rewards exists, but cryptocurrency integration deters potential users, suggesting a need for user-friendly designs in P2E-based digital health apps, especially for those with limited cryptocurrency knowledge.

The second research question explored which P2E app design factors are most valued using a discrete choice experiment. For the *Game Activity* attribute, the significant coefficient of about 0.5003 for competitive sports challenges suggests users prefer engaging activities supported by AI over simple distance tracking. Regarding the *Reward Mechanism*, a coefficient of about 0.5000 shows a strong preference for in-game currencies redeemable within the app's marketplace over direct financial rewards in cryptocurrency, reflecting greater utility and accessibility. For the *Entry Barrier* attribute, the coefficient of about 0.5031 for setups requiring a digital wallet and initial NFT purchase indicates that users view these features as enhancements, not barriers. Additionally, demographic variables such as age and gender did

not significantly affect the choice outcomes, suggesting that these preferences are consistent across different demographic groups. These insights emphasize the importance of engaging game activities, integrated reward systems, and meaningful entry requirements, suggesting that these elements can enhance user engagement and experience, providing guidance for developers towards optimizing P2E digital health app designs.

2.2.4 Study Limitations and Future Research

The study on user motivations and preferences for P2E-based digital health applications, though insightful, has several limitations. The sample size of 67 participants is sufficient for exploratory purposes but not robust enough to generalize across diverse populations. Furthermore, 91% of participants were aged 18-30, which may not reflect older demographics' motivations and preferences.

Statistically, the discrete choice experiment showed explanatory power with an adjusted R-squared of 0.7470, capturing significant variance in user choices. All attribute coefficients were statistically significant below the 0.05 level. However, the lack of significant effects from demographic factors indicates a need for further research to explore other influences or broader sample variations. Further, the simplification in measuring variables related to motivations and barriers, using binary coding for game activities, reward mechanisms, and entry barriers, might not capture the complexity of users' real-world decision-making processes, potentially limiting the findings' applicability. Also, the survey's distribution method and its availability for only one week, might have introduced bias by not reaching a representative sample of the general population. Thus, while this study is the first of its kind, it highlights the need for further research with a more robust methodology to better understand engagement dynamics.

2.2.5 Conclusion Research Section Two

This study section explored motivations for adopting P2E-based digital health applications.

The survey revealed that the primary motivation for using these apps was health status improvement, with financial incentives as a secondary driver. Barriers included the effort required to download and set up apps (38%), a lack of interest or knowledge in cryptocurrency (32%), and doubts about the usefulness of P2E apps for health improvement (15%). Additionally, a discrete choice experiment examined three attributes (game activity, reward mechanism, entry barrier) to determine which design features of P2E apps users value most.

Results indicated a clear preference for interactive game activities, such as those evaluated and rewarded in competitive sports challenges, over simple distance tracking. Also, there was a strong preference for in-app currency rewards over crypto-based rewards, reflecting concerns over the complexity of cryptocurrencies. Opposed to initial expectations, the experiment showed a preference for higher entry barriers, like digital wallet and NFT requirements, suggesting that users value the exclusivity or security the features provide in P2E apps.

3 Management Recommendations

This final section offers actionable management recommendations for Dotmoovs based on the insights from the literature review and field research. The following subchapters detail these recommendations, providing strategic rationale and outlining the management implications.

3.1 Management Recommendation 1

"Target Audience Refinement: Target physically active users and streamline cryptocurrency features to align with health-focused motivations"

This paper's literature review revealed that digital health apps are predominantly used by young, health-conscious individuals primarily focused on enhancing their health status (Wang & Qi, 2021). In contrast, users of P2E games typically have knowledge about crypto and are driven by the potential for financial rewards (Delic, 2023). This indicates a misalignment between the demographic and motivational factors of digital health app and P2E game users.

Survey results reinforced this misalignment, showing that while most respondents were

physically active, only a few possessed significant knowledge of cryptocurrencies. Specifically, 20 respondents were very active physically, but only two had expert knowledge in crypto, suggesting that those who are physically active may be less likely to be knowledgeable in the crypto field. The survey also found that potential users of P2E-based digital health applications were primarily interested in improving their health status, with financial gains as a secondary motivation.

Following the literature and study findings, decision-makers should target physically active individuals rather than those knowledgeable in cryptocurrency. This demographic is not only larger but also more likely to adopt to digital health solutions. Simplifying cryptocurrency integration and reducing initial barriers could improve adoption rates. This strategy would align the offerings with the users' main motivations, merging health enhancement benefits with the appeal of financial rewards.

3.2 Management Recommendation 2

"App Usability for Crypto Beginners: Simplify the app's crypto features and enhance educational content to lower entry barriers for health-focused users"

The discrete choice experiment conducted in this paper aimed to identify which design features of P2E apps are most valued by users. Results on the preferred gaming activity indicated a slight preference among users for competitive sports challenges over simple step tracking. This underlined that, among its competitors, Dotmoovs emerged as having the most appealing game design. However, in terms of reward mechanisms, respondents showed a preference for in-app currencies over cryptocurrencies. Also, participants named the involvement of cryptocurrencies, as well as the high perceived barriers through digital wallet creation and NFTs, as significant deterrents to adopting P2E digital health apps. These findings align with the demographic and motivational insights highlighted in the first recommendation, arguing

that more people are physically active than crypto savvy.

Given these observations, it is evident that while the gaming aspect of the app resonates well with potential users, the reward mechanism and the complexity of entry barriers, specifically the requirements related to cryptocurrency knowledge, discourage adoption among health-conscious, active individuals who are not familiar with cryptocurrencies. Therefore, it is crucial for Dotmoovs to address these challenges through thoughtful app design and communications tailored to users with limited knowledge of cryptocurrencies. Measures to enhance user-friendliness and accessibility could include simplifying the dashboard, providing step-by-step guides, creating educational content such as videos and articles, and employing targeted marketing communications that focus on the gaming activity and simplify messaging around rewards. These adjustments will make the app more accessible to newcomers to cryptocurrencies and can help bridge the gap between engaging game design and the complexities of crypto, ultimately encouraging wider adoption among the target demographic.

3.3 Management Recommendation 3

"Game Design Enhancement: Prioritize engaging health-focused game activities and manage user expectations about financial rewards to improve satisfaction"

The literature review on P2E games highlighted a general focus on optimizing reward schemes while often neglecting game activity design, which significantly influences user engagement (Lee, 2023). The study within this paper supported this observation, finding that users value health status improvement more highly than financial rewards. Thus, developers are advised to prioritize health-enhancing game designs, using financial incentives as an additional motivator.

Two findings underscore the importance of game activity. Firstly, the sentiment analysis revealed user frustration with Stepn and Sweatcoin's game activities, criticizing the monotony

and inaccuracies in step tracking. Secondly, a discrete choice experiment showed Dotmoovs' game activities as significantly more appealing than those of the others. Thus, managers should focus on an app design that centers on improving health through engaging gaming activities, which is likely to resonate more with users than designs primarily focused on rewards.

Further research on P2E game reward mechanisms noted the importance of managing reward expectations. Literature warns that apps failing to deliver on their promises quickly lose users (Proelss et al., 2023). Sentiment analysis underscored user frustration with earning potential, especially with Sweatcoin, where unmet expectations led to dissatisfaction. Therefore, transparency about the earning potential in these apps is crucial. Setting realistic expectations can prevent dissatisfaction and enhance user retention, making it essential for P2E health applications, including Dotmoovs, to address these issues directly to improve the user experience and sustain engagement.

3.4 Management Recommendation 4

"Social Media Strategy: Shift to a community-focused content strategy with humor and user-generated content to boost engagement"

The literature review on digital health applications highlighted the significant impact of social networking in boosting interest, achievement, and retention rates in mobile health applications (Lee et al., 2017; Wang & Qi, 2021). A comparative social media analysis of Dotmoovs, Sweatcoin, and Stepn on Instagram revealed that Stepn had the highest engagement rate, indicating the most average interactions per follower. A content analysis among the three apps helped identify what types of content most effectively resonate with users. Stepn's strategy involves engaging content that includes humor related to app usage, educational posts about running with athletes, and updates on app features, all of which effectively engage and retain its community. Conversely, Dotmoovs takes a broader approach, focusing on showcasing app

features and AI technology, supplemented by motivational content and nutrition tips.

These findings suggest that Dotmoovs could enhance its social media management strategies to boost user engagement. Adopting a more community-centric approach, similar to Stepn's successful methods, could be beneficial. This involves content that resonates personally with users, incorporating humor, user-generated content, and real-life experiences related to daily app usage, which has been effective for Stepn in maintaining high engagement rates.

Conclusion

Digital health apps struggle with securing sustained user adoption rates. This paper aimed to identify strategies on how P2E models within the health context can increase the adoption of digital health apps. An initial literature review identified factors where P2E approaches might enhance the adoption of digital health apps. While GameFi models offer significant potential to increase digital health app adoption, their success depends on tailored strategies that consider user security, cost sensitivity, social features, ease of use, and effective gamification to accommodate user differences and preferences. These factors were applied and measured on the P2E apps Dotmoovs, Stepn, and Sweatcoin. Further, field research assessed user motivations and preferences for adoption, indicating that health benefits and financial rewards are significant drivers, whereas setup complexity and unfamiliarity with cryptocurrency are barriers for app adoption. A discrete choice experiment found that users favored interactive game designs such as competitive sport challenges over step tracking and in-app currencies over crypto rewards. The paper concluded with strategies to enhance Dotmoovs' app adoption rates. Thus, moving forward, refining engagement tactics, simplifying cryptocurrency features, and improving usability and educational content to better meet user needs, are measures Dotmoovs' decision makers should consider to enhance the app's sustained user adoption rate.

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Appendices

Appendix 1: Corpus of Analysis

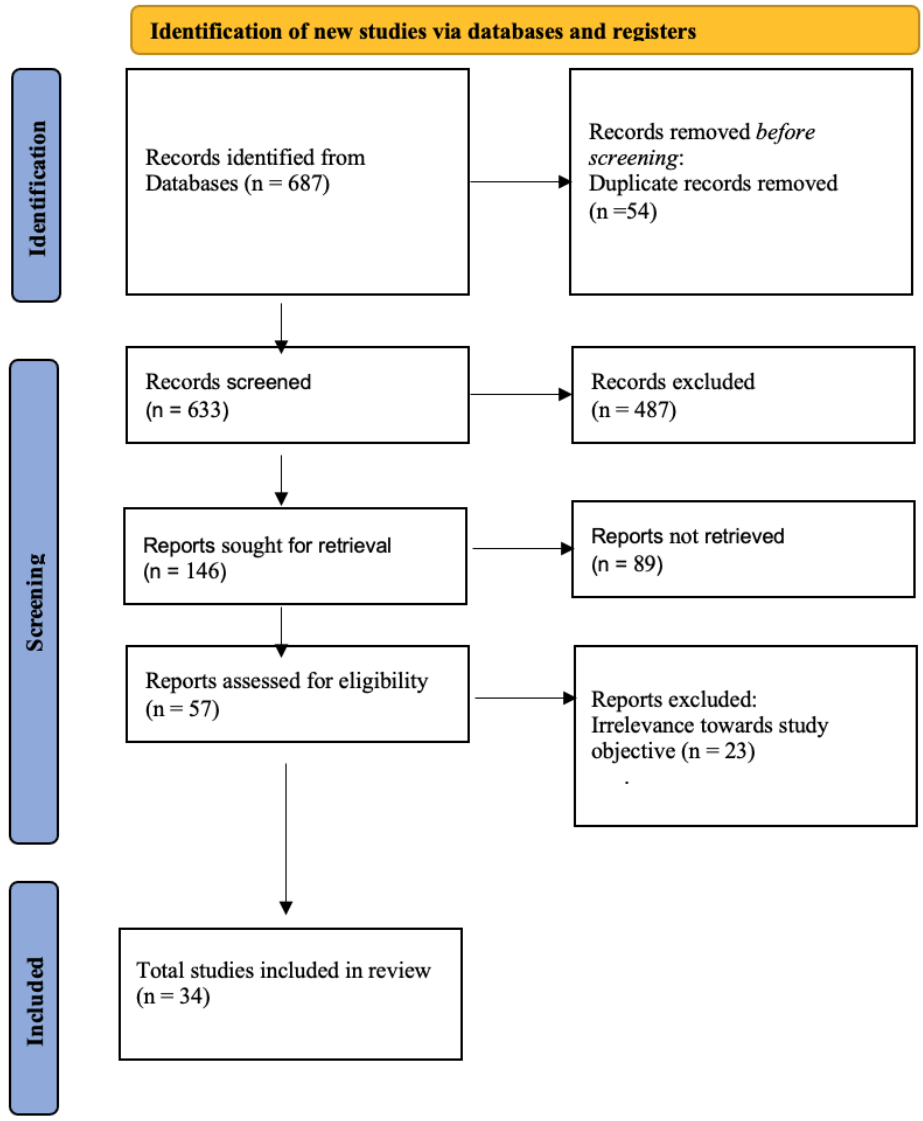

Figure 1: Corpus of Analysis (Source: own construction)

Appendix 2: Papers included in the literature review

Paper Code	Author(s)	Year	Name of Journal	Title
S1	Wan V., Cheng S.	2020	Frontiers in Psychology	Recommendations for implementing gamification for mental health and wellbeing
S2	Aschentrup L., Steiner P.A., Dadaczynski K., Mc Call T., Fischer F., Wrona K.J.	2024	BMC Public Health	Effectiveness of gamified digital interventions in mental health preventionand health promotion among adults: a scoping
S3	Wang C., Qi H.	2021	MDPI Healthcare	Influencing Factors of Acceptance and Use Behavior of Mobile Health Application Users: Systematic Review
S4	Zhao Y., Qi N., Zhou R.	2018	International Journal of Information Management	What factors influence the mobile health service adoption? A meta-analysis and the moderating role of age
S5	Lee C., Kyoungsun L., Dacho L.	2017	MDPI Sustainability	Mobile Health Applications and Gamification for Sutstained Helath Maintanance
S6	Woldaregay A. Z., Issom D.-Z., Henriksen A., Martinsen M., Mikalsen M., Pöhl G., Sato K., Loyis C., Hartvigsen G.	2018	Studies in Health Technology and Informatics	Motivational Factors for User Engagement with mHealth Apps
S7	Dugueleană A. R., Dugueleană M., Tănăsescu C. R.	2024	Journal of theoretical and applied electronic commerce research	Emerging Trends in Play-to-Earn (P2E) Games
S8	Berger V., Schrader U.	2016	MDPI Sustainability	Fostering Sustainable Nutrition Behavior through Gamification
S9	Patel M. S., Small D. S., Harrison J. D., Hilbert V., Fortunato M. P., Oon A. L., Rareshide C. A. L., Volpp K.	2021	Journal of the American Medical Association	Effect of Behaviorally Designed Gamification With Social Incentives on Lifestyle Modification Among Adults With Uncontrolled Diabetes: A Randomized Clinical Trial
S10	Van Velthoven M. H., Cordon C.	2019	Journal of Medical Internet Research	Sustainable Adoption of Digital Health Innovations: Perspectives From a Stakeholder Workshop
S11	Kinross J. M.	2018	Method	Precision gaming for health: Computer games as digital medicine
S12	Maqbool B., Herold S.	2018	Journal of Systems and Software	Potential effectiveness and efficiency issues in usability evaluation within digital health: A systematic literature review
S13	Mouloudj K., Bouarar A. C., Martínez Asanza D., Saadaoui F.	2023	IGI Global	Factors Influencing the Adoption of Digital Health Apps: An Extended Technology Acceptance Model (TAM)
S14	Johnson D., Deterding S., Kuhn K.-A., Staneva A., Stoyanov S., Hides L.	2016	European Society for Research on Internet Interventions	Gamification for health and wellbeing: A systematic review of the literature
S15	van der Heide A., Želinský D.	2021	Journal of Cultural Economy	'Level up your money game': an analysis of gamification discourse in financial services
S16	Yeoh E. D., Chung T., Wang Y.	2023	Journal of Contemporary Mathematics	Predicting Price Trends Using Sentiment Analysis: A Study of StepN's SocialFi and GameFi Cryptocurrencies
S17	Proelss J., Sévigny S., Schweizer D.	2023	International Review of Financial Analysis	GameFi: The Perfect Symbiosis of Blockchain, Tokens, DeFi, and NFTs?
S18	Schär F.	2021	Federal Reserve Bank of St. Louis *Review*	Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets
S19	Popescu A.-D.	2020	Social Science Research	TRANSITIONS AND CONCEPTS WITHIN DECENTRALIZED FINANCE (DEFI) SPACE
S20	Werner S., Klages-Mundt A., Perez D., Harz D., Gudgeon L., Knottenbelt W. J.	2023	Association for Computing Machinery	SoK: Decentralized Finance (DeFi)
S21	Brummer C.	2023	STANFORD JOURNAL OF BLOCKCHAIN LAW & POLICY	DISCLOSURE, DAPPS AND DEFI
S22	Smutny Z., Sulc Z., Lansky J.	2021	MDPI Mathematics	Motivations, Barriers and Risk-Taking When Investing in Cryptocurrencies
S23	Chen Y., Bellavitis C.	2020	Journal of Business Venturing Insights	Blockchain Disruption and Decentralized Finance: The Rise of Decentralized Business Models
S24	Delfabbro P., Delic A., King D. L.	2022	Journal of Behavioral Addictions	Understanding the mechanics and consumer risks associated with play-to-earn (P2E) gaming
S25	Lee, M.,Park, C.	2023	MDPI Sustainability	Examining Consumer Motivations for Play-to-Earn Gaming: Application of Analytic Hierarchy Process Analysis
S26	Delic A., Delfabbro P., King D. L.	2023	International Journal of Mental Health and Addiction	Understanding the Risks and Individual Difference Factors Associated with Engagement in Monetised (Play-to-Earn) Gaming
S27	De Jesus S. B., Austria D., Marcelo D. R., Ocampo C., Tibudan A. J.	2022	International Journal of Psychology and Counseling	Play-to-Earn: A Qualitative Analysis of the Experiences and Challenges Faced By Axie Infinity Online Gamers Amidst the COVID-19 Pandemic
S28	Zetzsche D. A., Arner D. W., Buckley R. P.	2020	Journal of Financial Regulation	Decentralized Finance
S29	Banaeian Far S., Rajabzadeh Asaar M., Imani Rad A.	2023	Data Science and Management	Blockchain and its derived technologies shape the future generation of digital businesses: A focus on decentralized finance and the Metaverse
S30	Sobolieva-Tereshchenko O.	2023	Journal of Management and Entrepreneurship	eHEALTH LITERACY IN DIGITAL ERA: TRENDS OF DEVELOPMENT
S31	Allam, A. H., Gomaa, I., Zayed, H. H., Taha, M.	2024	Journal of Cluster Computing	IoT-based eHealth using blockchain technology: a survey
S32	Bente B., van Dongen A., Verdaasdonk R., van Gemert-Pijnen J.	2024	Frontiers in Digital Health	eHealth implementation in Europe: a scoping review on legal, ethical, financial, and technological aspects
S33	Bueno-Muñoz C, Gajardo Sánchez A. D., López Sánchez J. Á., Murillo Zamorano L. R.	2023	SAGE Open	Gamification in Health Care Management: Systematic Review of the Literature and Research Agenda
S34	Mazanakis A.	2021	i-com	Gamification Reloaded Current and Future Trends in Gamification Science

Table 1: Papers included in the literature review (Source: own construction)

Appendix 3: Publication years of articles included

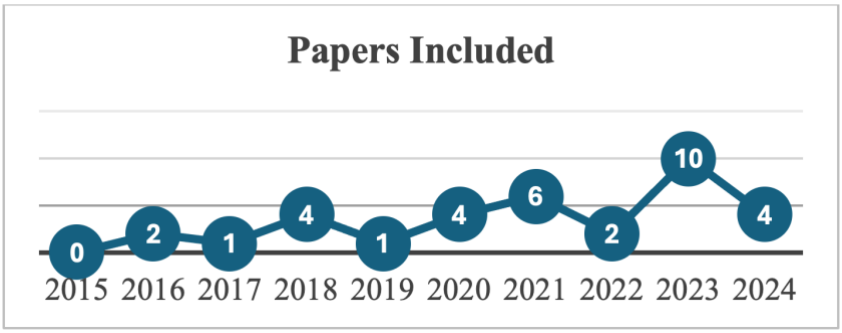

Figure 2: Publication years of articles inlcuded (Source: own construction)

Appendix 4: Stakeholders and roles in Axie Infinity

In his work, Proelss et al. (2023) investigated Axie Infinity, the most successful GameFi application to date. He elaborated on the key stakeholders and their roles with respect to the overall success of the game. These stakeholders include investors, managers, and scholars. Investors are individuals who speculate on a game's success and contribute capital indirectly by purchasing the game's currency. They invest in the game's economy without actively participating in the gameplay, betting on the overall success and adoption of the game to increase the value of their investments. Managers, on the other hand, play a crucial role by lending their in-game assets, such as Axies, to other players. This allows them to monetize idle assets while facilitating new players' access to the game without upfront investment. Ultimately scholars are active players who, lacking the resources to acquire initial assets, borrow them from managers to participate in the game. They contribute to the game's ecosystem by playing and earning rewards, which are then shared with the managers as per their agreement (Proelss et al., 2023) .

Appendix 5: Factors contributing to GameFi's current success

Research on GameFi remains scarce, with no extensive academic studies exploring its success factors to date. Nevertheless, Proelss et al. (2023) conducted a notable case study on Axie Infinity. The study explored its economic and social impacts, particularly how it introduces

new monetization strategies beyond traditional gaming revenue models. Key to Axie Infinity's success is its ability to offer real economic incentives, allowing players to earn in-game and governance currencies and Axie NFTs, which can be sold for fiat currencies on cryptocurrency exchanges. The democratization of game asset ownership via blockchain technology and the creation of new revenue streams through NFTs also play vital roles. Axie benefits from low entry barriers and high entertainment value, attracting a broad user base and fostering an ecosystem where gaming experiences are monetized and owned by players, leading to an engaged and financially empowered community (Proelss et al., 2023) .

However, Proelss et al. (2023) also points out significant challenges faced by P2E games like Axie Infinity, particularly their reliance on continuous new player investment for economic sustainability. The model risks collapse if the entrance of new players slows, leading to asset value depreciation due to oversupply. Additionally, the game struggles with inflation issues due to limited mechanisms to control its in-game currency supply, increase price drops during market downturns. These challenges necessitate innovative strategies to stabilize and grow the P2E economy (Proelss et al., 2023) .

Appendix 6: Additional insights on Risk Sharing Mechanisms

GameFi also leverages the DeFi ecosystem by adopting its risk-sharing mechanisms. Within the scope of this paper's literature review, these mechanisms have also been explored. Three papers have been included in the review, as they deliver an in-depth outline of the mechanisms.

The risk sharing mechanisms addressed across all papers, Dragos (2022), Schär (2021) and Werner (2022), include smart contracts, yield farming, DeFi insurance, and derivatives. Briefly summarized, smart contracts automate and enforce agreements without intermediaries, reducing counterparty risks. Yield farming rewards users for lending or staking crypto assets,

involving strategies that distribute protocol risks. DeFi insurance protects against losses from vulnerabilities or hacks, enhancing ecosystem trust. Lastly, derivatives, as financial instruments tied to an underlying asset, offer participants ways to hedge against market volatility, further securing investments against the unpredictable nature of crypto markets (Dragos, 2022). Schär (2021) derived the opportunities arising from risk mechanisms in the DeFi ecosystem. He highlighted the transformative impact of DeFi on the financial sector by leveraging blockchain technology to enhance efficiency, accessibility, and transparency. DeFi automates and reduces the cost of financial processes, broadens access to services, and fosters innovation through its open-source, interoperable protocols. It ensures transparency and security, democratizes the financial system, and introduces new financial products like stablecoins and decentralized exchanges. These developments promise a more inclusive, efficient, and transparent financial ecosystem (Schär, 2021).

Appendix 7: Ten factors affecting mobile health app behaviour

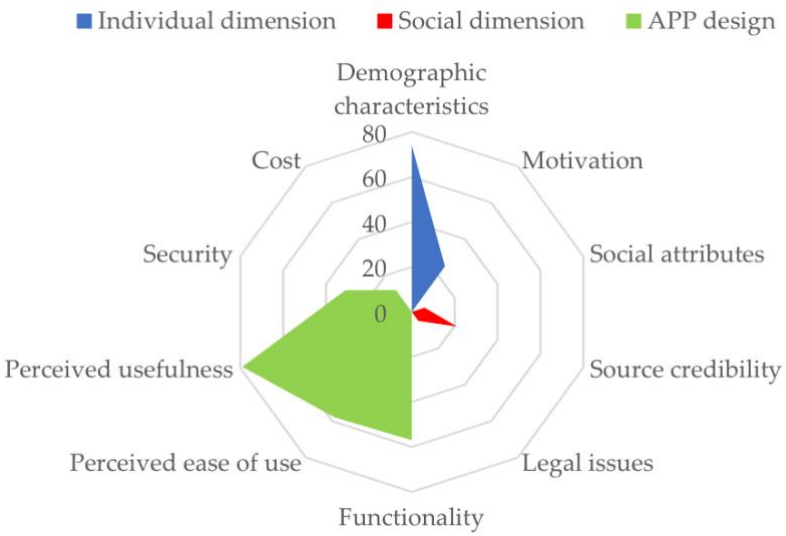

Figure 3: Ten factors affecting mobile health app behaviour (Source: Wang & Qi, 2021)

Appendix 8: GameFi & Risk sharing opportunity for Digital Health App adoption

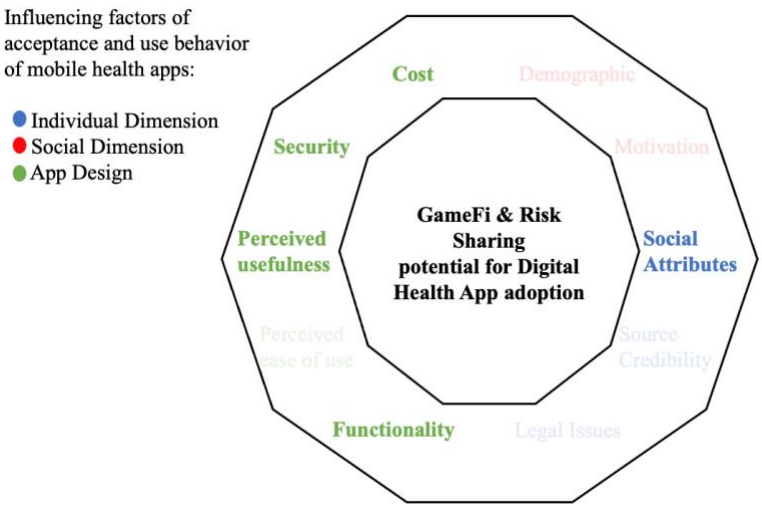

Figure 4: GameFi & Risk sharing opportunity for digital health app adoption (Source: Own Graphic)

Appendix 9: Summary Table Literature Review

Dimension & Factor	Finding on Digital Health App adoption	Implications for the adopotion of P2E-based Digital Health Apps
Individual Dimension **Demographics**	Mobile health applications are predominantly utilized by younger individuals, whereas older adults, particularly those over the age of 70, rarely adopt or make use of these mobile health tools. Negative self-health assessments deter app use, chronic conditions increase it.	Potential risk identfied. Digital health app users are primarlily heatlhy individuas, interested in increasing their heatlh status. They are not necessarily educated on cyrptocurrencies.
Individual Dimension **Motivation**	Health awareness positively correlates with health application use.	Potential risk identfied. Users of digital health applications are interested in increasing their health status. GamFi users are intersted in achieving financial return or enterainment.
Social Dimension **Social Attributes**	Social networking boosts mobile health app engagement by increasing interest, achievement, and retentions.	**Potential opportunity** identified. GamFi applications such as Axie Infinty incoportate social attributes by game design through various user roles which interact and enage in game.
Social Dimension **Source Credibility**	Support from healthcare institutions or healthcare professionals may enhance the credibility of mobile health applications.	No significant potential for adoption of digital health apps through GamFi identfied.
Social Dimension **Legal Issues**	Absence of legal oversight reduces user confidence in mobile health applications.	No significant potential for adoption of digital health apps through GamFi identfied.
App Design **Functionality**	Gamification provides an emotional support for maintaining motivations. Personalization is a key characteristic that enhances the attractiveness and acceptability of mobile health applications.	**Potential opportunity** identified. P2E models do not only require minimal investment but also provides financial retrun.
App Design **Perceived Ease of Use**	Clean and simple user interface benefits user interaction with app. The enormous amount of energy and time consumed is a hindrance to users' acceptance and use.	Potential risk identfied. Digital health app users lack knowledge on cryptocurrencies. They might refrain from using GamFi applications when they perceived as overwhelmingly complicated.
App Design **Perceived Usefulness**	User perception is determined by information quality, core functions, individualisation, and social attributes.	**Potential opportunity** identified. Through its financial incentives, GamFi might add significant potential to the perceived usefulness.
App Design **Security**	Users' concern about the security and privacy of health data is one reason why they do not use or do not continuously use mobile health applications.	**Potential opportunity** identified. Smart contracts etc. can create a more stable and engaging GamFi environment. P2E digital health apps might require fewer personal health related data than other digital health apps, which might increase the secruity perception.
App Design **Cost**	Some users are not willing to pay for mobile health applications.	**Potential opportunity** identified. P2E models do not only require minimal investment but also provides financial retrun.

Table 2: Literature Review Summary Table (Source: own construction)

Appendix 10: Sentiment Analysis

Financial Return	Stepn	Sweatcoin	Dotmoovs
Positive	41%	21%	88%
Neutral	14%	5%	4%
Negative	41%	71%	4%
Mixed	5%	2%	4%
Total	100%	100%	100%

Health Status	Stepn	Sweatcoin	Dotmoovs
Positive	69%	58%	100%
Neutral	8%	21%	0%
Negative	23%	21%	0%
Mixed	0%	0%	0%
Total	100%	100%	100%

Entertainment	Stepn	Sweatcoin	Dotmoovs
Positive	71%	59%	93%
Neutral	0%	0%	0%
Negative	21%	41%	0%
Mixed	7%	0%	7%
Total	100%	100%	100%

Functionality	Stepn	Sweatcoin	Dotmoovs
Positive	17%	6%	44%
Neutral	3%	3%	22%
Negative	77%	90%	33%
Mixed	3%	1%	0%
Total	100%	100%	100%

Table 3: Sentiment Analysis (Source: own construction)

Appendix 11: Social Media Analysis

Social Media Engagement Rate	Stepn	Sweatcoin	Dotmoovs
Instagram	0,21%	0,03%	0,01%
X	0,08%	1,33%	2,64%
Youtube	4,98%	81,40%	13,31%

Instagram	Stepn	Sweatcoin	Dotmoovs
Content Themes (Categorized based on the posts of the last 90 days)	1. Educational content on running in collaboration with athletes (4) 2. Humourus content related to the usage of the Stepn App and community (9) 3. Updates on new Stepn features (4)	1. Humorous videos and memes related to collecting steps (11) 2. Showcasing Sweatcoin rewards (3)	1. Showcasing App features, AI technology and subscription plans (11) 2. Fitness motivation and educational content (9) 3. Nutrition tipps (3)
Engagement Strategy	Engaging through content that adresses and binds the Stepn community	Engaging through content that adapts to current instagram trends	Engaging community through fitness motivation

Table 4: Social Media Analysis (Source: own construction)

Appendix 12: Security Analysis

Security	Stepn	Sweatcoin	Dotmoovs	mySugr
Types of Personal Data Collected	**Explicitly mentioned:** Name, email, phone number, GPS	**Explicitly mentioned:** Name, email, phone number, device info, app interaction	**Explicitly mentioned:** Name, email, physical address (prerequisite for financial exchanges), video records	**Explicitly mentioned:** Name, email, device info: ID, OS version
Financial Data Collection	**Explicitly mentioned:** Collects financial information for processing transactions, potentially including bank account details and payment information for in-app purchases and rewards.	**Explicitly mentioned:** Collects payment information for transactions within the app, including credit/debit card details and other payment services.	**Explicitly mentioned:** Collects payment information for transactions within the app, including credit/debit card details and other payment services.	**Explicitly mentioned:** Includes payment information for transactions within the app, including payment status and method
Health Data Collection	Indirectly through physical activity tracking: Collects data on physical activity for conversion into in-app currency, indirectly involving health-related information.	Indirectly through physical activity tracking: Collects data on physical activity for conversion into in-app currency, indirectly involving health-related information.	Not explicitly mentioned: While biometric data is collected (e.g., video records for activity verification), there is no explicit mention of collecting health data directly.	**Explicitly mentioned:** Diabetes type, therapy details, physical activities, blood glucose measurements, insulin dosages, meal information

Table 5: Security Analysis (Source: own construction)

Appendix 13: Cost Analysis

Cost	Stepn	Sweatcoin	Dotmoovs
Initial Download Cost	Free	Free	Free
In-App Purchases	NFT Sneakers, Digital Wallet	Optional Premium Subscription	Plan subscription, Digital Wallet, NFTs
Subscription Fees	Not applicable	Optional $5.99/month or $29.99/year	Optional €59,99/month, €149,99/3 months, €294,99/year
Initial Investment Required	Cost of NFT sneakers + cryptocurrency for transactions	None for basic use	Non for "play for fun" use / Cost for NFT for "play for reward"
Earnings Mechanism	Movement converted to in-app currency	Walking converted to in-app currency (Sweatcoin) or crypto currency (Sweat Wallet)	Movement analyzed by AI and converted to in-app currency
Earnings Limitations	Depends on sneaker type and activity level	Daily cap on free version, increased cap with premium	Not specified
Additional Notes	Digital wallet setup and cryptocurrency purchase required	Earnings increase and ad removal with premium subscription	Potential costs for personalized workouts or nutrition
	Cost of cheapest NFT: 49$ (06.03.2024)	Free version is capped to 10.000 steps. 6.000 steps are converted into token (crypto) , 4.000 steps are converted in sweatcoins (in-app). Cryptocurrency conversion is optional, not manadatory by game design	Cost of cheapest NFT: 29,99€ - 99,99€

Table 6: Cost Analysis (Source: own construction)

Appendix 14: Summary Table Field Research Section One

Factor & Analysis	Dotmoovs	Sweatcoin	Stepn
Functionality & Perceived Usefulness (Sentiment Analysis)	• **Financial Return:** 88% postive sentiment on reward opportunities • **Health Improvement:** Insufficient data • **Entertainment:** 93% postive sentiment, Gaming activity reasonates well with user • **Functionality:** 44% postive sentiment on functionality	• **Financial Return:** 71% negative sentiment due to perceived false claims on reward potential • **Health Improvement:** 58% postive sentiment. Users acknowledge positive effect on health • **Entertainment:** 59% postive sentiment. Some users perceive gaming activity as boring • **Functionality:** 90% negative sentiment. Users complain about malfunctions in the step collection	• **Financial Return:** 41% positive sentiment. Users acknowledge earning potential yet criticize high initial investment cost. • **Health Improvement:** 69% positve sentiment. Users value the motivation to move the apps provides. • **Entertainment:** 71% postive sentiment. User largely perceive app as fun and engaging, some perceive activity as boring • **Functionality:** 77% negative sentiment. Users complain about malfunctions in the step collection.
Social Attributes (Social Media Engagement Rate & Content Analysis)	Low social media engagement (0.01% engagement rate) Content comprises of: 1) Showcasing App features, AI technology and subscription plans 2) Fitness motivation and educational content	Moderate social media engagement (0.03% engagement rate) Content comprises of: 1) Humorous videos and memes related to collecting steps 2) Showcasing Sweatcoin rewards	Highest social media engagement (0.21% engagement rate) Content comprises of: 1) Educational content on running in collaboration with athletes 2) Humourus content related to the usage of the Stepn App and community 3) Updates on new Stepn features
Security (Survey conducted)	Dotmoovs collects biometerical Data, Sweatcoin and Stepn collect GPS data. Research Section Two investigates if the type of data collection affects app adoption. See Summary Table Research Section Two for result.		
Cost (Comparative Cost Analysis)	Free but requires NFT and digital wallet for full functionality	Free with optional premium subscriptions for enhanced earnings. Cryptocurrency conversion is optional, not manadatory by game design	Requires initial investment in NFT sneakers. Less accessible due to initial investment cost required.

Table 7: Summary Table Field Research Section One (Source: own construction)

Appendix 15: Discrete Choice Experiment Design

Design: Three attributes, two levels each, full factorial choice set design

Attribute	Level
Game Activity	1. Daily distance walked/ran measured and rewarded 2. Competitive sports challenges (Fitness, Football, Dance) Movements are analyzed, evaluated and rewarded by AI technology
Reward Mechanism	1. Financial reward (crypto), to be redeemed for fiat currency (e.g. USD) on crypto exchange platforms) 2. In-game currency (no cryptocurrency), to be redeemed on in-app marketplace for goods, services or donations
Entry Barrier	1. No entry barrier 2. Digital wallet setup and initial NFT purchase required

Table 8: Discrete Choice Experiment Design (Source: own construction)

Appendix 16: Discrete Choice Experiment Regression Results

```
      Source |       SS           df       MS      Number of
obs   =       268
-------------+----------------------------------   F(3,
264)       =    263.76
       Model |  50.1013711         3   16.700457   Prob >
F         =    0.0000
    Residual |  16.7157931       264   .063317398   R-
squared       =    0.7498
-------------+----------------------------------   Adj R-
squared   =    0.7470
       Total |  66.8171642       267   .250251551   Root
MSE       =    .25163

------------------------------------------------------------------
-----------------
      Choice | Coefficient  Std.
err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------
-----------------
  GameActivity
|   .5003404   .0307449    16.27   0.000     .4398039    .5608
768
RewardMechan~m
|          .5   .0307414    16.26   0.000     .4394704    .5605
296
  EntryBarrier
|   .5030633   .0310227    16.22   0.000       .44198    .5641
466
       _cons |  -.2402995   .0297146    -8.09   0.000    -
.2988072   -.1817918
------------------------------------------------------------------
```

```
. reg Choice GameActivity RewardMechanism EntryBarrier,
cluster(RespondentID)

Linear regression                               Number of
obs     =        268
                                                F(3,
66)           >   99999.00
                                                Prob >
F          =     0.0000
                                                R-
squared          =     0.7498
                                                Root
MSE           =     .25163

                            (Std. err. adjusted for 67
clusters in RespondentID)
------------------------------------------------------------------
------------------
                |               Robust
         Choice | Coefficient  std.
err.      t    P>|t|     [95% conf. interval]
----------------+-------------------------------------------------
------------------
  GameActivity
|   .5003404   .0013686   365.58   0.000     .4976079    .5030
729
RewardMechan~m
|         .5   .0012193   410.06   0.000     .4975655    .5024
345
  EntryBarrier
|   .5030633   .0032484   154.87   0.000     .4965777    .5095
489
          _cons |  -.2402995   .0099246   -24.21   0.000    -
.2601145   -.2204845
------------------------------------------------------------------
------------------


. reg Choice GameActivity RewardMechanism EntryBarrier Age18
Age1830 Age3045  Fem
> ale, cluster(RespondentID)

Linear regression                               Number of
obs     =        268
                                                F(6,
66)           =          .
                                                Prob >
F          =          .
```

```
                                                R-
squared         =     0.7518
                                                Root
MSE             =     .25253

                              (Std. err. adjusted for 67
clusters in RespondentID)
------------------------------------------------------------------
------------------
                |               Robust
         Choice | Coefficient  std.
err.      t    P>|t|     [95% conf. interval]
----------------+-------------------------------------------------
------------------
  GameActivity
|    .496741   .0034335   144.67   0.000     .4898857    .5035
963
RewardMechan~m
|   .5037203   .0033198   151.73   0.000     .4970921    .5103
485
  EntryBarrier
|   .5057323   .0041149   122.90   0.000     .4975167    .5139
479
          Age18 |  -.0104626   .0179029    -0.58   0.561    -
.0462069    .0252817
       Age1830 |   .0985331   .0696257     1.42   0.162     -
.040479    .2375453
       Age3045 |   .1507264   .0844075     1.79   0.079    -
.0177987    .3192515
         Female |  -.0021234   .0236646    -0.09   0.929    -
.0493714    .0451246
          _cons |  -.3361777   .0693995    -4.84   0.000    -
.4747383   -.1976172
------------------------------------------------------------------
------------------

. reg Choice GameActivity RewardMechanism EntryBarrier ,
nocons cluster(Responden
> tID)

Linear regression                               Number of
obs     =        268
                                                F(3,
66)           =     965.37
                                                Prob >
F             =     0.0000
                                                R-
squared         =     0.8358
                                                Root
MSE             =     .28054
```

```
                                (Std. err. adjusted for 67
clusters in RespondentID)
------------------------------------------------------------
------------------
               |               Robust
      Choice | Coefficient  std.
err.      t    P>|t|     [95% conf. interval]
--------------+---------------------------------------------
------------------
  GameActivity
|   .3734062    .009382    39.80   0.000     .3546744     .392
138
RewardMechan~m
|   .3714026   .0086778    42.80   0.000     .3540767    .3887
284
  EntryBarrier
|   .3894353   .0113912    34.19   0.000      .366692    .4121
787
------------------------------------------------------------
------------------
```

Source: Stata

Appendix 17: Survey Results Field Research

1. Have you used or are you currently using digital health applications of any kind? (e.g. Fitness and Sport, Nutrition/Diet, Meditation/Stress Management, Telehealth Services)

- Yes 44 (66%)
- No 23 (34%)

2. What types of digital health applications have you used or are currently using? Select all that apply.

- Fitness and Sports 41(61%)
- Nutrition/Diet 15 (22%)
- Meditation/Stress Management 10 (15%)
- Telehealth Services 1 (1%)

3. Have you spend money on digital health apps (e.g. download/subscription fees)?

- Yes 12 (27%)
- No 32 (73%)

4. What motivated you to start using digital health applications? Select all that apply

- To improve physical health 39 (49%)
- To improve mental health 16 (20%)

- Doctor's recommendation 1 (1%)
- Family or friend recommendation 8 (10%)
- Curiosity 11 (14%)
- Other Option 4 (5%)

5. How often do you use digital health applications?

- Daily 12 (27%)
- Weekly 26 (59%)
- Monthly 2 (5%)
- Rarely 4 (9%)
- Never 0 (0%)

6. What impact, if any, have digital health applications had on your physical health?

- Significantly Positive 4 (10%)
- Moderately Positive 30 (73%)
- No Impact 4 (10%)
- Moderately Negative 3 (7%)
- Significantly Negative 0 (0%)
- Not Sure 3 (7%)

7. What would make you more likely to increase your usage of digital health applications in the future?

- More features 21 (24%)
- Better privacy/security 6 (7%)
- More personalized recommendations 27 (31%)
- Lower cost 16 (18%)
- Easier usability 14 (16%)
- Nothing 3 (4%)
- Other 2 (3%)

8. Do you know somebody who uses digital health applications? (If answered "No" in question 1)

- Yes 13 (57%)
- No 10 (43%)

9. What would make you more likely to use digital health applications in the future? (If answered "No" in question 1)

- Recommendations by healthcare professional 12 (27%)
- Better privacy/security 2 (5%)
- More Features 2 (5%)
- More personalized recommendations 10 (23%)
- Lower cost 10 (23%)
- Easier usability 9 (20%)

- Nothing 1 (2%)
- Other 1 (2%)

10. How would you describe your current level of physical activity?

- Inactive (0 min per week) 5 (7%)
- Lightly Active (120 min) 22 (32%)
- Moderately Active (120-180min) 20 (29%)
- Very Active (more than 180min) 20 (29%)

11. How would you rate your overall health?

- Excellent 4 (6%)
- Very Good 30 (45%)
- Good 24 (36%)
- Fair 9 (13%)
- Poor 0 (0%)

12. How would you describe your understanding of cryptocurrencies?

- I have no knowledge 22 (33%)
- I have basic knowledge 32 (48%)
- I have an intermediate understanding 11 (16%)
- I consider myself an expert 2 (3%)

13. Which of the following two options do you prefer? (1/4)

Option 1:

- **Game Activity:** Daily distance walked/ran measured and rewarded
- **Reward Mechanism:** In-game currency (no cryptocurrency), to be redeemed on in-app marketplace for goods, services or donations
- **Entry Barrier:** No entry barrier

Option 2:

- **Game Activity:** Competitive sports challenges (Fitness, Football, Dance). Movements are analyzed, evaluated and rewarded by AI technology
- **Reward Mechanism:** Financial reward (crypto), to be redeemed for fiat currency (e.g. USD) on crypto exchange platforms
- **Entry Barrier:** Digital wallet setup and initial NFT purchase required

Result: Option 1= 37, Option 2= 30

14. Which of the following two options do you prefer? (2/4)

Option 1:

- **Game Activity:** Daily distance walked/ran measured and rewarded

- **Reward Mechanism:** Financial reward (crypto), to be redeemed for fiat currency (e.g. USD) on crypto exchange platforms
- **Entry Barrier:** No entry barrier

Option 2:
- **Game Activity:** Competitive sports challenges (Fitness, Football, Dance). Movements are analyzed, evaluated and rewarded by AI technology
- **Reward Mechanism:** In-game currency (no cryptocurrency), to be redeemed on in-app marketplace for goods, services or donations
- **Entry Barrier:** Digital wallet setup and initial NFT purchase required

Result: Option 1= 40, Option 2= 27

15. Which of the following two options do you prefer? (3/4)

Option 1:
- **Game Activity:** Daily distance walked/ran measured and rewarded
- **Reward Mechanism:** Financial reward (crypto), to be redeemed for fiat currency (e.g. USD) on crypto exchange platform
- **Entry Barrier:** Digital wallet setup and initial NFT purchase required

Option 2:
- **Game Activity:** Competitive sports challenges (Fitness, Football, Dance). Movements are analyzed, evaluated and rewarded by AI technology
- **Reward Mechanism:** In-game currency (no cryptocurrency), to be redeemed on in-app marketplace for goods, services or donations
- **Entry Barrier:** No entry barrier m,opm

Result: Option 1= 28, Option 2= 39

16. Which of the following two options do you prefer? (4/4)

Option 1:
- **Game Activity:** Competitive sports challenges (Fitness, Football, Dance). Movements are analyzed, evaluated and rewarded by AI technology
- **Reward Mechanism:** Financial reward (crypto), to be redeemed for fiat currency (e.g. USD) on crypto exchange platforms
- **Entry Barrier:** No entry barrier

Option 2:
- **Game Activity:** Daily distance walked/ran measured and rewarded
- **Reward Mechanism:** In-game currency (no cryptocurrency), to be redeemed on in-app marketplace for goods, services or donations
- **Entry Barrier:** Digital wallet setup and initial NFT purchase required

Result: Option 1= 36, Option 2= 31

17. Which of the following three factors motivates you the most to download one of the three apps?

- Enjoyment/fun 14 (22%)
- Financial rewards 19 (30%)
- Health status improvement 28 (44%)
- None of the above 4 (6%)

18. Which of the following might be reasons why you would refrain from adapting to one of the P2E health apps? Select all that apply

- I have no interest in increasing my health status through digital health apps 14 (14%)
- I have no interest/knowledge in crypto 31 (32%)
- I do not find P2E digital health apps useful to increase my health status 15 (15%)
- I perceive the effort involved as too high (download, set up, cost) 37 (38%)

19. Consider that the different game activities require the collection of either GPS or biometrical (video recording) data. How does this affect your decision to adapt to a P2E-based digital health app?

- I would not download any app that collects either GPS or biometrical data 2 (3%)
- The type of data collected does not affect my decision to download an app 36 (56%)
- I would only download an app that collects GPS data 14 (22%)
- I would only download an app that collects biometricalata 12 (19%)

20. Please select the age group that applies to you.

- Younger than 18 1 (1%)
- 18-30 61 (91%)
- 30-45 2 (3%)
- 45-60 3 (4%)
- older than 60 0 (0%)

21. What gender do you most identify with?

- Male 39 (55%)
- Female 28 (45%)
- Non-Binary 0 (0%)
- Prefer not to say 0 (0%)

Appendix 18: Summary Table Field Research Section Two

Research Topic	Aspect	Finding
Demographic Results	Age & Gender	Majority aged 18-30 (91%), more males (58%)
	Digital Health App Usage & Spending	66% currently use digital health apps, primarily fitness apps (61%), only 27% spent money
	Physical Activity Level	Most are actively engaged (58% moderately or very active), 7% inactive
	Health and Crypto Knowledge	Generally positive health perceptions, limited cryptocurrency knowledge (81% with no or basic knowledge)
RQ 1: What motivates individuals to use P2E-based digital health applications?	Primary Motivations	Main motivators: improving physical health (49%), mental health (20%), and curiosity (13%)
	Barriers to Usage	Main barriers: app setup effort (38%), lack of crypto knowledge (32%), doubts on health improvement (15%)
	Preferences for Features	Preferences include personalized recommendations (31%), more features (24%), lower costs (18%), and easier usability (16%)
RQ2: Which design features of P2E apps are most valued by users? (Discrete Choice Experiment)	Game Activity	Slight preference for competive sport challenges vs. step tracking
	Reward Mechanism	Preference for in-app currencies over cryptocurrencies
	Entry Barriers	Preference for lower barriers, no digital wallet/NFTs required
Security (Addition from Research Section One)	Preference over Data Collection (Biometrical vs GPS)	Type of data collected does not affect the majority to download a P2E Digital Health App (56%). 22% would only download an app that collects GPS, 19% would only download an app that collects biometrical data.

Table 9: Summary Table Field Research Section Two (Source: own construction)