The Key Success Factors for an M-Learning Cryptocurrency Application

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The "buzz" surrounding cryptocurrencies in online media last year has led to an increased interest in the topic as a possible source for investments. This paper aims to identify the key success factors for an m-learning cryptocurrency application that explains blockchain technology and cryptocurrencies for non-tech savvy people. The research methodology used for this paper applies the experimental method and probative logic. A survey was conducted among 128 participants, the target population being composed of people who have an interest in cryptocurrencies and who are involved in online crypto communities. The results of the study show that the people who invest in cryptocurrencies are usually those who have a high income and who possess other investment methods as well. When it comes to analyzing the mobile applications success factors, the study revealed that there are no significant differences between people who have cryptocurrency investments and those who do not in ranking mobile apps success factors. Also, besides cryptocurrency training the news and prices are among the most important features of an m-learning cryptocurrency application and on that account such an app must include them. The originality of this study comes from addressing an innovative topic as the research in this field is scarce. Furthermore, this paper raises awareness towards the necessity of educating people on this topic, on the need to research before investing in a specific project.

Keywords: *Cryptocurrency, m-learning cryptocurrency applications, key success factors*

1 Introduction

This decade witnesses the emergence of an interconnected, mobile society which has a variety of information sources and means of communication. The pervasiveness of smartphones, driven by improved software and hardware and the evolving abilities of mobile device users has brought forward the concept of just-in-time learning. The world in which learning evolves into a self-paced process of finding information and acquiring new skills exactly when and where they are needed is slowly becoming a reality.

A series of four studies [1] realized by top American universities suggest that when people are faced with difficult questions and they expect to have future access to that specific information they tend to remember where to find it rather than the substance of that information. This means that people are using just-in-time technologies as an external memory store or transactive memory, where specific information is stored collectively outside ourselves.

Cryptocurrencies have become an interesting topic for non-tech savvy people last year due to the fact that it was widely covered in the media. According to [2], the "buzz" surrounding cryptocurrencies in online media was confirmed by Coinbase, the most popular cryptocurrency exchange in the United States, who reported that the Coinbase app has seen a huge spike in monthly user numbers from 407,000 in January 2017 to 4.3 million in December 2017.

Considering the hype around the blockchain revolution and cryptocurrencies, this study is aimed at discovering the key success factors for a mobile cryptocurrency application. This research shifts the focus from the business corporations to the people in order to shine a light of knowledge regarding blockchain technology and the use of cryptocurrencies into their minds. This being said, the main research question of this study is: *what are the key success factors for an m-learning cryptocurrency application?*

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2 Literature Review

The mobile applications market is expected to grow 270% within 5 years, from $70 billion in 2015 to $189 billion in 2020 [3]. At the end of 2017, Google Play Store had over 3.6 million apps, while Apple Store had 2.1 million apps [4]. [5] discovered that more than that 80% of users stop using a new mobile app within 90 days. Considering these facts it is therefore essential to determine the key success factors for mobile applications.

Taking into account the fact that this literature review covers a number of key success factors for mobile apps, it will be organized in multiple sections. This paper will deal with each success factor by turns and detailed information will be provided in the following sections. The information gained by realizing this literature review will be used to design and structure an effective questionnaire to ensure that valuable insights are captured for the main research question.

Innovation

Innovation has given people the opportunity to harness the power of connectivity and has created smartphone functionalities never imagined before. According to [6], the demand for continuous innovation creates intense competition from emerging players and new functionalities are often developed faster than anyone can predict. Research conducted by [7] has shown that 99% of the lists of installed applications are unique, therefore diversity dominates the mobile marketplace. One of the ways to provide something unique is through innovation. As stated by [8] through adopting the latest technology trends and through creating mobile applications that solve a specific problem for the target audience, companies can add value to the customer's lives and can achieve business growth.

User Friendly Design

According to [9] intuitive graphical user interfaces integrating user experience (UX) and user interface (UI) design principles are an indispensable element of a successful mobile application. Considering the fact that today's marketplaces have manifold apps that perform the same functions, the design of a mobile application is oftentimes the differentiating factor [10]. Due to the fact that customer emotions are concerned, assessing the customer experience is a complex area of study [11]. [12], [13], [14] attempted to develop algorithms that are mining user opinions from reviews in order to create a sentiment analysis for mobile apps so as to improve user experience.

Ease of use

[15] determined that the effort expectancy is a subjective perception that represents how easy or difficult it is to understand and utilize a specific system. In this case, effort expectancy is a measure of the ease of use for a mobile app. [16] believes that the ease of use influences the attitude toward an innovation, consequently it increases technology adoption. If users perceive that a mobile application is simple and easy to use they are inclined to engage with the app [17]. [18] indicates that the most important factor influencing the user perception to turn down a mobile app is the lack of usability. By prioritizing the most essential content and by creating a simple and intuitive interface mobile applications can obtain a greater retention rate, therefore achieving success.

Branding

Research conducted by [19] determined that a seamless experience across all devices is very important for the users. Provided that mobile application engagement motivate users to make personal connections with brands across all channels [20] encouraging engagement with a branded mobile app will lead to consumer-brand connections [17]. Branded mobile applications, strengthen and promote brands and create positive attitudes towards them. Research concerning consumer behavior conducted by [21] showed that when users utilize a mobile application to interact with a brand the positive emotional response is higher than on all other platforms. With this being said, mobile application branding contributes to the success of the mobile

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application which in turn help achieve the company's long term goals.

Interactivity

For a mobile application to be successful it is important to keep supporting it with marketing efforts. [22] concluded that the cost of attracting a new customer is six times higher than keeping an old one. Consequently, it is important to offer existing customers a reason to interact with the app. A report created by [23] shows that 77% of customers have chosen, endorsed or paid more for a brand that offers a personalized service or experience. Personalization is therefore essential in delivering extraordinary customer experiences, a fact demonstrated in a survey conducted by Forrester Research which showed that personalization technology is one of the top investment priorities for companies [24]. By interacting with the users via the mobile app and by offering them a personalized experience the company can add value to the user.

Performance

When referring to mobile applications, performance represents both loading speed and reliable functionalities. [25] determined that time convenience signifies the degree to which the user appreciates the mobile app as offering immediate or timely benefits. Users become less tolerant for mobile apps with slow loading issues and it is important to deliver a seamless customer experience. [26] discovered that 37% of users found apps that have functional issues and 86% of the users uninstalled mobile applications because of them. Moreover, [27] found that mobile application performance can lead to happier users, a higher engagement rate and positive ratings, therefore determining business benefits and brand loyalty.

Security

Due to the fact that sensitive data resides now on mobile devices, and bring-your-own-device (BYOD) policies are in place, [28] considers that information security must be taken into account right from the application architecture design. From downloading applications which contain vulnerabilities to giving mobile apps unnecessary permissions, serious information security and data privacy issues can take place [29]. [30] regards the mobile environment as being far from secure and 86% of users deleted or stopped using a mobile app over privacy or security concerns, while 47% would recommend a trustworthy app to other people. Considering the statistics provided above, offering a secure mobile environment can lead to mobile application success.

3 Methodology

The research methodology used for this research applies the experimental method and probative logic. The experimental method consists of applying the following methods in the analysis and interpretation of the research results: the agreement, the difference, the joint method of agreement and difference method, the method of residue and the method of concomitant variations. By using probative logic, the key success factors for mobile applications will be extrapolated for mobile cryptocurrency applications.

In the questionnaire-based analysis there is a mix of the qualitative – quantitative methods due to the fact that the qualitative questions have measurable, quantitative answers. To be more precise, people's perceptions and opinions about key success factors for mobile applications are transformed into quantitative data.

Considering the main research question "*what are the key success factors for an m-learning cryptocurrency application?"* the research conducted through this questionnaire included three questions that aimed at providing an answer for the main research question by offering it a broad view of the topic at hand.

Question 1: Is there any connection between people's income and other investments and their level of interest in cryptocurrencies?

H_0. People's income and other investments do not influence their level of interest in cryptocurrencies.

H_1. People's income and other investments influence their level of interest in

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cryptocurrencies.

To analyze the first question three methods have been employed: multiple linear regression, regression trees and boosting. For the multiple linear regression method the model was created using backward elimination. The regression trees method follows a top-down greedy approach known as recursive binary splitting. It successively splits the predictor space into two new branches down the tree, concerning only about the current split. The GBM (Gradient Boosting Machine) boosting is used to train a 10.000 tree model. The summary of the model shows the variable importance in the model, representing the relative influence of each variable to the dependent variable.

Regarding the first question, it is expected that people with higher income are more likely to invest in cryptocurrencies due to the fact that the market is highly volatile. Also, people who have other investments are more inclined to invest in cryptocurrencies because they want to diversify their investment portfolio. To support this statement, a survey realized this year showed that 40% of Americans who haven't invested in cryptocurrencies reported that that main reason for it was disinterest or seeing no need to do so [31].

Question 2: Are there any significant differences between people who have cryptocurrency investments and those who do not in ranking mobile applications success factors?

H_0. There are no significant differences between people who have cryptocurrency investments and those who do not in ranking mobile applications success factors.

H_1. There are significant differences between people who have cryptocurrency investments and those who do not in ranking mobile applications success factors.

In order to analyze the second question for each mobile app success factor a new question is created, each with its own null and alternative hypotheses. For the purpose of testing these hypotheses the Wilcox and Kruskal tests are used to determine if there are statistically significant differences between two (Wilcox) or more (Kruskal) groups of an independent variable on a continuous dependent variable. The majority of answers for all the mobile app success factors represents the answer to the second question.

Regarding the second question, it is anticipated that for the majority of mobile app success factors the results will be different for people who have investments and those who do not. This prediction is based on the fact that people who invest in cryptocurrencies are usually interested in the technical aspects where there other ones are inclined to provide a higher rank to the marketing aspects. To advocate this statement at the beginning of the year a new community was created on Reddit dedicated to technical discussions of cryptocurrency technology and its adoption. Within just a few months this community gained over 20.000 subscribers.

Question 3: Besides cryptocurrency training are the news and prices the most important features of an m-learning cryptocurrency app?

H_0. Besides cryptocurrency training the news and prices aren't among the most important features of an m-learning cryptocurrency app.

H_1. Besides cryptocurrency training the news and prices are among the most important features of an m-learning cryptocurrency app.

The third question is addressed by analyzing the data from the multiple choice question dealing with the most desired features of an m-learning cryptocurrency app. The data is explored by sorting the data frame and by counting the number of apparitions for each mobile app feature.

Regarding the third question, it is predicted that besides cryptocurrency training, the news and prices would be among the most important features of an m-learning mobile application. This assumption is based on the fact that by analyzing the mobile applications on both Google Play and Apple App Store the majority of cryptocurrency mobile applications contain these two features, irrespective of the specific cryptocurrency topic the mobile app addresses.

4 Survey Results

In order to address the three questions of the study and to present the survey results it is

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important to take into account the research method employed, therefore the experimental method is used in the analysis and interpretation of the research results. The three questions that are the basis of the questionnaire design are analyzed systematically in the following section.

The first question is analyzed using the difference method. As a means to analyze whether or not there is a connection between people's income and other investments and their level of interest in cryptocurrencies it is important to examine the distribution of the variable "interestlvl".

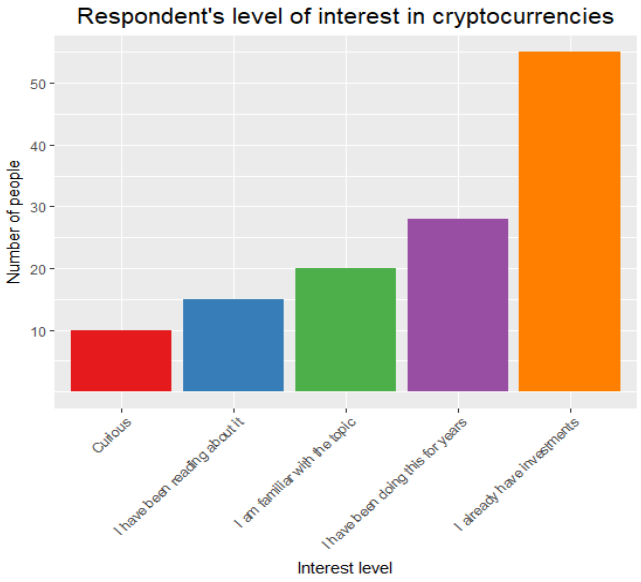

Fig. 1. Respondent's level of interest in cryptocurrencies

As it can be seen in the figure above more than half of the respondents already have cryptocurrency investments. Also, it appears that among those who have invested, the majority of people have been doing this rather recently.

In addition, the first three categories are grouped into a single category representing no investments, while the last two are grouped into the investments category. As a result, this research can attempt to model the relationship between the variables of this question.

The first method employed to analyze the question at hand is the multiple linear regression. The final regression model that explores the relationship between interest levels in cryptocurrencies and the respondent's profile is presented below.

In the Figure 2 it can be seen that the variables that have the highest influence on the interest level are the income and whether or not people have other investments. Considering the fact that this model concerns social sciences and that human behavior cannot be accurately predicted, the multiple r-squared value of 0.3107 is regarded as moderate or substantial, therefore 31% of the variance found in the response variable interestlv can be explained by the predictor variables income and otherinv.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.07855    0.12918  -0.608 0.544238
income       0.17716    0.05176   3.423 0.000839 ***
otherinv     0.34865    0.08817   3.954 0.000128 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4011 on 125 degrees of freedom
Multiple R-squared:  0.3107,    Adjusted R-squared:  0.2996
F-statistic: 28.17 on 2 and 125 DF,  p-value: 0.00000000007974
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Fig. 2. The multiple linear regression model

The second method used to analyze the first question at hand is the regression trees. Taking into account the fact that the model created with regression trees is over fitting the data, in the figure below the optimized model is presented.

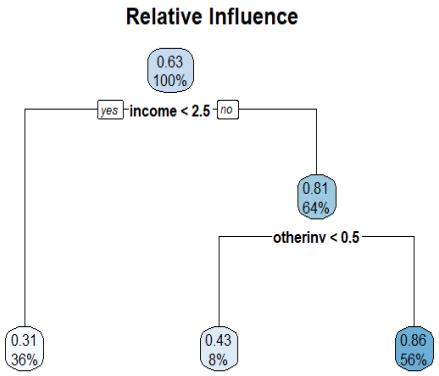

Fig. 3. Regression trees

As it can be seen in the figure above, the same variables, income and otherinv are the ones who influence the most the dependent variable, "interestlvl". The regression trees start with the variable income and go through the branches by adding only one variable in the model, otherinv. In order to evaluate the optimized regression model the rmse value is utilized, representing the standard deviation of the unexplained variance. The rmse value is 0.4333136 which means that the model predicts the response with a standard variation of 0.4333136.

The third and the last method applied to analyze the first question is boosting. The GBM (Gradient Boosting Machine) boosting type is used to train a 10.000 tree model and the summary of the model is presented in the Figure 4. This figure shows the variable importance in the model represents the relative influence of each variable to the dependent variable interestlvl.

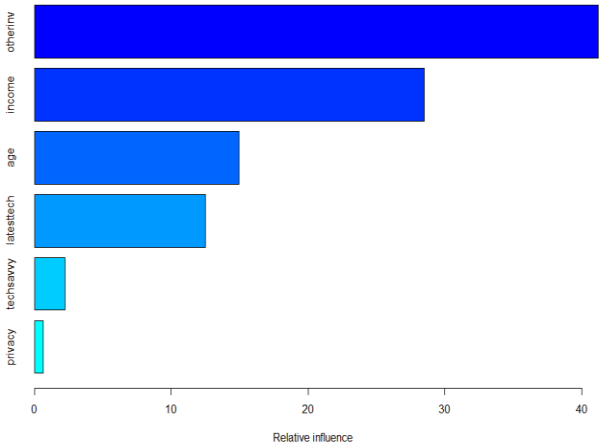

Fig. 4. The boosting method

In the Figure 4 it can be observed that the variables otherinv and income have by far the highest influence on the dependent variable interestlvl. The fact that the technical aspects do not influence the interest level is not a surprise at all, considering the fact the "buzz" surrounding cryptocurrencies attracted many people who are not necessarily tech-savvy. The AUC (Area Under Curve) representing the probability that a randomly selected subject with the condition has a test result indicating greater suspicion than that of a randomly chosen subject without the condition is 0.769 for this model, indicating a good classifier.

Considering the results of the three methods presented above, the null hypothesis H_0 is rejected, therefore people's income and other investments influence their level of interest in cryptocurrencies.

The second question is analyzed using the method of concomitant variations. To provide an answer for this question it is essential to offer an overview image of the likert scale

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data, as well as detailed information for each mobile application success factor. It is to be noted that the respondents were asked to rank the mobile app success factors in levels of importance from not important to very important.

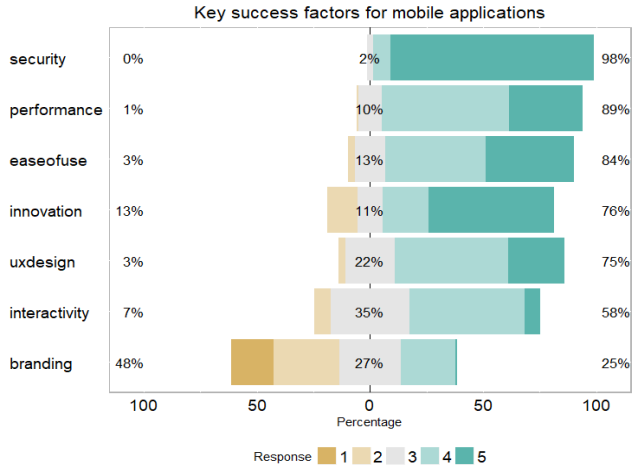

Fig. 5. Key success factors for mobile application

In the Figure 5 an overview image of the Likert scale data is offered. The key success factors are sorted and ordered according to their importance for the mobile application success. Considering the rating scale and the statistics provided in the previous chapter it is not surprising that the technical aspects (security, performance, ease of use and innovation) are the highest rated factors. The marketing aspects (ux design, interactivity and branding) have lower values but in general people tend to underestimate them.

With the aim of providing an answer for the second question it is imperative to provide detailed information for each mobile app success factor. In the table below the p-values for each mobile app success factor are presented.

Table 1. Likert data analysis

KFS	P-Value
innovation	0.000002854
ux design	0.7066
ease of use	0.1577
branding	0.04302
interactivity	0.2143
performance	0.295
security	0.03606

The table presented above examines whether there are any significant differences between people who have cryptocurrency investments and those who do not in ranking mobile apps success factors. It can be seen that there are three factors with p-values less than 0.05.

Considering the fact that the crypto community often addresses the technical aspects of cryptocurrencies, it is not unexpected that there are two technical factors with p-values under 0.05, namely innovation and security. The third factor, branding, completes the overall picture as it is controversial among people, especially in the modern days.

By taking into account the fact that only three out of the seven individual null hypotheses were rejected, the null hypothesis for the second question H_0 is not rejected, therefore there are no significant differences between people who have cryptocurrency investments and those who do not in ranking mobile applications success factors.

The third question is analyzed using the agreement method. In order to evaluate the third question it is appropriate to provide an overall view of the number of apparitions for each mobile application feature. The figure presented below provides this perspective by offering an ordered view of the categorized data.

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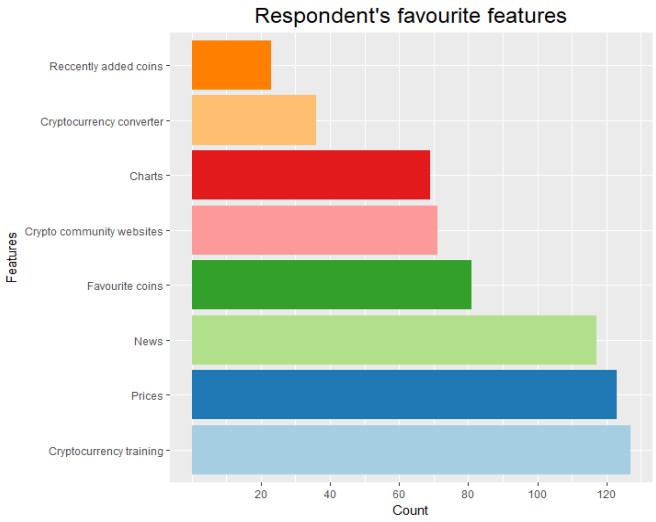

Fig. 6. Respondent's favorite features

In the Figure 6 it can be observed that besides cryptocurrency training only the news and prices have more than one hundred apparitions. Taking into account that the responses for this question were provided using a checklist and the fact that these two features distance from the others in a significant way, the trend that users expect to see these two features irrespective of the specific cryptocurrency application type can be confirmed.

Considering the significant gap between the first three cryptocurrency mobile app features from the rest of them, the null hypothesis for the third question H_0 is rejected, therefore besides cryptocurrency training the news and prices are among the most important features of an m-learning cryptocurrency application.

5 Discussions

Provided that the hypotheses for the three questions that form the basis of the questionnaire have been tested and that the anticipated results have been confirmed or infirmed this section will go into greater depth when exploring the findings for each question.

The assumption about the first question of the research has proven to be correct. The results of the three methods employed showed that people's income and other investments influence their level of interest in cryptocurrencies. People with higher income tend to be more open to invest in cryptocurrencies due to the fact that they have a greater level of risk tolerance towards the highly volatile cryptocurrency market. Also, people who have other investments are more inclined to research other investment methods to diversify their investment portfolio therefore they are more likely to find out about the cryptocurrency market.

The anticipated result of the second question turned out to be inaccurate. Even though the result was tight and three out of the seven individual null hypotheses were rejected, the alternative hypothesis was accepted, therefore there are no significant differences between people who have cryptocurrency investments and those who do not in ranking mobile applications success factors. This outcome seems to be a consequence of the fact that the questionnaire was distributed to a target population composed of people who have an interest in cryptocurrencies and who are involved in online crypto communities, therefore the differences between people's favorite mobile applications features are not that substantial.

An interesting pattern was identified in the way people rated the mobile app success factors, namely the fact that people tend to offer high scores for the technical aspects compared to the marketing factors. Reflecting on the large technology advancements of the last decade and on the fact that people are becoming better at dealing with technology, this patterns seems to validate the study results. It is to be noted that in general people

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underestimate the impact of marketing on their decisions therefore the authenticity of the low rankings for marketing is questionable.
For the third question the assumption has proven to be correct. The three features (cryptocurrency training, news and prices) have distanced themselves substantially from the other ones therefore the null hypothesis was rejected. Besides cryptocurrency training the news and prices are among the most important features of an m-learning cryptocurrency application and on that account such an app must include them. This result can be explained by the fact that people try to find a "one stop app" that satisfies all their needs in the myriad of cryptocurrency apps offered on the marketplaces.

6 Conclusions

In order to draw a conclusion from this study about the customer's needs regarding a cryptocurrency app it is important to keep in mind the main research question "*what are the key success factors for an m-learning cryptocurrency application?*". By combining the insights gathered from the three questions that formed the questionnaire design, this study can provide an answer for the main research question.
The people who invest in cryptocurrencies are usually those who have a high income and who possess other investment methods as well. By outlining the characteristics of a cryptocurrency investor the user profile can be determined and, as a result, an m-learning cryptocurrency application can be designed within a customer centered strategy. By using deductive reasoning the mobile app success factors can be extrapolated for the cryptocurrency app, therefore a special attention should be given to the highest rated factors (security, performance, ease of use and innovation) when designing the mobile application. Furthermore, the most important features of an m-learning cryptocurrency mobile application (cryptocurrency training, news and prices) should be implemented as well in order for the application to become a "one stop app" for the people who are interested in cryptocurrencies.
The limits of the research come from the fact that the blockchain technology and cryptocurrencies are still relatively new concepts, being a branch of the IT field for only about a decade. However, the cryptocurrency market is growing and an entirely new ecosystem of cryptocurrencies is emerging in the spotlight.
The research presents itself with multiple new ways of thinking about the research problem. For example, based on the results of this study a focus group can be organized in order to provide a deeper understanding of the topic at hand.
The originality of this study comes from approaching an innovative topic and on that account a gap in the literature has been addressed. If this research contributes to creating a successful m-learning cryptocurrency application that educates people on this topic or it forms the basis for a more in-depth study on the subject, then it has fulfilled its purpose completely.

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