Enabling Technology Adoption: Examining web3 Educational Assets

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Dedication

George Hart-Hidalgo

My *abuelo* was a principal of a secondary school in Cuba and his legacy of triumph and sacrifice fueled my conviction to forge my path in this world through the path of education.

To my wife Catalina, thank you for the support and love you have given me to chase my dreams. To my son, Levi, know that you are the light that guides me, and I wrote every word imagining that one day you would read this. To Ashlyn, I know that I would never have gotten this far if you had not pushed me to be a better educator every day (shine on!). Thank you to the faculty who guided me to be the researcher and scholar practitioner I am with a special thank you to Dr. Matthew Campbell, Dr. Sherard Robbins, Dr. Cynthia Nebel, and Dr. sj Miller.

Finally, I am so honored (and lucky!) that I worked with Lizzy Rodriguez who is such a brilliant and dedicated scholar practitioner. I know that I never could have approached this work without Lizzy's strategic eye and her optimism that fueled our pursuits in the field of technology adoption. Thank you, Lizzy, for your partnership, friendship, and making me a better scholar practitioner. Every journey begins with a choice, and I am so grateful that we choose this path together. I look forward to our continued collaborations in technology adoption. Cheers!

Elizabeth "Lizzy" Rodriguez

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learning journey over the past three years. I am forever grateful for the constant support and guidance throughout the ups and downs of this effort.

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Executive Summary

Our partner organization is a web3 company that explores innovations in blockchain tech, cryptocurrency, and non-fungible tokens (NFTs). A global leader, our partner organization entered this industry in the last five years and is currently valued over $10 million USD. They strive to push the space forward from niche consumer markets towards mainstream market adoption. Their vision of web3's future to empower digital communities, and enthusiastic desire to actualize this vision, informs their strategic focus on consumer education; however, they currently lack the educational materials and resources that meet the learning needs of mainstream customers. Their strategic team sought to understand what makes effective educational assets for supporting the web3 knowledge of new community members.

An experiment designed to measure the effect of three different websites' web3 educational assets upon participants' web3 confidence and attitudes towards NFT marketplaces. Depending on the educational assets reviewed, the study revealed a difference in participants' web3 confidence and attitudes towards NFT marketplaces. The data supports two recommendations for our partner organization to leverage learner-constructed instructional models and to employ a scaffolded, personalized instructional approach for a more effective educational strategy. Study limitations informed the third recommendation to employ usability testing with online educational assets in observable environments to deepen knowledge of the user experience of online educational assets.

This study leverages relevant research on technology adoption and human learning science to inform these strategic recommendations for our partner's organizational leaders. To preserve our partner organization's privacy, names and key identifiers have been removed.

Background

Since the emergence of the World Wide Web in the 1990s, the internet's design and function has expanded tremendously. The first iteration, Web 1.0, characterized by its primary function of reading text, revolutionized our world by connecting people on a mass scale (Edelman, 2022). Web 2.0 expanded that functionality by allowing people to read and write text, increasing individual agency (i.e., the social media wave) and paving the way towards a more global economy (Edelman, 2022). The newest iteration of the internet, however, may prove to be even more transformative. With the technological capacity for authentic digital ownership, Web 3.0 has the power to change how society and the individual engage with one another (Edelman, 2022).

Web 3.0 (referred to hereafter as web3) encompasses the innovative advancements of the "metaverse," machine learning, and blockchain technologies (Ozair, 2023). Web3 has the potential to both deepen how we connect globally as a society and enable individuals to take control and ownership with greater transparency (Edelman, 2022). Web3 proponents envision a future of democratic digital spaces in response to how the internet is currently operated by a small number of organizations (Cao, 2022). For example, Synergy Research Group, an IT market research firm, states that as of November 2022, over 76% of all internet data in the United States is stored and owned by three companies: Amazon, Microsoft, and Google, with that 76% market share expected to increase (Haranas, 2022). The technological advancements of cryptocurrency, token-based economies, and non-fungible tokens (NFTs) supports the web3 aim of democratized digital spaces and the embrace of individual agency. Our partner organization, a web3 company, seeks to evaluate the general public's educational needs with web3 and NFTs. This capstone project examines the effectiveness of currently available educational assets by employing the principles of technology adoption and human learning theory.

What is web3?

With the technological capacity for authentic digital ownership, web3 proponents believe that this space has the power to change how society and the individual engage with one another (Edelman, 2022). Web3 proponents believe that this redefines the power of the individual in a digital world (Ozair, 2023). With its operations of transparency, web3 structures empower individuals to take control and ownership of digital assets more easily (Edelman, 2022).

The individually centered, "permissionless" web3 economy has created opportunities for tech innovations including cryptocurrencies, decentralized autonomous organizations (DAOs), decentralized finance (DeFi), and non-fungible tokens (NFTs) (Ante, 2021; Kshetri, 2022). Web3 advocates claim that these emerging technologies "transform the static, consumer-oriented Web 1.0 and the dynamic, producer and platform-oriented Web 2.0 into a decentralized web ecosystem" (Cao, 2022, p.7). Within a blockchain architecture that facilitates peer-to-peer interactions, a web3 system removes the need for banks, corporations, and centralized social media platforms (Kshetri, 2022). Specifically, one can simply transfer ownership of "any asset or data…peer-to-peer without the need for a trusted intermediary" (Ante, 2021, p. 1). In other words, without the need for a financial institution to broker a transaction, the financial ecosystem becomes a more equitable space.

Blockchain & Non-Fungible Tokens (NFTs)

On a technical level, blockchain computing operates through edge nodes or networks, supporting decentralized computation, communication, storage, sharing, and management at end devices or edge nodes (Cao, 2022). The blockchain, also known as Distributed Ledger Technologies (DLTs), opens the World Wide Web and paves the way for web3 (Belotti et al., 2019). Blockchain is a decentralized network (Cao, 2022) of cryptographically grouped records, or blocks of data, chained together and validated by multiple parties (Belotti et al., 2019). This technology builds on the concept of third-party validation which provides legitimacy and fosters trust. For example, financial institutions maintain account ledgers of transactions, and operate as intermediaries who keep score of transactions, ensuring integrity of the system. Blockchain functions in a similar manner as a trusted ledger via its shared, peer-to-peer network. All participants must agree and validate a transaction as legitimate via a consensus that records are distributed and match across all nodes (Nakamoto, 2009).

The democratizing promise of blockchain lies in this decentralized structure. The technology facilitates a "decentralized IT movement [via] the open and shareable initiatives and programs, represented by open source, open data, open access, and open science" (Cao, 2022, p. 6). As never-changing, online public-records, the blockchain's multiple ledgers cross-validate one another, and thus, provide a secure, transparent transaction validation process (Cao, 2022). Through blockchain, the need for financial institutions, which are more susceptible to human error, could be eliminated (Nakamoto, 2009).

Although popularized with the rise of Bitcoin and other forms of cryptocurrency, blockchain permits the secure storage of *any* type of information maintained by the integrity of its peer-to-peer network. Blockchain is a digital ledger of economic transactions that is immune to corruption, capable of recording various valuable information beyond just finances (Bawa, 2019). Coupled with the innovation of tokens, digital credentials that function as proof of ownership shared publicly on the blockchain, digital ownership is possible (Di Angelo & Salzer, 2021).

Non-fungible tokens (NFTs) are newer technological inventions relevant to our partner organization produced by the architecture of blockchain technology. NFTs are digital assets that are stored on the blockchain. They can represent a variety of assets including artwork, music, videos, and other forms of digital content (Ante, 2022). NFTs are unique and cannot be traded for one another. However, the blockchain provides an unalterable, transferable record of ownership for each NFT, enabling creators and collectors to own and profit from digitized assets. Additionally, NFTs have the potential to revolutionize online as well as brick-and-mortar industries by empowering creators to monetize digital assets and establish ownership rights. As blockchain technology continues to evolve, web3 proponents believe that NFTs will play a key role in the future of digital ownership and intellectual property rights.

Our Partner Organization

Our partner organization collaborating on this capstone project launched its first collection of NFTs in the past three years. Since this launch, they have remained focused on how NFTs can be utilized to build communities of like-minded, tech enthusiasts. As recent as March 2023, the organization has been valued over $10 million USD. They are strategically positioned to be a leader in the web3 space which is why they feel motivated to design and execute initiatives focused on building a stronger web3 community and brand presence.

For organizations like our partner, NFTs represent more than digital characters; they serve as identity markers that allow people to extend the real-world by bringing their identity to the virtual world, connecting with others, and creating opportunities for self-expression (van Rijmenam, 2022). According to our partner organization, recent developments in the space, such as the ability to grant NFT holders the intellectual property (IP) rights of their NFTs, has created more opportunities for digital democratization as well as paved the way for increased general market adoption. Nevertheless, they face an issue of mainstream adoption with their disruptive product.

Problem of Practice

Web3 represents a significant departure and ideological shift for the general public's perception and use of the internet; despite the intentions to give the user agency and ownership, the abstract ideas and novel terminology associated with web3 serves as a barrier for the public. Our partner organization's strategic team not only stated their role as a leader in the space of NFTs, but also saw a unique opportunity to support the general public's knowledge and adoption of web3. The strategic team claimed a desire to support the democratization of the internet, however the organization has relied primarily on the interests of niche audiences of early innovators and tech enthusiasts.

Our partner organization believes in a link between technology adoption and educational onboarding for audiences. The strategic team sees education as an important pathway of encouraging brand trust and recognition which may lead to a future of general web3 adoption; however, they have no educational assets or materials to assist general audiences in their learning of NFTs and web3.

Research Questions

To inform our partner organization's goal to create educational resources for the public, we needed to evaluate the most effective educational assets currently available online that targets general audiences. Given that the organization did not have any educational assets, we identified three NFT marketplaces that currently have educational assets available for the public. Focusing on our partner organization's problem of practice to develop an educational strategy that would encourage web3 technology adoption, we developed three central research questions to evaluate these available educational assets. Our research questions aimed to unpack the relationship between user knowledge, learning process, and technology adoption. The research questions follow:

Research Question 1: What is the effect of educational assets upon confidence with web3?

Research Question 2: What is the effect of educational assets upon attitudes towards NFT marketplaces?

Research Question 3: How do distinct audience segments evaluate the quality of these educational assets?

To address these research questions, the study design drew upon foundational frameworks of technology adoption and human learning theories.

Literature Review

The mainstream technology adoption of web3 has been slow for several reasons. For the average consumer, the technology and associated nomenclature is just too abstract and inaccessible and prevents the public from seeing the benefits and solutions offered by the technology. This also stymies the wider acceptance of NFTs. *Forbes* remarked, "non-fungible tokens, or NFTs, have garnered a lot of attention in recent years…but their very name, as jargon, and the focus on technology instead of consumer value is halting their mainstream adoption" (Anderson, 2022). Accessibility is key for web3 tech adoption: "The tech is new, and so are many of the words…it's okay to say *crypto* when talking shop with fellow insiders…but generally, it's better to use *digital*. It's a lot friendlier than scary *crypto*, and, besides, everyone's familiar with digital, since we now live in a digital world" (Edelman, 2022, p. 9). To address these barriers, our partner organization can leverage the technology adoption model informed by human learning principles to analyze, develop, and refine an effective web3 learning strategy.

Constructivist Learning Theory

Contemporary cognitive theorists portray learning as *a process of constructing* knowledge instead of accumulating it from the outside environment (Ormrod, 2019). Constructivism emphasizes the agency of learners as they "construct new knowledge and understandings based on what they already know and believe (e.g., Cobb, 1994; Piaget, 1952, 1973, 1977, 1978; Vygotsky, 1962, 1978)" (Bransford J. & National Research Council*,* 2000, p.

10). The constructivist theory of learning and knowledge places power primarily with the learner (Ormrod, 2019. Constructivism has origins in the work of Jean Piaget and Lev Vygotsky (Ruey, 2010). The Piagetian school of thought paints the learner as an active agent, who actively self-constructs knowledge while regularly revising their understanding of that knowledge (Ormrod, 2019). Meanwhile, the Vygotskian school acknowledges the importance of context and highlights the significance of *social interactions and culture* upon one's cognitive development (Bransford J. & National Research Council, 2000). While the various branches of constructivist theories may differ slightly, a shared theme follows:

> People's thinking and learning are inextricably intertwined with the contexts in which they occur, whether those contexts be internal (e.g. a person's physical body or emotional state) or external ones (e.g. a person's immediate physical environment or more general community and society). (Ormrod, 2019, p. 165)

A learner-constructed knowledge model emphasizes the contextual layers of learning made up of the learner's physical environment, family, local community, and broader culture. Pre-existing knowledge also plays an important role in this theory of cognitive development; new knowledge must be constructed from existing knowledge (Bransford J. & National Research Council, 2000). As a result, those creating learning experiences must employ a holistic approach towards instructional design considering the beliefs, misunderstandings, and incomplete perspectives that learners may bring into this new context (Bransford J. & National Research Council, 2000).

A constructivist design promotes the learner's ability to apply and adapt new concepts on their existing schemas while considering the role of prior knowledge (Ruey, 2010). This contextual perspective is crucial for designers of learning experiences seeking to meet the needs of a broad audience (Ormrod, 2019). Research has been shown to indicate more effective learning experiences occur online through a collaborative, interactive constructivist approach (Murphy, Mahoney, Chen, Mendoza-Diaz & Yang, 2005 as cited by Ruey, 2010, p. 706). A constructivist learning environment encourages learners to bring their whole selves to the learning experience as they discuss, debate, and collaboratively build on their knowledge. As learners wrestle with new concepts and ideas, they utilize a combination of their existing knowledge and beliefs with what they encounter creating a distinct new understanding and perspective (Ormrod, 2019).

Practitioners designing educational experiences must consider both the context of their learner's identities and the appropriate path of learning (Ruey, 2010). The constructivist view of the impact of context upon a learner's ability to self-construct knowledge is a significant takeaway for practitioners tasked with designing instructional content (Ruey, 2010). For the digital environment, this may be even more challenging for designers as they must consider the requirements of a global audience of learners.

Cognitive Load Theory

When designing learning experiences, practitioners must consider the task capacity as learners can process only a limited amount of information at a given time (Ormrod, 2019). Any learning experience "imposes a cognitive load–a certain amount of information that learners must simultaneously think about, along with certain ways that they must think about it " to understand what they are learning (Ormrod, 2019, p. 192). This learner-centric perspective, known as Cognitive Load Theory (CLT), explains how the brain processes and organizes information when faced with new ideas (Paas, Tuovinen, et al., 2003). CLT encourages practitioners to consider the structure and presentation of information as this has significant impacts upon the learner's ability to learn and understand material (Paas, Renkl, et al., 2003, p. 2). The organization and presentation of information, including objectives and associated tasks, affects the mental effort to effectively process what the learner sees and hears.

A CLT-informed practitioner designs and conducts learning experiences considering how much load on learners' mental capacity can reasonably handle (Ormrod, 2019). In the effort to create an effective learning experience, practitioners can implement CLT strategies such as intentional structure, pacing, and signaling of important information (Ormrod, 2019). Scaffolding in this manner is especially beneficial when individuals face difficult and unfamiliar concepts that test their cognitive load limits.

Instructional methods guided by CLT help audiences to learn more effectively by leveraging limited processing capacity in the most effective way possible, which in turn, allows learners to apply their new knowledge and skills to novel situations (Paas & van Merriënboer, 1994; Sweller et al., 1998, as cited in Paas, Tuovinen et al., 2003, p. 63). Given the limitations of learner's working memory, CLT suggests that "instructional design should aim at reducing extraneous cognitive load and promoting beneficial cognitive load" (Sweller, 1988; Sweller et al., 1998 as cited in de Jong, 2010, p. 106). Beneficial cognitive load means that in some cases the 'working memory bottleneck' encourages learner creativity in organizing and synthesizing new information (Ormrod, 2019). This is exemplified when a learner interprets new information through visual imagery or utilizes both verbal and visual forms of information (Ormrod, 2019). Coupled with the constructivist approach, another helpful strategy to mitigate cognitive load is dynamic problem selection (Camp et al., 2001). Additionally, research has shown evidence that software programs designed with a learner-centric lens can enhance one's ability to lessen the task's cognitive load (Ormrod, 2019). A specialized approach to learning in this manner, which dynamically responds to learners' contexts and capacities, might be able to expand the limitations of a learner's working memory (Ormrod, 2019).

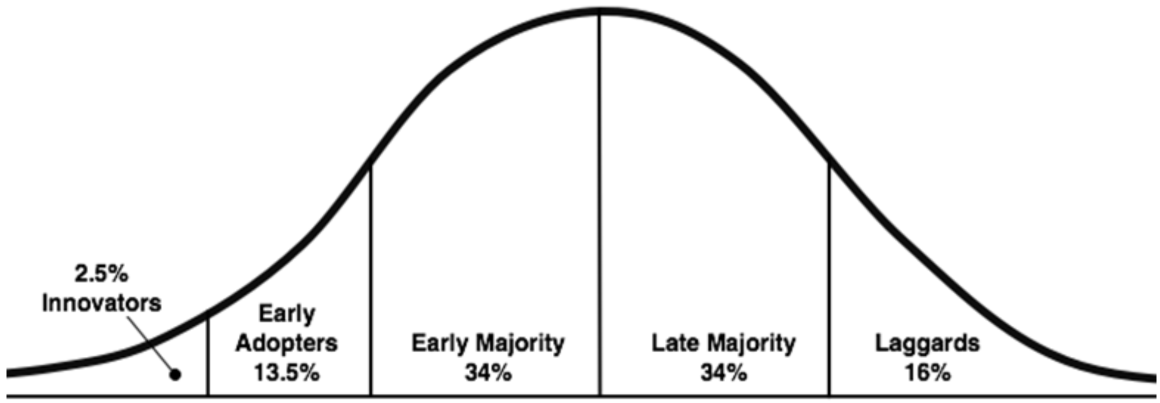
Diffusion of Innovations

Building upon theories of human learning, we examine the development of higher-order cognitive processes applied to learning *about* and *engaging with* modern-day technologies. The Diffusion of Innovations supports this goal as it is a social science model for understanding and analyzing how, when, and why people engage with new ideas and practices (Beal & Bohlen, 1957). In essence, the diffusion of innovations theory posits, "the adoption of an innovation progresses along the timeline from the earlier to the later adoption phases, as a result of a higher proportion of people within an organization making the adoption decision at each next phase of adoption" (Elgort, 2005, p. 181) The theory originates from rural, midwestern sociologists in the 1950s and 1960s interested in understanding why farmers adopt new agricultural technologies (Valente & Rogers, 1995).

The original diffusion of innovations model developed by Everett Rogers represents the distribution of adopters with a normal, bell-shaped curve, breaking down adopter populations into segments (Rogers, 1995) (see Figure 1). The model depicts the "who" and "when" for understanding the attitudes and behaviors of audience segments as they encounter new technologies (Sharp & Miller, 2016). According to the model, there are five adoption identities: innovators, early adopters, early majority, late majority, and laggards (Sharp & Miller, 2016). Each identity possesses a unique set of attributes and values (Elgort, 2005), that distinguishes it from another based on their characteristic response to a new technology (Moore, 2014).

Figure 1

Diffusion of Innovations Bell-Curve



Note. Technology adoption distribution according to the diffusion of innovations (Rogers, 1995).

These adoption profiles, and how they relate to one another, are key to understanding how an organization can present a new product, idea, or service that disrupts the 'norm' (Moore, 2014). The responses of these audience segments are characterized as follows:

- *Innovators:* intrinsically motivated to use new technologies (Elgort, 2005)
- *Early Adopters*: thought leaders with extrinsic reasons to adopt (Elgort, 2005); appreciative of the potential of new technologies (Moore, 2014)
- *Early Majority:* the 'pragmatists', driven by a strong sense of practicality; their buy-in is fundamental for growth (Moore, 2014)
- *Later Majority:* Followers and skeptics, not as comfortable with new technology (Elgort, 2005)
- *Laggards*: the 'resistors', hesitant and resistant to innovation, and may never adopt (Moore, 2014)

This model presents five stages for audience segments adopting a new idea, behavior, or product (Beal & Bohlen, 1957). The five stages include: (1) awareness, (2) interest, (3) evaluation, (4) trial, and (5) adoption (Moore, 2014). Gradually, the individual moves from this new knowledge construct towards large-scale use and satisfaction of the idea. Factors of complexity and source of information play an important role in how the rate of adoption spreads across the population (Beal & Bohlen, 1957). Many organizations implement this audience segmentation paradigm to gauge and strategize how consumers embrace new products or practices.

The "Chasm" of Technology Adoption

Geoffrey Moore modified the diffusion of innovation for emerging technologies by adding a new concept: between the early adopters and the mainstream early majority is a "chasm" (Moore, 2014). While diffusion of innovations argues that implementation occurs by groups in stages that correspond to their identity profile within the community, Moore posits that it is not a smooth, linear transition (Elgort, 2005). At each stage of the technology adoption curve, there is a risk of loss of momentum especially when a new audience segment encounters the innovation (Elgort, 2005). A particularly large break in the bell curve of technology adoption lies between the early adopters and early majority (Moore, 2014).

The chasm speaks to the unique strategies that organizations must implement to be successful with meeting the needs of each audience segment. Moore explains that these different motivations and resources create a need for organizations to understand audiences according to their psychographic profiles (Moore, 2014). For example, individuals may fall into the early adopter group because they have limited available resources for exploring new technologies (Beal & Bohlen, 1957). Meanwhile, early majority 'pragmatists' are more risk-averse, and require reliability and confidence in the product in order to adopt it (Elgort, 2005). For organizations launching a new technology or a disruptive idea, earning the trust and confidence of the early majority is crucial for growth (Moore, 2014); as one-third of the market, the early majority control the financial bulk and momentum of the market (Moore, 2014). If marketing strategies are not implemented to attract the early majority pragmatists, the technology adoption life cycle will stall at the first two audience groups and the product will remain an outlier of the main market (Elgort, 2005).

Bridging the “Chasm” for Mainstream Audiences

Although the chasm is an intimidating feat for any organization to encounter, it is not insurmountable. To bridge the gap of engagement between audience segments, especially when it comes to high-tech products, organizations need to finetune strategies that build confidence, and foster trust (Moore, 2014). In short, the organization needs to prioritize strategies that strengthen its relationship of confidence with the early market pragmatists by earning “a reputation for quality and service” (Moore, 2014, p. 59).

A limitation of the Diffusion of Innovation model is that it does not consider how an individual’s specific context, such as resources or relationships, support the adoption of a new technology (Beal and Bohlen, 1957). The disruptive context of an innovation imposes a significant cognitive load upon audiences; however, digital technologies themselves have the ability to offload some of the cognitive burden if designed intentionally as an electronic ‘playground’ where students can experiment with and expand on ideas (Langer, 2011; Spiro & DeSchryver, 2009, as cited by Ormrod, 2019). Moore’s “chasm” also highlights the importance of context by focusing on audience segments' identities and the importance of developing targeted strategies to address the specific needs and motivations of the different groups (Moore, 2014). Moore states, “the key lesson is that the longer your product is in the market, the more mature it becomes, and the more important the service element is to the customer” (Moore, 2014, p. 65). By bridging the gap between early adopters and early majority audience segments with user-centered strategies while leveraging technology to offload cognitive burden, organizations can succeed in encouraging the adoption of complex, cognitively taxing ideas.

An appropriately designed technology-driven learning experience can facilitate meaningful learning for audiences (Ormrod, 2019). Nevertheless, the usability of the innovation is central to supporting the user's confidence and encouraging future engagement with the product (Krug, 2013). The diffusion of innovations theory cautions organizations that audience perception of the advantages, compatibility, and complexity are among the barriers of adoption; a high degree of complexity is negatively related to the innovation's rate of adoption (Rogers, 1995).

Usability is a dynamic, and powerful, feature of the instructional design of online materials. Usability functions as a bridge between the complexities of the human experience and the product itself (Dianat, Adeli, Asgari Jafarabadi, & Karimi, 2019). Usability is central to building trust between the user and the technology they are attempting to use. Steve Krug describes this relationship thus:

> The more you watch users carefully and listen to them articulate their intentions, motivations, thought processes, the more you realize that their individual reactions to web pages are based on so many variables that attempts to describe users in terms of one-dimensional likes and dislikes are futile and counterproductive. Good design, on the other hand, takes this complexity into account. (2013, p. 128)

Nielsen defines usability as "a quality attribute which assesses how easy user interfaces are to use" (Nielsen, 2003 as cited in Khajouei & Farahani, 2020). Usability is critical for attracting audiences and has a direct impact on user satisfaction, thereby increasing confidence with a product or service (Mujinga et al., 2018). The five factors that contribute to a system's usability include learnability, efficiency, memorability, error prevention, and user satisfaction (Nielsen, 2003 as cited in Khajouei & Farahani, 2020).

Key Conceptualizations

Drawing upon the foundational theories of human learning and technology adoption, we posit that one of the adoption barriers for web3 technologies is its shroud of complexity. Not only is the technical operations difficult to understand, but the language surrounding the phenomenon itself can be abstract for mainstream audiences. *The Truth About Crypto* articulates the importance of the technology's accessibility: "The tech is new, and so are many of the words…it's okay to say *crypto* when talking shop with fellow insiders…but generally, it's better to use *digital*. It's a lot friendlier than scary *crypto*, and, besides, everyone's familiar with digital, since we now live in a digital world" (Edelman, 2022, p. 9). Web3 organizations, like our partner, need to understand the identity of their audiences, how audiences construct their schema for understanding web3, and how this learning pathway can inform and respond to their educational needs.

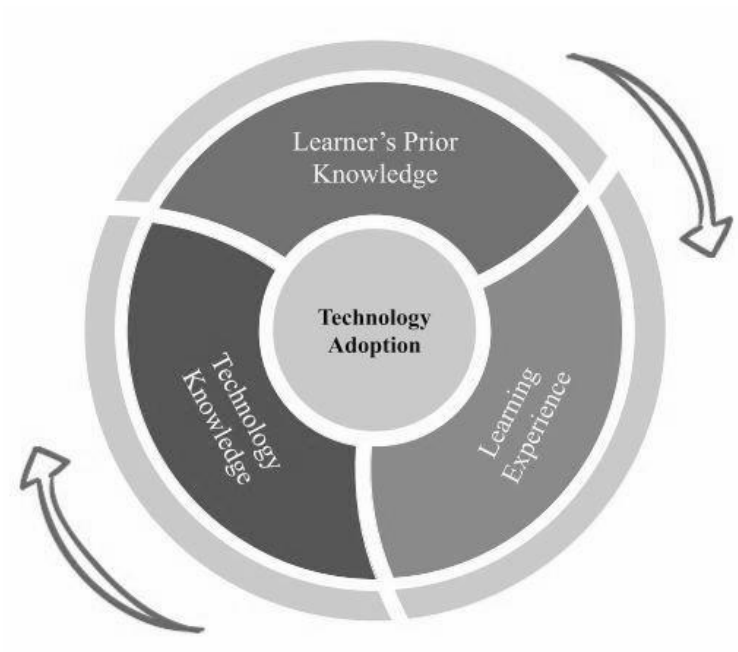
Conceptual Frameworks

The anchor for our conceptual framework is the technology adoption model (see Figure 2). We employed a multi-dimensional approach, tying together planes of technology and learning. Using constructivism and cognitive load theory, we view the technology adoption process by first understanding the learner, particularly *the identity and prior knowledge* of the learner. We employ a constructivist theory of knowledge because of the emphasis on the learner and the encouragement of the learner to apply new concepts while considering the knowledge that they bring.

The quality of the learning experience is a path towards confidence with a new idea or product, which opens the door to possible technology adoption. We utilized cognitive load theory strategies to understand the relationship between learner and learning path. The instructional design of the learning path, as informed by our literature review, must consider the cognitive load of its various audience groups, to scaffold their learning.

Figure 2

The Relationship Between Learner's Prior Knowledge, Learning Paths, and Tech Adoption

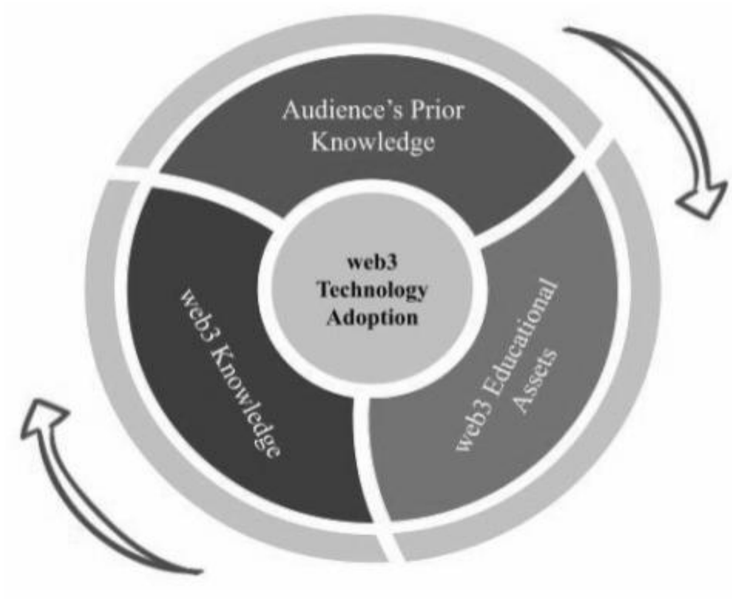


Research Methodology

We employed this conceptual framework as a model for our study's design and research approach. We designed our study as an experiment with approximate randomization so that we could understand the learner, learning path, and openness towards technology adoption. Our partner organization was interested to learn more about how readily available educational assets, such as those currently provided by NFT marketplace websites, would impact the public attitudes and confidence towards NFTs and web3. The study design and research approach reflected this conceptual framework of audience knowledge, learning paths via web3 educational assets, and web3 technology adoption (see Figure 3).

Figure 3

The Relationship Between Audience Knowledge, web3 Educational Assets, and web3 Adoption



Research Approach

The study's data was obtained through an anonymous online questionnaire. Given our partner organization's objective to understand public audience attitudes and behaviors, the study's unit of analysis was adults above the age of 18. The independent variable for the study is the educational asset provided by the NFT marketplaces. The dependent variable is the difference between the pre/post-test assessments demonstrating the effect of the educational assets upon participants' confidence and attitudes.

We designed an experiment administered through an online questionnaire to evaluate the user experience of the educational resources provided by three non-fungible token (NFT) marketplaces: OpenSea, Nifty Gateway, and Coinbase. These NFT marketplaces were identified based on their brand recognition, NFT sales volumes, and instructional design of materials towards new crypto / NFT audiences (Quigley & Gilbert, 2023). Each NFT marketplace curates and provides its own informational resources that address web3 fundamentals as well as documentation of NFT processes to acquire, own, and sell. The respondents' evaluation of these educational materials supported our study's goal to inform our partner organization's endeavors to realize the potential of web3.

The study design addresses our partner organization's goal to better understand how various audience segments respond to web3 and NFT educational tools and resources. Based on the conceptual framework of the relationship between the learning process and technology adoption, our partner organization is hopeful that a positive learning experience with educational assets will increase the likelihood of participants' future engagement with web3 communities.

Data Instruments

The tool for implementing our experiment was a survey informed by our conceptual model and developed from survey models in the space of usability testing and e-learning research. The survey included a total of 47 items to assess the independent variable of educational materials provided by NFT marketplaces. With the experimental design, participants responded with their opinion towards web3 and NFTs pre- and post-viewing a randomly assigned NFT marketplace's educational materials. Via an approximated randomization process, respondents were required to input a birth month to view one of the three preselected educational landing pages of one of the three selected NFT marketplaces (see Table 1). The approximate randomization of the independent variable assignment increased the experiment's internal validity. The NFT marketplace brand name was not provided to mitigate potential bias, while also allowing for a secure logic path connecting a participant's response to a specific NFT marketplace. The survey instrument may be reviewed in Appendix A.

Table 1

Survey Question Path: Birth Month to NFT Marketplace

Survey Question	Birth Month	NFT Marketplace
Please select your birth month.	January - April	OpenSea
	May - August	Nifty Gateway
	September - December	Coinbase

The online questionnaire is divided into two sections: a ten-question experimental investigation based on the system usability scale (SUS) (Brooke, 1995) and a twenty question user experience assessment modified from a user experience research informed e-learning assessment tool (Wang et al., 2007). These two sections enabled us to identify trends of user perspectives based on technology adoption's psychological profiles with a focus on each respondent's confidence towards the usability of NFTs pre and post viewing educational materials. We situated our research in terms of usability and confidence as these are key indicators of successful user-centered web design (Dianat, Adeli, Asgari Jafarabadi, & Karimi, 2019).

To capture the participants' determination of the usability of the web3 technologies, we modified Brooke's SUS (Brooke, 1995). SUS provides an efficient, subjective measure of the usability of a product (Mujinga et al., 2018). SUS accounts for measures of effectiveness, efficiency, and satisfaction (Brooke, 1995). The ten-statement assessment tool employs a Likert scale for scoring SUS statements on a five or seven point scale (Brooke, 1995). We used the five-point Likert scale to measure the degree of agreement with the SUS statements, from *strongly disagree* to *strongly agree*, scored 1 to 5. We adapted the statement language to clearly indicate NFT marketplaces.

To further support our comparison of the three NFT marketplaces, we modified an e-learning assessment tool (Wang et al., 2007) to understand why participants may or may not have changed in their confidence level towards web3 and NFTs. While their survey instrument includes 36 items (Wang et al., 2007), we identified twenty evaluative statements relevant to our research questions. Each participant received the same evaluative statements on five key qualities: website quality, information quality, service quality, user satisfaction, and net benefits (Wang et al., 2007). We also replaced the language of “e-learning system” to ‘“NFT marketplace” to eliminate any confusion (see Appendix A). To parallel the structure of the pre-assessment section, we used the five-point Likert scale to measure the degree of agreement with the evaluative statements, from strongly disagree to strongly agree, scored 1 to 5 (Brooke, 1995).

After reviewing the website, participants were asked to answer the twenty-question e-learning quality section which captured their user experience with scaled statements of website quality, information quality, service quality, user satisfaction, and net benefits. This evaluation process was followed by a post assessment of the same previous ten SUS modified statements with the aim to indicate a change in attitude or confidence towards NFTs after review of these NFT marketplace educational assets.

Cronbach’s alpha was used to determine the internal consistency of the survey instruments’ scales. Table 2 details each scale’s Cronbach’s alpha.

Table 2

Scale Tests

Cronbach's Alpha by Scale	
Website Quality Items	.9
Information Quality Items	.9
User Satisfaction Items	.9
web3 Confidence Items	.88
Net Benefits Items	.85
Pre / Post NFT marketplace Assessment Items	.85
Service Quality Items	.71

We hosted our survey online via Qualtrics as it provides a secure cloud-based platform with accessibility features for phones, tablets, or computers. Qualtrics allows for a user-friendly, reliable, and accommodating experience for participants. Furthermore, Qualtrics is securely designed to scan submissions to prevent instances of spam.

NFT Marketplace Characteristics

The randomized, quasi-experimental design allowed us to determine the impact of the instructional design of the educational resources upon participants' confidence and attitudes towards the emerging technology sector of web3. As aforementioned, the NFT marketplaces of OpenSea, Nifty Gateway, and Coinbase were identified based on their brand recognition, NFT sales volumes, and instructional design towards new crypto / NFT audiences (Quigley & Gilbert, 2023). Each of these websites uniquely curates and provides its own informational resources to address new audiences with web3 and NFT fundamentals.

OpenSea is a leading NFT marketplace that offers a platform for buying, selling, and discovering unique digital assets and collectibles, and is one of the primary exchange platforms for our partner organization. With over 20 million items on the marketplace and a growing community of creators and collectors, OpenSea is a key player and partner in the web3 space. The platform uses blockchain technology to ensure the authenticity and scarcity of each asset, making them one-of-a-kind. OpenSea prides itself for its user-friendly interface and secure environment, making it a popular destination for those in the market to purchase or sell NFTs (OpenSea, 2023).

Nifty Gateway is a fast-growing NFT marketplace that specializes in offering limited edition, high-quality collectibles created by artists, celebrities, and influencers. It was one of the first marketplaces to launch a mobile app, making it accessible to a wider audience. Nifty Gateway has collaborated with numerous high-profile names in the art, fashion, and music industries to offer exclusive NFT drops. The platform's focus on scarcity and authenticity, along its strong partnerships in the space, has helped secure its standing as a prominent NFT marketplace (Nifty Gateway, 2023).

Coinbase is a well-established cryptocurrency exchange and crypto wallet provider that recently entered the NFT market. As one of the most trusted names in the crypto space, Coinbase offers a secure and reliable platform for buying, selling, and storing NFTs. The company has an already established, large user base and a commitment to making NFTs accessible to a wider audience via gamified learning resources. Coinbase offers customized educational resources and support to help users understand web3, crypto, and NFTs to encourage new adopters to get involved in these emerging markets (Coinbase: NFTs, 2023).

Participant Recruitment

The online questionnaire launched November 10, 2022, and concluded December 31, 2022. Participant recruitment occurred through social media (e.g., LinkedIn, Instagram), online communication platforms (e.g., Slack, Discord), and the online research platform SurveyCircle (SurveyCircle, 2023) (Appendix B). Participants were informed about the voluntary nature of participation with the right to withdraw at any time. Participants were informed that the survey would take approximately 20 minutes to complete.

Participants were made aware that all responses were anonymous, and that the survey was “designed to gather information on how current web3 educational materials affect the user experience with non-fungible token (NFT) marketplaces” (see Appendix B). Participants were not compensated for their participation and Qualtrics software determined that one of 248 responses was “spam.”

Experiment Sample

A total of 248 survey responses were submitted. The analysis of this experiment only included fully completed surveys (n=110) which yielded a 53% overall completion rate. There were 31 responses that had only had a login into the survey and a 0% completion rate were excluded from the analysis. Nineteen percent of all respondents (n = 40) completed 29% or less of the survey and 28% of respondents completed between 47-94% of the survey (see Appendix C).

Demographic Profiles

We employed audience segmentation strategies found in similar “audience attitudes” studies (Kanna & Veazie, 2014; Maibach et al., 2011) to understand the demographics of research participants.

Before completing the survey's experimental section, respondents were asked seven demographic questions related to age, educational attainment, website navigation knowledge, web3 familiarity, and NFT experience (see Table 3). According to the Pew Research Center (2018), we binned open responses of age to define audience segments by generations: Gen Z (18-27), Millennials (28-46), Gen X (47-53), and Baby Boomers (54-78). This composed the demographic profile of respondents that supported our ability to answer the research questions related to the impact of web3 educational materials on different audience segments as informed by the literature review.

Table 3

Survey Demographic Questions

Demographic Data	Survey Questions	Response Format
Age	1. *What is your age?*	Open response
Education	2. *What is the highest level of education you have received?*	Multiple choice
Website Knowledge	3. *How would you rate your ability to navigate websites?*	5-point Likert Scale: Novice - Expert
Web3 Familiarity	4. *How would you rate your web3 knowledge? (5-point Likert scale)*	5-point Likert Scale: Novice - Expert
NFT Experience	5. *I own or have owned cryptocurrency.* 6. *I own or have owned a non-fungible token (NFT).* 7. *I have transferred cryptocurrency between wallets before.*	Y/N

The audience segment categories are provided below in Tables 4- 9. Our survey uses these categories to construct our framework for audience segments: age, level of education, self-evaluation of technology expertise, self-evaluation of web3 knowledge, NFT ownership, and cryptocurrency ownership. In alignment with the interests of our partner organization, we were interested in evaluating the experiences and feedback of different audience segments to more granularly understand the effectiveness of each NFT marketplace's educational assets in comparison to each other in affecting NFT marketplace confidence, web3 attitudes, and overall evaluation of website quality of each educational asset.

Table 4
Descriptive Statistics for Education Level

	Frequency	***Percent***
High School	*12*	*10.82*
Bachelor's	*30*	*27.02*
Master's	*48*	*44.14*
Doctorate	*20*	*18.02*
Total	*110*	*100.00*

Table 5
Descriptive Statistics for Age

	Frequency	***Percent***
Generation Z (18-27)	*16*	*14.41*
Millennials (28-46)	*76*	*69.37*
Generation X (47-53)	*8*	*7.21*
Baby Boomers (54-78)	*10*	*9.01*
Total	*110*	*100.00*

Table 6
Descriptive Statistics for Cryptocurrency Ownership

	Frequency	***Percent***
Yes	*46*	*41.67*
No	*64*	*58.33*
Total	*110*	*100.00*

Table 7
Descriptive Statistics for NFT Ownership

	Frequency	***Percent***
Yes	*24*	*21.62*
No	*86*	*78.38*

Total	*110*	*100.00*

Table 8
Descriptive Statistics for web3 Knowledge

	Frequency	***Percent***
Novice	*51*	*46.85*
Advanced Beginner	*28*	*25.23*
Competent	*7*	*6.34*
Proficient	*15*	*13.51*
Expert	*9*	*8.12*
Total	*110*	*100.00*

Table 9
Descriptive Statistics for Website Navigation Ability

	Frequency	***Percent***
Novice	*0*	*0.00*
Advanced Beginner	*14*	*12.61*
Competent	*3*	*2.70*
Proficient	*40*	*36.04*
Expert	*53*	*48.65*
Total	*110*	*100.00*

Data Analysis

Data that was organized in data tables and filtered to only include surveys that had 100 percent completion (n=110), 53% of the overall responses.

The primary analysis focused on the effects of the educational assets upon confidence with web3 and attitudes towards NFT marketplaces. To determine the effect of the educational assets, an average of the pre- and post-assessment score for each participant was calculated by averaging the responses for scales "Attitudes towards NFT Marketplaces" and "Confidence with web3." Then, the post-assessment composite score was subtracted by the pre-assessment score to determine an overall effect score. A sum of the differences for each educational asset was then calculated and divided by the total number of users for each marketplace to get the average difference and determine our dependent variables. Additionally, a one-way ANOVA test was conducted to directly investigate the effects of the NFT marketplace educational modules (independent variable) on the dependent variables (post minus pre scores for web3 confidence and NFT marketplace attitudes).

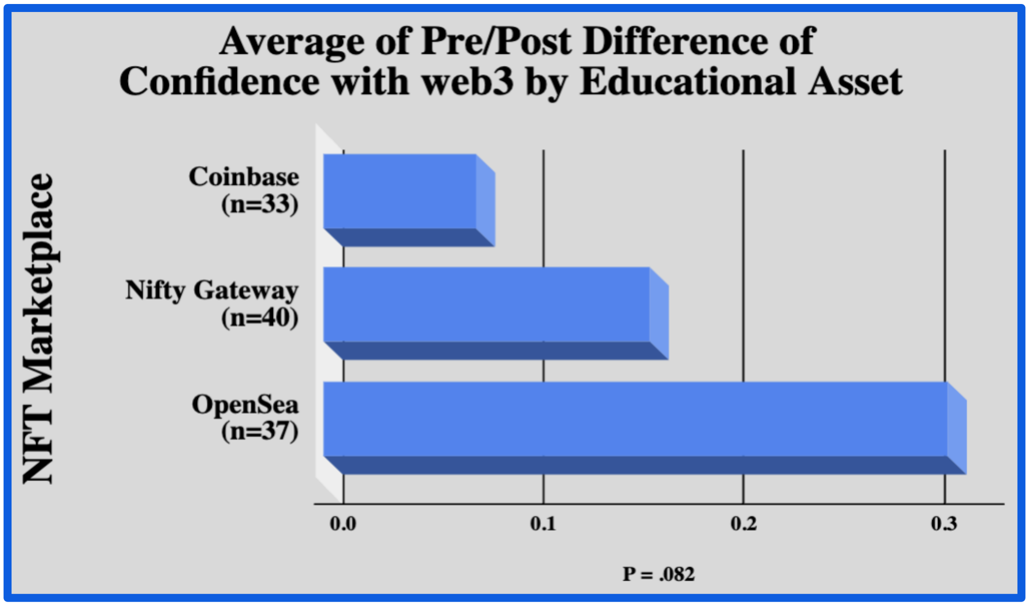
To determine how distinct audience segments evaluated the quality of each educational asset, data was gathered from the five sections of the “Website Evaluative Statements” (see Appendix A): Website Quality, Information Quality, Service Quality, User Satisfaction, and Net Benefits. The inputs of each survey participant were averaged for each section of the “Website Evaluative Statements” scale to develop a summative score for each section. Then, an analysis was conducted by sorting participants’ responses by one of the five audience segments: generation (age), highest achieved level of education, NFT ownership, cryptocurrency ownership, self-reported web3 knowledge, and self-reported website navigation ability. Descriptive statistics were then employed by using the summative scores of each distinct audience segment to inform a determination as to how the quality of each educational asset was evaluated. The small sample size of the various audience segments did not allow for an inferential investigation into differences between audience segments.

Findings

Research Question 1: What is the effect of educational assets upon confidence with web3?

OpenSea had the greatest positive effect in making participants’ more confident with web3.

Figure 4
Descriptive Graph of Pre/Post Difference in Confidence with web3



As shown in Figure 4, the Pre/Post Difference confidence with web3 averages for each educational asset showed that OpenSea had the greatest positive effect on participants' confidence with web3 overall. Coinbase had the least positive effect on participants' confidence with web3.

A one-way ANOVA to understand group differences between educational assets had a marginally significant p-value of .082 (see Table 10), providing more evidence there are differences in effectiveness between the three educational assets for increasing confidence with web3.

Table 10
ANOVA Difference Between Confidence with web3

Cases	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
NFT Marketplace	*1.714*	*2*	*0.857*	*2.861*	*0.082*

Note. Type III Sum of Squares

While there are marginally significant between-group differences, pairwise comparisons using independent samples t-tests determined that the three pairings of OpenSea-Coinbase, OpenSea-Nifty Gateway, and Coinbase-Nifty Gateway revealed no significant differences between the means of any pairwise comparison (see Table 11). Our sample size may have reduced our ability to detect significant differences between the means of the independent variable groups.

Table 11
Independent Samples T-Test by Pairwise Comparison

Pairwise Comparison	t	p
Coinbase-Nifty Gateway	-.595	.554
Coinbase-OpenSea	-1.698	.094
Nifty Gateway-OpenSea	-1.263	.210

Note. Student's t-test.

Research Question 2: What is the effect of educational assets upon attitudes towards NFT marketplaces?

OpenSea had the greatest positive effect in improving attitudes towards NFT marketplaces.

Figure 5
Pre/Post Difference in Attitudes towards NFT Marketplaces

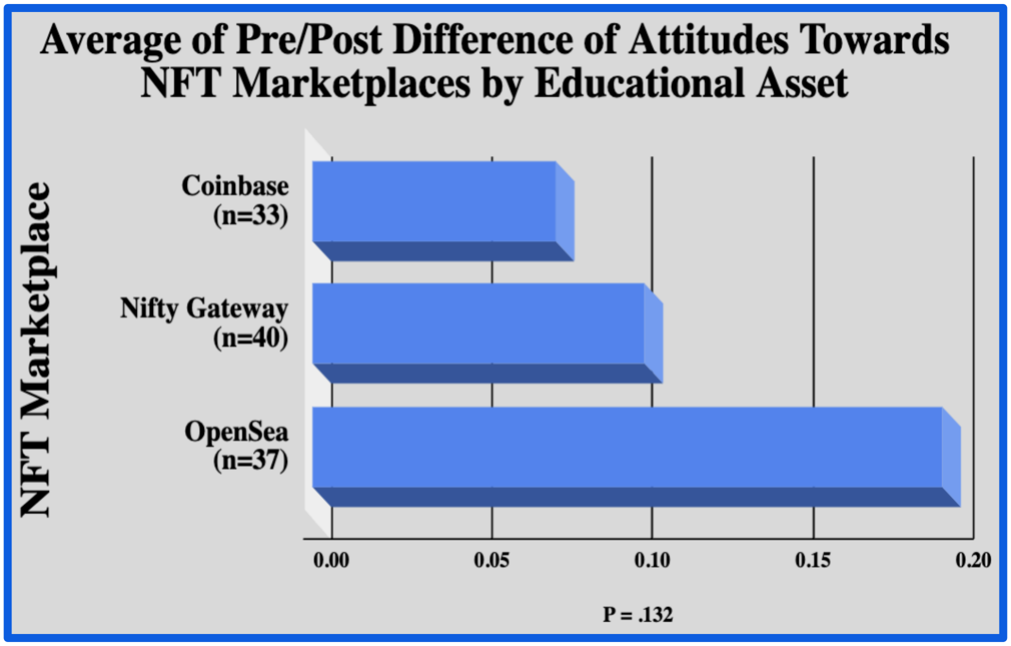


Figure 5 shows the Pre/Post Difference averages for attitudes towards NFT marketplaces for each educational asset and demonstrates that OpenSea had the greatest positive effect on participants' attitudes towards NFT marketplaces. Moreover, Coinbase had the least positive effect on participants' attitudes towards NFT marketplaces.

A one-way ANOVA was employed to understand group differences between educational assets had a marginally significant p-value of .132 (see Table 12), providing some evidence there are differences in effectiveness between the three educational assets for increasing positive attitudes towards NFT marketplaces.

Table 12
ANOVA Difference Between Attitudes towards NFT Marketplaces

Cases	Sum of Squares	df	Mean Square	F	p
NFT Marketplace	0.285	2	0.143	0.616	0.132

Note. Type III Sum of Squares

While there are marginally significant between-group differences, pairwise comparisons using independent samples t-tests determined that the three pairings of OpenSea-Coinbase, OpenSea-Nifty Gateway, and Coinbase-Nifty Gateway revealed no significant differences between the means of any pairwise comparison (see Table 13). Our sample size may have reduced our ability to detect significant differences between the means of the independent variable groups.

Table 13
Independent Samples T-Test by Pairwise Comparison

Pairwise Comparison	t	p
Coinbase-Nifty Gateway	-.257	.798
Coinbase-OpenSea	-1.039	.302
Nifty Gateway-OpenSea	-.806	.423

Note. Student's t-test.

Research Question 3: How do distinct audience segments evaluate the quality of each educational asset?

OpenSea received the highest summative scores for audience segments with more web3 and technology experience (crypto ownership, web3 knowledge, NFT ownership, and website navigation ability).

Coinbase received the highest summative scores for audience segments with more web3 and technology experience (crypto ownership, web3 knowledge, NFT ownership, and website navigation ability).

Figure 6

Website Evaluative Statements Summative Scores for Crypto Ownership and NFT Ownership

Crypto Ownership					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
No Own Crypto	COUNTA of WQ Summative	19	24	23	66
	AVERAGE of WQ Summative	3.95	3.52	4.08	3.84
	AVERAGE of IQ Summative	3.83	3.23	3.61	3.53
	AVERAGE of SQ Summative	3.61	3.40	3.09	3.35
	AVERAGE of US Summative	3.51	3.19	3.52	3.40
	AVERAGE of OB Summative	3.39	3.28	3.57	3.41
	Grand Total Average	3.66	3.32	3.57	3.51
Yes Own Crypto	COUNTA of WQ Summative	13	16	15	44
	AVERAGE of WQ Summative	3.81	3.91	4.48	4.07
	AVERAGE of IQ Summative	3.82	3.58	4.17	3.85
	AVERAGE of SQ Summative	3.88	3.47	3.68	3.66
	AVERAGE of US Summative	3.74	3.71	4.27	3.91
	AVERAGE of OB Summative	3.44	3.47	4.02	3.65
	Grand Total Average	3.74	3.63	4.12	3.83
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64

NFT Ownership					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
No Own NFT	COUNTA of WQ Summative	23	33	30	86
	AVERAGE of WQ Summative	3.93	3.63	4.17	3.90
	AVERAGE of IQ Summative	3.88	3.38	3.77	3.65
	AVERAGE of SQ Summative	3.68	3.47	3.20	3.43
	AVERAGE of US Summative	3.64	3.36	3.69	3.55
	AVERAGE of OB Summative	3.39	3.36	3.66	3.47
	AVERAGE of Grand Total	3.71	3.44	3.70	3.60
Yes Own NFT	COUNTA of WQ Summative	9	7	8	24
	AVERAGE of WQ Summative	3.78	3.89	4.50	4.05
	AVERAGE of IQ Summative	3.69	3.31	4.05	3.70
	AVERAGE of SQ Summative	3.81	3.21	3.78	3.63
	AVERAGE of US Summative	3.52	3.57	4.29	3.79
	AVERAGE of OB Summative	3.47	3.32	4.06	3.63
	Grand Total Average	3.65	3.46	4.14	3.76
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64

Descriptive statistics inform these findings via a pivot table comparison of summative scores for evaluative statements (see Figure 6). The summative score total for each section of the

Website Evaluative Statements scale is represented in the pivot table as “Grand Total Average.” Pivot table cells are shaded green to indicate the highest score per row.

Figure 6 reveals that Coinbase had the highest summative score for participants who did not own crypto, while OpenSea had the highest summative score for participants who owned crypto. Nifty Gateway was also shown to be evaluated with the lowest summative score for both participants who owned and did not own crypto.

Figure 6 also demonstrates that Coinbase had the highest summative score for participants who did not own an NFT, whereas OpenSea had the highest summative score for participants who owned an NFT. Nifty Gateway was once again evaluated with the lowest summative score for both participants who owned and did not own an NFT.

Figure 7

Website Evaluative Statements Summative Scores for web3 Knowledge and Website Navigation Ability

How would you rate your ability to navigate websites?					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
Advanced Beginner	COUNTA of WQ Summative	5	3	6	14
	AVERAGE of WQ Summative	3.85	3.58	3.71	3.73
	AVERAGE of IQ Summative	3.84	3.20	3.47	3.54
	AVERAGE of SQ Summative	3.90	3.08	2.63	3.18
	AVERAGE of US Summative	3.80	3.22	3.33	3.48
	AVERAGE of OB Summative	3.70	3.25	3.25	3.41
	Grand Total Average	3.82	3.27	3.28	3.47
Competent	COUNTA of WQ Summative	1	2	N/A	3
	AVERAGE of WQ Summative	1.75	3.13	N/A	2.67
	AVERAGE of IQ Summative	2.20	3.10	N/A	2.80
	AVERAGE of SQ Summative	2.50	3.50	N/A	3.17
	AVERAGE of US Summative	2.00	3.17	N/A	2.78
	AVERAGE of OB Summative	1.25	3.38	N/A	2.67
	Grand Total Average	1.94	3.25	N/A	2.82
Expert	COUNTA of WQ Summative	15	14	24	53
	AVERAGE of WQ Summative	4.10	4.25	4.31	4.24
	AVERAGE of IQ Summative	4.04	3.74	3.86	3.88
	AVERAGE of SQ Summative	3.83	3.66	3.34	3.57
	AVERAGE of US Summative	3.78	3.69	3.86	3.79
	AVERAGE of OB Summative	3.42	3.45	3.82	3.61
	Grand Total Average	3.83	3.76	3.84	3.82
Proficient	COUNTA of WQ Summative	11	21	8	40
	AVERAGE of WQ Summative	3.82	3.36	4.41	3.69
	AVERAGE of IQ Summative	3.67	3.16	4.03	3.48
	AVERAGE of SQ Summative	3.59	3.31	3.78	3.48
	AVERAGE of US Summative	3.42	3.25	4.04	3.46
	AVERAGE of OB Summative	3.48	3.31	3.88	3.47
	Grand Total Average	3.60	3.28	4.03	3.52
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total

web3 Knowledge					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
Advanced Beginner	COUNTA of WQ Summative	7	10	11	28
	AVERAGE of WQ Summative	4.14	3.65	4.14	3.96
	AVERAGE of IQ Summative	4.20	3.24	3.62	3.63
	AVERAGE of SQ Summative	3.96	3.20	3.41	3.47
	AVERAGE of US Summative	3.71	3.20	3.82	3.57
	AVERAGE of OB Summative	3.71	3.18	3.61	3.48
	Grand Total Average	3.95	3.29	3.72	3.62
Competent	COUNTA of WQ Summative	3	2	2	7
	AVERAGE of WQ Summative	3.83	3.88	4.00	3.89
	AVERAGE of IQ Summative	3.07	2.80	3.40	3.09
	AVERAGE of SQ Summative	3.33	3.13	3.50	3.32
	AVERAGE of US Summative	3.22	3.50	3.00	3.24
	AVERAGE of OB Summative	2.50	3.38	3.00	2.89
	Grand Total Average	3.19	3.34	3.38	3.29
Expert	COUNTA of WQ Summative	3	2	3	8
	AVERAGE of WQ Summative	4.08	4.00	4.38	4.13
	AVERAGE of IQ Summative	3.93	3.67	4.20	3.90
	AVERAGE of SQ Summative	3.67	3.42	3.50	3.53
	AVERAGE of US Summative	3.33	3.67	4.17	3.67
	AVERAGE of OB Summative	3.50	3.67	3.13	3.47
	Grand Total Average	3.70	3.68	3.87	3.74
Novice	COUNTA of WQ Summative	13	21	18	52
	AVERAGE of WQ Summative	3.79	3.55	4.29	3.87
	AVERAGE of IQ Summative	3.72	3.44	3.90	3.67
	AVERAGE of SQ Summative	3.62	3.57	3.10	3.42
	AVERAGE of US Summative	3.67	3.48	3.80	3.63
	AVERAGE of OB Summative	3.44	3.50	3.79	3.59
	Grand Total Average	3.65	3.51	3.78	3.63
Proficient	COUNTA of WQ Summative	6	5	4	15
	AVERAGE of WQ Summative	3.75	3.90	4.56	4.02
	AVERAGE of IQ Summative	3.93	3.20	4.45	3.83
	AVERAGE of SQ Summative	3.88	3.35	3.94	3.72
	AVERAGE of US Summative	3.67	3.13	4.42	3.69
	AVERAGE of OB Summative	3.42	3.20	4.31	3.58
	Grand Total Average	3.73	3.36	4.34	3.77
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total

Figure 7 reveals that Coinbase had the highest summative score for participants who had the lowest self-reported level of website navigation ability (Advanced Beginner). OpenSea had the highest summative score for participants of all other self-reported levels of website navigation ability (Expert, Proficient). Nifty Gateway was evaluated to have the lowest summative score for participants who self-reported the website navigation abilities of Advanced Beginner, Expert, and Proficient. The website navigation ability of "Competent" is not included in this finding because there is an incomplete data set as no participants evaluated OpenSea for this website navigation ability.

Figure 7 also demonstrates that Coinbase had the highest summative score for participants who had the lowest self-reported level of web3 knowledge (Advanced Beginner). OpenSea had the highest summative score for participants of all other self-reported levels of web3 knowledge (Novice, Proficient, Confident, and Expert).

Figure 8

Website Evaluative Statements Summative Scores for Education Level and Generation

Highest level of Education Achieved					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
Bachelor's degree	COUNTA of WQ Summative	12	6	11	29
	AVERAGE of WQ Summative	3.77	3.58	3.95	3.80
	AVERAGE of IQ Summative	3.87	3.30	3.65	3.67
	AVERAGE of SQ Summative	3.77	3.38	3.07	3.42
	AVERAGE of US Summative	3.69	3.00	3.45	3.46
	AVERAGE of OB Summative	3.42	3.46	3.66	3.52
	Grand Total Average	3.70	3.34	3.56	3.57
Doctorate	COUNTA of WQ Summative	7	8	5	20
	AVERAGE of WQ Summative	4.36	3.56	4.00	3.95
	AVERAGE of IQ Summative	4.00	2.93	3.72	3.50
	AVERAGE of SQ Summative	3.57	3.16	3.35	3.35
	AVERAGE of US Summative	3.71	3.17	3.73	3.50
	AVERAGE of OB Summative	3.61	3.25	3.45	3.43
	Grand Total Average	3.85	3.21	3.65	3.55
High School	COUNTA of WQ Summative	3	5	6	14
	AVERAGE of WQ Summative	3.83	3.85	4.21	4.00
	AVERAGE of IQ Summative	3.80	3.20	3.83	3.60
	AVERAGE of SQ Summative	3.92	3.70	3.54	3.68
	AVERAGE of US Summative	4.00	3.33	3.94	3.74
	AVERAGE of OB Summative	3.75	3.00	3.79	3.50
	Grand Total Average	3.86	3.42	3.86	3.70
Master's degree	COUNTA of WQ Summative	10	21	16	47
	AVERAGE of WQ Summative	3.73	3.70	4.52	3.98
	AVERAGE of IQ Summative	3.66	3.59	3.99	3.74
	AVERAGE of SQ Summative	3.70	3.48	3.41	3.50
	AVERAGE of US Summative	3.30	3.62	4.04	3.70
	AVERAGE of OB Summative	3.18	3.45	3.88	3.54
	Grand Total Average	3.51	3.57	3.97	3.69
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total

Generation					
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total
Baby Boomer	COUNTA of WQ Summative	1	4	4	9
	AVERAGE of WQ Summative	5.00	3.44	4.38	4.03
	AVERAGE of IQ Summative	4.80	2.85	3.90	3.53
	AVERAGE of SQ Summative	4.25	2.88	3.19	3.17
	AVERAGE of US Summative	5.00	2.75	4.00	3.56
	AVERAGE of OB Summative	5.00	3.25	4.06	3.81
	Grand Total Average	4.81	3.03	3.91	3.62
Gen X	COUNTA of WQ Summative	3	4	2	9
	AVERAGE of WQ Summative	4.25	4.31	4.00	4.22
	AVERAGE of IQ Summative	3.53	3.75	4.00	3.73
	AVERAGE of SQ Summative	3.75	3.75	3.50	3.69
	AVERAGE of US Summative	3.11	3.83	4.00	3.63
	AVERAGE of OB Summative	2.92	4.00	4.00	3.64
	Grand Total Average	3.51	3.93	3.90	3.78
Gen Z	COUNTA of WQ Summative	6	4	6	16
	AVERAGE of WQ Summative	3.88	3.50	4.17	3.89
	AVERAGE of IQ Summative	3.77	3.55	3.80	3.73
	AVERAGE of SQ Summative	3.75	4.06	3.17	3.61
	AVERAGE of US Summative	3.72	3.67	3.67	3.69
	AVERAGE of OB Summative	3.46	3.31	3.63	3.48
	Grand Total Average	3.71	3.62	3.69	3.68
Millennials	COUNTA of WQ Summative	22	28	26	76
	AVERAGE of WQ Summative	3.80	3.64	4.25	3.89
	AVERAGE of IQ Summative	3.84	3.36	3.82	3.65
	AVERAGE of SQ Summative	3.68	3.37	3.37	3.46
	AVERAGE of US Summative	3.58	3.39	3.81	3.59
	AVERAGE of OB Summative	3.40	3.29	3.70	3.46
	Grand Total Average	3.66	3.41	3.79	3.61
Grand Total	COUNTA of WQ Summative	32	40	38	110
	AVERAGE of WQ Summative	3.89	3.68	4.24	3.93
	AVERAGE of IQ Summative	3.83	3.37	3.83	3.66
	AVERAGE of SQ Summative	3.72	3.43	3.32	3.48
	AVERAGE of US Summative	3.60	3.40	3.82	3.60
	AVERAGE of OB Summative	3.41	3.36	3.74	3.51
	Grand Total Average	3.69	3.44	3.79	3.64
	NFT Marketplace	Coinbase	Nifty Gateway	Opensea	Grand Total

Figure 8 shows Coinbase with the highest summative score for participants who self-reported their highest level of education achieved as either a bachelor's degree or doctorate's degree. OpenSea had the highest summative score for participants who self-reported their highest level of education achieved being a master's degree. Both Coinbase and OpenSea had the highest summative score for participants who self-reported their highest level of education achieved being High School (scores were both 3.86).

Figure 8 also indicates that Coinbase had the highest summative score for participants who self-reported as members of Generation Z or Baby Boomer populations. OpenSea had the highest summative score for participants who self-reported as Millennials. Finally, Nifty Gateway revealed the highest summative score for participants who self-reported as Generation X population members.

Summary

As observed in Figures 4 and 5, OpenSea had the most positive effect in making participants more confident with web3 in addition to positively improving attitudes towards NFT marketplaces. Coinbase had about half the positive effect as OpenSea in making participants more confident with web3 in addition to positively improving attitudes towards NFT marketplaces. Nifty Gateway had the least positive effect in making participants more confident with web3 in addition to positively improving attitudes towards NFT marketplaces.

As observed in Figures 6-7, OpenSea received the highest summative scores for audience segments with more web3 and technology experience (crypto ownership, web3 knowledge, NFT ownership, and website navigation ability). Interestingly, Coinbase received the highest summative scores for audience segments with more web3 and technology experience (crypto ownership, web3 knowledge, NFT ownership, and website navigation ability). Nifty Gateway only received the highest summative scores for one audience segment: Generation X.

Recommendations

With support of the literature review and study findings, we uncovered three opportunities for our partner organization's educational strategy moving forward. These opportunities will support their efforts to help NFTs cross the chasm of engagement from early adopters to the mainstream "pragmatist" audiences unfamiliar with or wary of web3's emerging landscape. By comparing the effectiveness of the three provided educational assets and evaluating their qualities, we offer these recommendations: employ learner-constructed models for instructional design, scaffold and personalize the instructional design of educational assets, and improve the reliability of future experiments.

Recommendation 1: Learner-Constructed Models for web3 Educational Assets

Informed by the study's findings that one NFT marketplace's educational assets (OpenSea) had the greatest positive effect on audience's confidence and attitudes towards web3, we identified an opportunity to utilize learner-constructed models based on constructivist instructional design strategies. We believe that our partner organization would benefit from employing a similar constructivist approach towards the design of their educational assets. As the literature review discussed, constructivism teaches instructors and practitioners the importance of enabling the user as an active agent in their learning (Ormrod, 2019). With a learner-constructed knowledge model, each member of the audience, despite their characteristics, self-constructs their knowledge of the web3 environment of NFT marketplaces based on their prior knowledge of environment, family, community, and culture (Bransford J. & National Research Council, 2000). Instructional designers in this context must consider this understanding by promoting the audience's ability to apply and adapt the new technological concepts to their existing schemas (Ruey, 2010).

One of the most difficult challenges presented by the technology adoption life cycle, particularly for high-tech advancements, is accessibility. As Moore explains, innovators and tech enthusiasts are intrinsically motivated to engage in a new environment, however the first wave of the early majority, the pragmatists, are more cautious (2014). Familiarity facilitates trust, which in turn encourages the pragmatists to follow in the footsteps of the early adopters; a learner-constructed model harnesses the familiarity of prior knowledge through user-friendly language and accessible instructional designs.

OpenSea exemplifies the use of constructivist instructional design strategies. OpenSea’s educational resources employed more user-friendly methods of instruction with web design principles of usability: accessible language, multiple learning modalities, and clear navigation. The accessibility of language used by the website demystifies the terminology often associated with NFTs by harnessing the power of the learner's prior knowledge. For example, they describe non-fungible using a metaphor familiar to the public; non-fungible means “the item is totally unique, and therefore has its own unique value. For example, two cars of the same make and model might have different values based on how many miles are on the odometer, their accident records, or if it was previously owned by a celebrity” (OpenSea, 2023).

OpenSea also includes multiple learning modalities for content via written, visual, and auditory methods. The organization of the web page chunks the content into digestible blocks of learning, highlighting key learning goals of blockchain basics and NFTs. Underneath these chunked written learning modules, the “Watch and Learn” section of OpenSea’s educational assets exemplifies a learner-constructed instructional design model that uses effective practices to offset cognitive load. They democratize their approach with friendly faces from various demographic profiles, the user has increased opportunities to identify with the persona as a participant in the web3 space. These individuals explained in small, chunked sections the following questions or issues: what an NFT is, how to buy an NFT, what is a crypto wallet, how to sell an NFT, and tips to stay safe in web3. Each video includes the speaker’s name and Twitter handle creating a sense of trust, familiarity, and transparency with the viewer.

OpenSea's design of their educational assets aligns with Moore's suggestion to assist technology adoption via a holistic, market-centric approach. A market-centric approach prioritizes the overall user experience with the product (Moore, 2014). OpenSea's educational assets present a market-centric strategy to create a whole-product experience with a learner centered experience and purposeful fit (Moore, 2014). By drawing up prior knowledge and familiarity with the user, OpenSea makes users feel more confident in their knowledge of web3. Our partner organization would benefit from employing similar strategies of educational development which can amplify their web3 presence and the public's openness towards these new technologies.

Recommendation 2: Scaffolded, Personalized Instructional Design

Informed by the study's third finding, the evaluation of the educational asset's quality differed for various audiences, we suggest that our partner organization strategically craft a scaffolded, personalized educational approach. With the findings for our third research question, a theme emerged that there is a difference of opinions towards quality that can suggest a connection to certain audience characteristics. Instructional designers crafting effective educational experiences must consider this learner variability when creating an effective learning strategy (Ruey, 2010). Learning pathways that incorporate choice opportunities for the learner are effective for delivering new content because it considers user identity, prior knowledge in addition to the content itself. Research shows that personalized, scaffolded instructional designs that account for how learners uniquely construct knowledge from prior experiences have a greater impact on learning outcomes (Bransford J. & National Research Council, 2000).

Instructional designs that provide choices of engagement enhance outcomes because the learner has agency to appropriately target and address their learning needs. Choice respects learner agency, offloads task capacity, leads to persistence, and improves learning outcomes (Cordova and Lepper, 1996). In contrast, a static, inflexible approach that does not account for individual differences may hinder learning outcomes by increasing the learner's cognitive load. Studies have found that personalized learning experiences with opportunities for choice mitigates cognitive load. As previously discussed, practitioners who harness cognitive load strategies of choice, pacing, and signaling of key information, create more effective learning experiences (Ormrod, 2019). One meta-analysis of over 40 educational psychology studies found that learning opportunities with choice built into their design improved learner performance and persistence (Patall et al., 2008).

For this study, the educational assets provided by the NFT marketplaces did not appear to provide scaffolded opportunities for the user to choose their own path of learning. While OpenSea exemplifies how to optimize for user-friendliness and accessibility, it does not optimize individual choice and autonomy by creating a personalized structure of learning. A learning path whereby the user can take a diagnostic assessment which then curates an educational experience based on their reported knowledge and comfortability may present a more meaningful way to enhance learning outcomes and encourage greater trust between the user and the partner organization.

Learning pathways with opportunities for audience choice democratizes web3 literacy. We recommend that our partner organization utilize the opportunity to create a scaffolded, personalized learning approach for various audience segments based on the technology adoption model. An approach in this manner could address each psychographic profile of technology adoption audience segments or could strategically target the two most important technology adoption identities: early adopters and early majority (Moore, 2014). Scaffolded, personalized learning respects learner variability by allowing users to choose how they engage in web3 learning. This may assist in their ability to retain the information longer, apply the knowledge more effectively, and encounter the new technology with confidence and openness (Samah et al. 2011).

Recommendation 3: Improve Reliability of Experimental Approach

Our final recommendation for our partner organization is informed by the limitations of our study design and research. Our first limitation was that the study yielded inconclusive findings regarding the distinctions between audience segments. The small sample size of the various audience segments did not allow for an inferential investigation into differences between audience segments for our third research question. Although we cannot say with certainty, we do feel that conducting the experiment with a larger sample size would increase the reliability of our study design for audience segments.

Moreover, the study did not allow for participants to be observed, and thus, we cannot say for certain how users engaged with the websites (i.e., click-paths, time on website). The research was therefore limited by the self-reporting element of the design. A structured environment of users exploring the websites via a usability testing model (Krug, 2013) may reveal a deeper understanding of the differences in the evaluation of the website qualities. We recommend a usability testing protocol occur within a structured environment where participants can be observed either in-person or via screen-recording (Krug, 2013). Finally, we see an opportunity for our partner organization to leverage this survey tool in the future with a targeted recruitment of participants who self-identify with characteristics of the audience segments that our partner organization is interested to investigate.

Conclusion

Overall, our capstone project and study's findings suggest that certain educational assets can have a positive impact on improving people's confidence towards web3 and attitudes towards NFT marketplaces. As instructional designers, we must consider, however, that not all educational assets are equally effective; informed by constructivist learning theories, targeted learning pathways for audiences can help facilitate knowledge acquisition that is crucial for audiences prior to their adoption of an emerging technology. We believe that there is a need for further investigation into the impact of educational assets upon the technology adoption psychographic profiles, especially as the nuances between participants suggest a powerful potential for designing effective strategies for technology adoption based on learner variability.

Furthermore, our findings emphasize for our partner organization the importance of understanding the broader technology adoption process. In today's rapidly changing technological landscape, adoption of disruptive ideas and technologies is more than educational assets, but rather a holistic approach of building trust and value for the needs of the early market (Moore, 2014). While our research focused on educational assets, future study related to the technology adoption of web3 may need to review the landscape of adoption from the lens of beliefs and utility for the average consumer. Adoption is more than learning; adoption also relies heavily on the value-add for consumers. As research partners in collaboration with our organization, we are excited to see the future research in deepening the connections between learning and technology adoption, and how it can contribute to bridging the gap between early adopters and mainstream customers.

Appendices

Appendix A

Educational Assets and Technology Adoption Survey

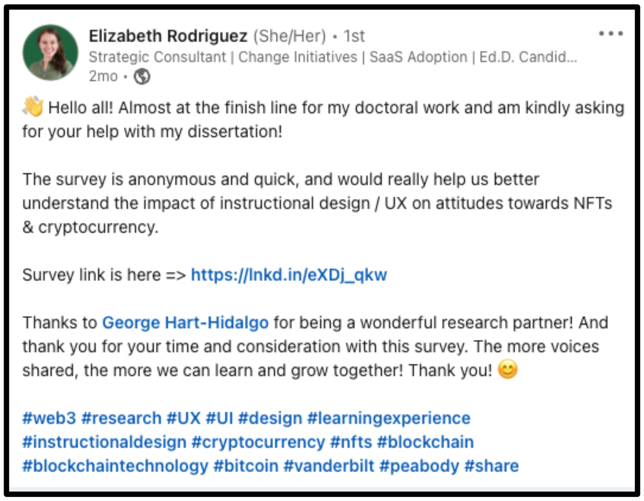
Survey Section	Survey Item
Demographic Profile of Audiences	1. *What is your age?* 2. *What is the highest level of education you have received?* 3. *How would you rate your ability to navigate websites?* 4. *How would you rate your web3 knowledge? (5-point Likert scale)* 5. *I own or have owned cryptocurrency.* 6. *I own or have owned a non-fungible token (NFT).* 7. *I have transferred cryptocurrency between wallets before.*
NFT Pre-Assessment Attitudes towards NFT Marketplaces	8. *I am aware of non-fungible token (NFT) marketplaces.* 9. *I would like to use and engage with NFT marketplaces.* 10. *I think NFT marketplaces are easy to use.* 11. *I think I would need support from a more technical person to help me use NFT marketplaces.* 12. *I believe that most people could learn to use and engage with NFT marketplaces quickly.* 13. *I find NFT marketplaces to be difficult to use.* 14. *I feel confident with engaging in NFT marketplaces.* 15. *I need to learn more about NFTs before I engage in the space more.*
NFT Pre-Assessment Confidence with web3	16. *I have a favorable view of blockchain technology, cryptocurrency, and NFTs.* 17. *I think blockchain technology, cryptocurrency, and NFTs will be a part of the future.*
Educational Material / Website Evaluative Statements	*Website Quality* 18. *The website provides high accessibility.* 19. *The website appears easy to use.* 20. *The website appears user-friendly.* 21. *The website has attractive features.*
	Information Quality 22. *The website provides relevant information for navigating NFT marketplaces.* 23. *The website provides information necessary for you to engage in NFT marketplaces.* 24. *The website provides sufficient information for you to engage in NFT marketplaces.*

Survey Section	Survey Item
	25. The website provides information that is easy to understand. *26. The website provides up-to-date information.*
	Service Quality *27. The website provides a proper level of explanation.* *28. The website provides opportunities to give feedback.* *29. The website provides opportunities for support.* *30. The website provides satisfactory support for users to utilize NFT marketplaces.*
	User Satisfaction *31. I felt a positive attitude towards this website.* *32. I found the education materials on this website to be useful.* *33. I am satisfied with this website.*
	Net Benefits *34. The website helped me improve my understanding of NFT marketplaces.* *35. The website encourages me to engage in NFT marketplaces.* *36. The website made me feel interested to learn more about NFT marketplaces.* *37. As a whole, the website is successful with its NFT educational materials.*
Post-Assessment Attitudes towards NFT Marketplaces	*38. I am aware of non-fungible token (NFT) marketplaces.* *39. I would like to use and engage with NFT marketplaces.* *40. I think NFT marketplaces are easy to use.* *41. I think I would need support from a more technical person to help me use NFT marketplaces.* *42. I believe that most people could learn to use and engage with NFT marketplaces quickly.* *43. I find NFT marketplaces to be difficult to use.* *44. I feel confident with engaging in NFT marketplaces.* *45. I need to learn more about NFTs before I engage in the space more.*
Post-Assessment Confidence with web3	*46. I have a favorable view of blockchain technology, cryptocurrency, and NFTs.* *47. I think blockchain technology, cryptocurrency, and NFTs will be a part of the future.*

Appendix B

Participant Recruitment

1. LinkedIn Participant Recruitment Language



Elizabeth Rodriguez (She/Her) • 1st
Strategic Consultant | Change Initiatives | SaaS Adoption | Ed.D. Candid...
2mo •

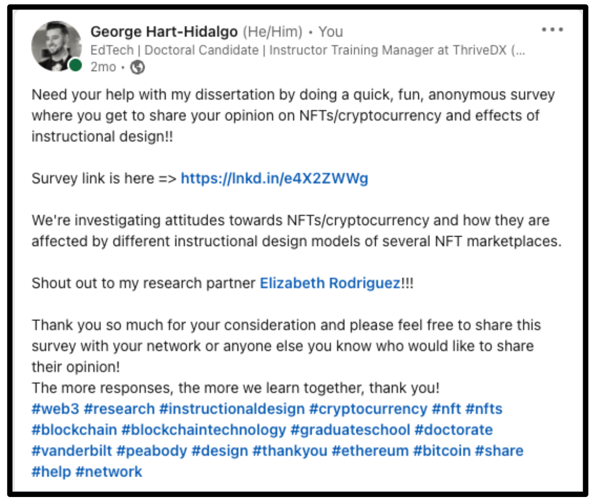
👋 Hello all! Almost at the finish line for my doctoral work and am kindly asking for your help with my dissertation!

The survey is anonymous and quick, and would really help us better understand the impact of instructional design / UX on attitudes towards NFTs & cryptocurrency.

Survey link is here => https://lnkd.in/eXDj_qkw

Thanks to George Hart-Hidalgo for being a wonderful research partner! And thank you for your time and consideration with this survey. The more voices shared, the more we can learn and grow together! Thank you! 😊

#web3 #research #UX #UI #design #learningexperience #instructionaldesign #cryptocurrency #nfts #blockchain #blockchaintechnology #bitcoin #vanderbilt #peabody #share



George Hart-Hidalgo (He/Him) • You
EdTech | Doctoral Candidate | Instructor Training Manager at ThriveDX (...
2mo •

Need your help with my dissertation by doing a quick, fun, anonymous survey where you get to share your opinion on NFTs/cryptocurrency and effects of instructional design!!

Survey link is here => https://lnkd.in/e4X2ZWWg

We're investigating attitudes towards NFTs/cryptocurrency and how they are affected by different instructional design models of several NFT marketplaces.

Shout out to my research partner Elizabeth Rodriguez!!!

Thank you so much for your consideration and please feel free to share this survey with your network or anyone else you know who would like to share their opinion!
The more responses, the more we learn together, thank you!
#web3 #research #instructionaldesign #cryptocurrency #nft #nfts #blockchain #blockchaintechnology #graduateschool #doctorate #vanderbilt #peabody #design #thankyou #ethereum #bitcoin #share #help #network

2. Recruitment Language on Survey

Thank you for assisting us with our research. This survey is designed to gather information on how current Web3 educational materials affect the user experience with non-fungible token (NFT) marketplaces.

All information shared is confidential, and your participation is voluntary. If you decide that you do not wish to participate, there is no penalty. The survey will take approximately 15-20 minutes to complete. Your time and feedback is greatly appreciated.

By clicking the next arrow below, I affirm that I am 18+ years of age and voluntarily consent to participate in this survey.

Note: This project has been reviewed and approved by the Vanderbilt Institutional Review Board (IRB).

Appendix C

Survey Completion Rates by Various Audience Segments

Audience Segment	Least Likely to Complete (Percentage)	Most Likely to Complete (Percentage)
Age	*Gen Z | 43%*	*Millennials | 59%*
Education	*High School | 43%*	*Master's | 58%*
Cryptocurrency Ownership	*No | 50%*	*Yes | 60%*
NFT Ownership	*No | 52%*	*Yes | 69%*
Web3 Knowledge	*Novice | 43%*	*Expert | 75%*
Ability to Navigate Websites	*Advanced Beginner | 44%*	*Expert | 59%*

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