The Dark Side of Fun: Understanding Dark Patterns and Literacy Needs in Early Childhood Mobile Gaming

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Abstract: Play has always been recognized as an essential aspect of human development, particularly during early childhood, as it contributes to learning, the formation of meanings, and experiencing the world. In today's digitalized society, early childhood education has increasingly integrated digital media into its practices, both in schools and at the family level. Mobile digital games (MDG) have received significant attention due to their impact on children's interactions, play, and learning. However, as young children engage more with MDGs, concerns about problem gaming have arisen, referring to conflicts and issues that emerge from game playing within everyday sociocultural contexts. Scholars such as Zagal et al. (2013) have identified certain game design patterns as "dark", which can be considered unethical as they manipulate players against their best interests. Given the prevalence of mobile gaming in early childhood, studying these dark patterns becomes even more crucial. This study aims to investigate the presence of dark patterns in MDG for young children (0-5 years old), through qualitative analysis. The five most popular free games for this age range on App Store (February 2023) were analysed, particularly focusing on the presence of temporal, monetary, social, and/or psychological dark patterns. The analysis uncovers the presence of temporal, monetary, and psychological dark patterns, including aesthetic manipulations, paywalls, and periodic rewards resembling gambling elements. The games also employ advertising strategies and engagement tactics that challenge young children's navigation. Parental control mechanisms offer limited safeguards, requiring continuous monitoring and parental involvement in play dynamics. The study highlights the importance of adult media and digital literacy in supporting children's online play effectively, while also emphasising the responsibility of game designers and developers to create healthier and less risky game experiences.

Keywords: Dark patterns, Game design, Mobile digital games, Digital literacy, Early childhood

1. Introduction

Play is a fundamental and essential aspect of early childhood development, with numerous studies highlighting its profound impact on children, namely until five years old. Research consistently demonstrates that play not only provides enjoyment and entertainment for young children but also serves as a crucial mechanism for learning and development across multiple domains (Waite-Jones and Rodriguez, 2022). According to Piaget's theory of cognitive development, play facilitates the construction of knowledge by allowing children to actively explore their environment, manipulate objects, and engage in imaginative and symbolic play scenarios. Through play, children develop critical cognitive skills such as problem-solving, decision-making, and abstract thinking (Piaget, 1962). Furthermore, play is closely linked to the development of social and emotional competencies. It provides opportunities for children to engage in social interactions, develop empathy, practice self-regulation, and enhance their communication, collaboration and negotiation skills. Empirical studies have consistently shown that play-based interventions in early childhood settings positively influence children's overall cognitive, social, emotional, and physical development (Blalock et al., 2019; Colliver et al., 2022; Pesce et al., 2016; Rao and Gibson, 2019).

The digitalization of contemporary society has had a profound impact on early childhood education, resulting in the integration of digital media at both school and family levels (Lindeman et al., 2021; Kumpulainen and Gillen, 2020). This also reshaped children's ways of interacting, acquiring knowledge and growing (Danby et al., 2018; Erstad et al., 2020). In this context, mobile digital games (MDGs) have emerged as a significant focus of attention, exploring their influence on children's interactions, playing, and learning (Morgade et al., 2020).

The presence of mobile technologies in children's daily lives might highlight how the blending of online and offline realms is occurring, based on how they depend on the digital environment. According to Livingstone and Pothong (2021), this premise, aligned with the integration of intelligent (AI-driven), data-centric, surveillance-oriented, and other types of 'smart' environments, by both public and private sectors, have been leading to notable advancements in persuasive design, the strategic enhancement of attention through algorithms, and the commercialization of individuals' personal information.

Despite the growing supply of media and media products - entertainment, learning or both - for children, there are few studies that focus on these subjects and reflect on younger children's interactions with digital mobile

media and how these interactions impact their literacy practices and the development of digital literacy skills (Kumpulainen et al., 2020).

1.1 The Dark Side: Design, Patterns and Digital Literacy

According to Macklin and Sharp (2016), game design is crucial in determining the mechanics, ideas, and overall gameplay experience of a game. It is through this process that the fundamental actions, themes, and interactions are established, influencing the entire play experience. Understanding and appreciating the significance of these foundational elements is key, as they directly impact children's engagement and immersion in the game. When game designers carefully craft these aspects, they create an environment that fosters meaningful play for children, enabling them to fully explore and enjoy the game.

In line with this understanding, Livingstone and Pothong's (2021) research provides a valuable perspective. Their studies with children and youth underscore the essential role of game design in bridging the gap between structured gameplay and the freedom of imaginative, child-led play – the so-called “free play”. By understanding the intricate interplay between game mechanics, concepts, and the overall gameplay experience, designers hold the power to create digital games that serve as gateways to a world of free play. Such games have the potential to stimulate children's curiosity, ignite their imagination, and empower them with a sense of agency over their play experiences.

On the other hand, the rise of unethical game design in mobile games, which focuses on maximising profits through manipulative tactics known as dark patterns (Dahlan and Susanty, 2022; Heimo et al., 2018; Zagal et al., 2013), appears to lead us towards a troubling intersection where young children and games might interact in a negative way. These unethical or manipulative design tactics raise significant ethical concerns regarding not only the user experience, but also digital literacy competencies. The use of digital technologies and media, and the growing prevalence of multimodality as Flewitt et al. (2015) and Kumpulainen et al. (2018)highlight, significantly influences children's digital literacy. Digital literacy plays a crucial role in empowering young children to navigate the digital landscape in an effective and responsible manner. These competencies are particularly relevant in today's increasingly connected world, where children are exposed to various digital platforms and technologies from an early age. Though, the rise of dark design strategies in platforms and applications aimed at these age groups poses significant challenges to their digital literacy and overall well-being - they exploit their vulnerabilities, lack of awareness, and immaturity (Tate & Warschauer, 2017).

2. The Study

In light of the previously detailed background, the objective of this study is to examine the existence of dark patterns in MDGs designed for young children aged 0-5 years old, using qualitative analysis as the research approach. In February 2023, AppStore’s five most popular free games for this age range were analysed, particularly focusing on the presence of temporal, monetary, social, and/or psychological dark patterns. The present research also seeks to prompt a critical reflection on the literacy needs of young children, their families, and educators within the context of these mobile games. By examining the presence of dark patterns in popular free games designed for children aged 0-5 years old, the study aims to shed light on potential ethical concerns related to game design.

2.1 Methods

In this study, a qualitative critical approach was employed to examine dark patterns in MDGs for young children. The analytical framework encompassed two main components: the application of an adapted approach of dark patterns heuristics and theory (Dahlan and Susanty, 2022; Zagal et al., 2013), and a formal analysis of gameplay (Lankoski and Björk, 2015).

The analysis of dark patterns involved the identification and evaluation of deceptive or manipulative design elements employed within mobile games, according to the established in Table 1. Dark patterns heuristics and theory were employed to systematically examine and interpret these design choices, considering their potential impact on players' behaviours and experiences.

Table 1: Dark patterns, subcategories and definitions. Based on Dahlan and Susanty (2022), Zagal et al. (2013), and Dark Pattern Games (https://www.darkpattern.games/)

Dark Patterns	Subcategory	Definition
Temporal: Dark patterns refer to tactics used in games to manipulate players into spending more time playing, often through deceptive or coercive means.	Playing by Appointment	Having to adhere to the game's predetermined schedule rather than being able to play on your own terms.
	Daily Rewards	Motivates players to log in daily by providing incentives, while also penalising them for failing to do so.
	Grinding	Being compelled to complete monotonous tasks in order to make progress.
	Advertisements	Compelled to view advertisements or incentivized to do so through the promise of rewards.
Monetary: Deceptive tactics that coerce or pressure players into spending money on the game.	Pay to Skip	Permitting or actively promoting players to spend money to speed up their progress in the game.
	Premium Currency	The true cost of in-game items is concealed by the exchange rate between real-world currency and virtual currency.
	Pay Wall	The game reaches a point where further progress is contingent on making a payment.
	Gambling/Loot Boxes	Using real money to participate in a game that involves an element of luck, with the possibility of receiving a prize as a reward.
Social: Manipulative techniques that leverage a player's social connections with friends and family to generate benefits for the game.	Social Pyramid Scheme	Players are incentivized to invite friends to join the game and are encouraged to continue spreading the invitation to others in their social circle.
	Social Obligation/Guilds	Due to a sense of responsibility towards one's friends, players may feel compelled to play the game even when they would prefer not to.
	Friend Spam/Impersonation	The game employs unsolicited messaging to a player's contact list or social media account.
	Fear of Missing Out (FoMO)	Players are pressured to continue playing the game by the fear of missing out on rewards or falling behind other players.
Psychological: Employ psychological manipulation techniques aimed at inducing players to	Invested/Endowed Value	Having invested significant time and money into advancing one's status in the game, it can be challenging to abandon those gains.
	Complete the Collection	The compulsion to acquire all the items, achievements, or hidden features in a game.

Dark Patterns	Subcategory	Definition
make decisions that may not be in their best interest.	Aesthetic Manipulations	The use of deceitful questions or manipulation of emotions and subconscious desires, mainly based on aesthetical game elements.
	Variable Rewards	Irregular or unexpected rewards have a greater potential to generate addiction compared to rewards provided on a predictable schedule.

The formal analysis of gameplay adopted a game-centric perspective, independent of specific player contexts. It focused on studying games as artefacts and activities, aiming to understand the game systems and how their components interact with each other. This approach blurred the distinction between games as designed systems and games as played experiences, as both aspects were considered integral to the analysis. To conduct the formal analysis of gameplay, the researchers engaged with the mobile games under investigation, actively playing and experiencing the gameplay first-hand.

The sample selection process involved conducting an examination of the top-ranking games in the App Store's children's category specifically targeting the age range of 0-5, in February 2023. The games that appeared at the highest positions in terms of popularity and downloads were identified and included in the analytical corpus. By focusing on the top-ranked games, the study aimed to analyse the games that were most widely accessible and likely to be encountered by young children and their families/educators. These games were considered influential due to their prominence in AppStore, suggesting their potential impact on children's gaming experiences and the prevalence of design elements within them.

After the selection, each game was played for at least 30 minutes using an iPhone 13.

3. Results

3.1 Sample of Games and Dark Patterns

The initial noteworthy finding within the examined sample of popular games for young children is that the majority of them, excluding Game 2, possess a distinct educational element. These games demonstrate connections with traditionally offline-based activities commonly observed within this age group, such as painting, creating object sequences, or engaging in imaginative play – the so-called “make believe”.

Another central aspect to consider is the significant inconsistency in the age ratings assigned to these games. As depicted in Table 1, all the games were classified in AppStore under the age rating "4+; Made for Ages 0 to 5". This rating is inherently paradoxical as it combines two incompatible designations—being suitable for children aged zero to four years old and also being appropriate for children older than four years old. Furthermore, certain games exacerbate this confusion by including conflicting age references in their app titles, such as Games 3 and 4, which mention suitability for children aged two and above.

Table 2: Overview of the sample of analysed games

Game No.	Title	Age Rating	In-App Purchases	Category	Developer
1	Baby colouring book for kids	4+; Made for Ages 0 to 5	Yes	Education	Bimi Boo Kids Learning Games for Toddlers FZ LLC
2	PAW Patrol Rescue World	4+; Made for Ages 0 to 5	Yes	Entertainment	Budge Studios
3	Toddler games for 2+ year old	4+; Made for Ages 0 to 5	Yes	Education	Educational Games for Kids and Toddlers. Early Learning Preschool.

Game No.	Title	Age Rating	In-App Purchases	Category	Developer
4	Kids cooking games 2+ year old	4+; Made for Ages 0 to 5	Yes	Education	Educational Games for Kids and Toddlers. Early Learning Preschool.
5	Kids Games for Drawing, Doodle	4+; Made for Ages 0 to 5	Yes	Education	Bini Bambini Academy

Note: the table above was developed according to the information available on AppStore.

The analysis of the dark patterns present in each of the five games included in the sample (Table 2), through the implementation of the taxonomy presented in Table 1, and based on Dahlan & Susanty (2022), Zagal et al. (2013), and Dark Pattern Games (https://www.darkpattern.games/) is presented in Table 3. The presence of each dark pattern was categorised with a number from zero (when a dark pattern is not identified in the game) to four (when a dark pattern was identified in the game and it detrimentally affects both the gameplay experience and the player's mindset), according to the heuristic evaluation proposal developed by Dahlan & Susanty (2022).

Table 3: Dark patterns in the sample of games according to the taxonomy presented in Table 1

Dark Patterns	Subcategory	Games				
		1	**2**	**3**	**4**	**5**
Temporal	Playing by Appointment	0	0	0	0	0
	Daily Rewards	0	0	0	0	0
	Grinding	0	0	0	0	0
	Advertisements	3	4	2	2	2
Monetary	Pay to Skip	0	1	0	0	0
	Premium Currency	0	0	0	0	0
	Pay Wall	4	0	4	4	4
	Gambling/Loot Boxes	0	0	0	0	0
Social	Social Pyramid Scheme	0	0	0	0	0
	Social Obligation/Guilds	0	0	0	0	0
	Friend Spam/Impersonation	0	0	0	0	0
	Fear of Missing Out (FoMO)	0	0	0	0	0
Psychological	Invested/Endowed Value	0	0	0	0	0
	Complete the Collection	4	3	4	4	4

Dark Patterns	Subcategory	Games				
		1	2	3	4	5
	Aesthetic Manipulations	4	3	4	4	4
	Variable Rewards	0	1	0	0	0

From the four categories of dark patterns, only social dark patterns were considered absent from these games. All the remaining categories – temporal, monetary, and psychological – were to some extent present in the games. All games presented both aesthetic manipulations and strategies to coerce players into completing the collection, with these subcategories of patterns heavily affecting their play experience – 19 out of 20 possible points for each subcategory. Similarly, paywalls were also found as a very characteristic dark pattern in these popular MDGs aimed at children, being present in four of the five analysed games, always to the highest possible degree. Examples of this are presented in Figures 1 and 2, representing an intricate of monetary and psychological dark patterns, including paywalls and the inherent aesthetical call to complete a collection.

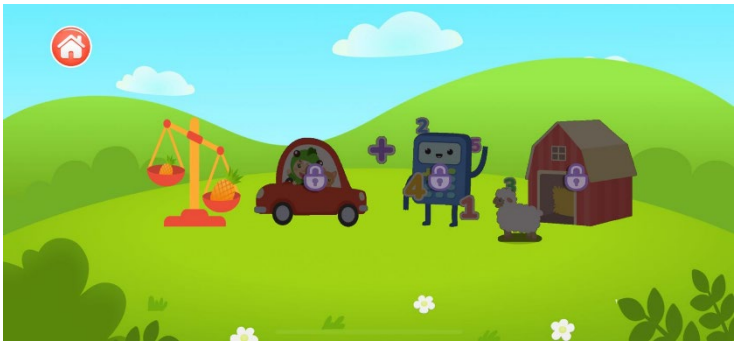

Figure 1: Screenshot from Game 3 menu (Source: Toddler games for 2+ year old | Educational Games for Kids and Toddlers. Early Learning Preschool)

Figure 2: Screenshot from Game 5 menu (Source: Kids Games for Drawing, Doodle | Bini Bambini Academy)

Advertisements were present in all games, although expressed differently in the sample – whether in terms of type or frequency. Game 1 and Game 2 was seen as having a significant impact on players' experiences and mentality, as represented in Figure 3. On the other hand, Games 3, 4, and 5 were seen as being minorly affected by the presence of advertisements. Pay to skip was present only in Game 2 but, even there, is analysed as posing little to no harm to the playing experience.

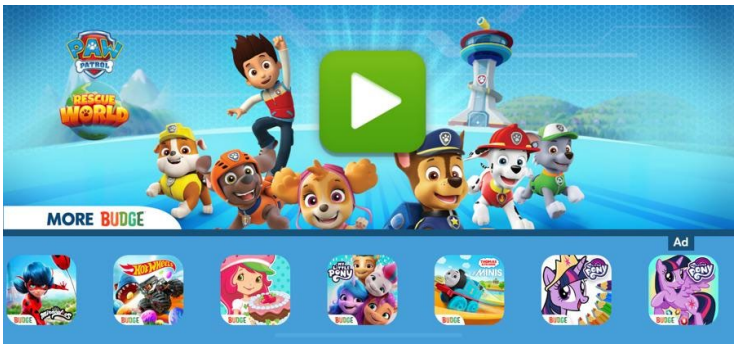

Figure 3: Screenshot from Game 2 menu (Source: PAW Patrol Rescue World | Budge Studios)

Social dark patterns, which leverage social networks to encourage game sharing among players through mechanisms like social obligation, were not observed in the analysed games, given their target age demographic.

3.2 Aesthetic Manipulation and Paywalls

The analysis of the games uncovers various noteworthy findings regarding the graphical representation of locked content, deceptive paywall mechanisms, periodic rewards, personalised plans, and the pervasive nature of in-app purchases. These findings shed light on the intricate design elements and monetization strategies employed within these MDGs for young children.

The aesthetically pleasing graphical representation of locked playable content – exemplified in Figures 1 and 2 – possesses the potential to evoke a stronger inclination towards purchasing or desiring ownership of said features. A feeling of dissatisfaction stemming from the absence of these features is present along with this effect. Consequently, the visually enticing paywalls, strategically implemented early in the game with minimal free-to-play content, appear to constitute a complex dark pattern. In essence, this design comprises a sophisticated approach that combines financial coercion (the paywalls, according to Table 1's model) with psychological coercion (the urge to complete collections and aesthetic manipulation, also according to Table 1's model).

Furthermore, within this domain, both Game 3 and Game 4 employ an initial, albeit deceptive, "paywall" mechanism. This design creates a false impression that payment is necessary for progression, even though it is not. This deceptive practice is accomplished by manipulating the size and placement of the close option within the paywall, intentionally making it less noticeable compared to the more prominent "continue" option, as depicted in Figure 4.

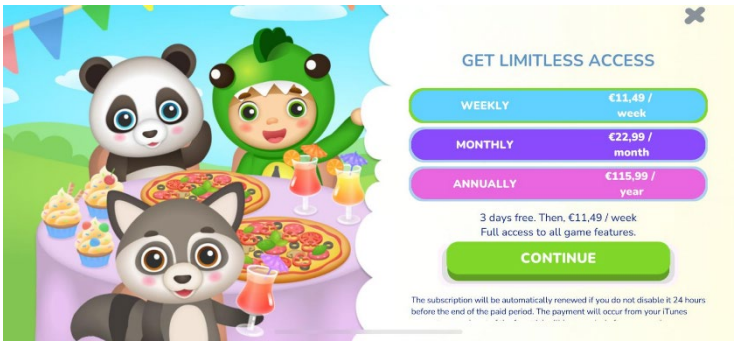

Figure 4: Screenshot from Game 4 initial paywall (Source: Kids cooking games 2+ year old | Educational Games for Kids and Toddlers. Early Learning Preschool)

Within a spectrum that is potentially more closely linked to gambling, it is noteworthy that Game 2 also offers periodic rewards. However, it is important to note that these rewards, although unpredictable, should not be classified as loot boxes.

In a rather distinctive way, Game 5 initially appears to target adult users by offering the option to create personalised plans for each child based on their individual interests. However, when outlining such a plan, users are redirected to a purchase screen where the most expensive option is consistently labelled as the "best value," and emphasis is placed on the "free trial" option. Conversely, the option to continue without subscribing is presented in a less prominent manner, located in the upper left corner.

This critical analysis serves as an overarching examination of the games, highlighting a significant aspect: despite presenting themselves as free, they function as a framework for facilitating – and persuading – in-app purchases. Therefore, the portion of gameplay that is effectively free to play is deliberately very limited. This trend is consistent across all games, but it becomes especially prominent in Games 3 and 4, which, being from the same company, share very similar monetization strategies.

3.3 Advertisement and Parental Control

The analysis of the games reveals noteworthy findings regarding their advertising strategies, engagement tactics, cross-marketing approaches, and consideration of parental control mechanisms.

In the context of game 2, the advertisements manifested as pop-ups that were both repetitive and visually similar to the gameplay, creating an illusion of seamless continuation. As a result, the act of clicking on these advertisements becomes nearly unavoidable, particularly when considering the limited literacy and cognitive abilities of young children. Still concerning Game 2, it appears to implement an engagement strategy that resides at the intersection of aesthetic and advertising considerations. This strategy leverages the recognizable imagery and narrative associated with a well-known franchise among the target age group, Paw Patrol, in order to attract prospective players. Additionally, as depicted in Figure 3, other games promoted within the same context seem to employ a comparable approach with other franchises – Miraculous: Tales of Ladybug & Cat Noir; Hot Wheels; Strawberry Shortcake; My Little Pony; and Thomas & Friends.

Despite not relying on popular franchises, Games 3 and 4 employ advertising strategies to engage in cross-marketing various games and applications from the same company. Additional advertising strategies can be observed in Game 5, notably through the presence of in-game visual references throughout the gameplay experience. Moreover, the inclusion of labels such as "try for free" further exemplifies the use of advertising techniques within the game (bottom left corner in Figure 2).

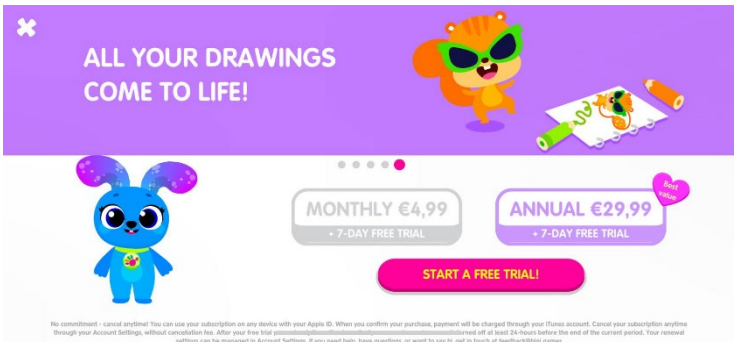

Figure 5: Screenshot from Game 5 subscription options (Source: Kids Games for Drawing, Doodle | Bini Bambini Academy)

Despite incorporating dark patterns within their game design, the examined games also appear to consider certain parental control mechanisms, particularly those associated with in-app purchases. This aspect is evident across all games, and is exemplified in Figures 6. Even though they are very simple, they can be considered relatively effective for young children – e.g. indicating the year of birth or doing a basic mathematical operation.

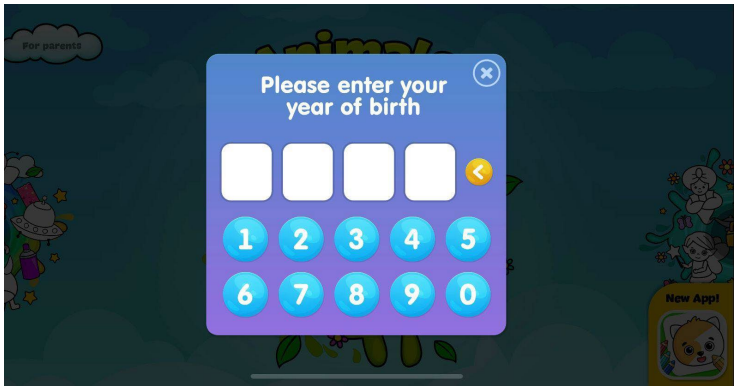

Figure 6: Game 1's in-app purchase parental control system (Game source: Baby colouring book for kids | Bimi Boo Kids Learning Games for Toddlers FZ LLC)

3.4 Early Childhood Mobile Gaming and Literacy Needs

The study's results highlight a significant finding: the primary literacy needs in children's engagement with mobile games rest with the adults who facilitate or supervise their interactions. This emphasises the importance of promoting adults' game and digital literacy to support children effectively. Additionally, the study raises questions about managing associated risks while fostering critical and empowering approaches and learning, particularly when considering dark patterns within the context of childhood.

Based on the age range and the games examined, a significant finding emphasises that the primary literacy needs lie with the adults who facilitate or supervise children's engagement with mobile games. This is evident, for example, when considering ambiguous age ratings, as it highlights the responsibility of adults in making decisions. It ultimately depends on their assessment of whether a game is suitable for the child's developmental stage, level of maturity, and need for stimulation.

Therefore, besides digital literacy in general, the obtained results emphasise the need to promote adults' game literacy. By embracing game literacy, parents can facilitate learning, critical thinking, and a richer gaming experience for their children. In this sense, we can adopt Zagalo's (2010) concept of creative game literacy, which contends that game literacy should concentrate on both understanding games (decoding) and designing games, highlighting the wide range of skills that families and educators need to develop.

According to Herdzina and Lauricella (2020), the support required for the development of children's media literacy is categorised based on age groups, which do not align with the age range defined by the AppStore (see Table 1). Within this framework, specific attention is given to children aged zero to two years, who face challenges (or vulnerabilities) in critically analysing media due to their specific and age-related developmental characteristics. Consequently, adult support during this stage should focus on engaging with the media together and, in the context of this study, engaging in co-play. Similarly, for children aged three to four years, there is notable cognitive development, although difficulties persist in distinguishing between fantasy and understanding abstract concepts. Therefore, when children of this age engage with mobile games, adults accompanying them are encouraged to gradually introduce elements of critical analysis and foster their agency in their own play and media consumption in general.

Moreover, the results sustain a need to re-contextualize dark patterns and associated literacy practices within the context of childhood, particularly early childhood. Prominent researchers have been placing dark patterns literacy within media education through an agency-driven perspective, which acknowledges that "some players deliberately find pleasure in engaging in processes designed to make them spend time and money, although they recognize them as such" (Dupont and Malliet, 2021, p. 18). The developmental characteristics and lack of maturity of certain age groups, such as the one discussed here, lead us to rethink this conceptual stance. While we may want to promote a critical and empowering approach, how can we do so while managing the associated risks?

4. Discussion

In this study, we aimed to examine the presence of dark patterns in MDGs designed for young children aged 0-5 years old. The findings revealed a combination of positive and concerning aspects within the analysed games, highlighting two complementary points: (a) the need for adult media and digital literacy and responsible management of children's engagement with these games; and (b) the need to foster ethical game design patterns within the industry, mainly focusing on the specific characteristics of this age range.

Most of the examined games demonstrated educational elements that aligned with offline activities commonly observed in young children, such as painting and imaginative play. This shows how diffuse the distinction between online and offline environments is and how they mutually influence the play environments in which young children engage. However, significant inconsistencies were observed in the age ratings assigned to them, which might lead to confusion for families and educators – which games are and are not appropriate according to the child's developmental stage? This discrepancy calls for clearer and more accurate age ratings, so that adults can make informed decisions about the suitability of games for their children.

The analysis of dark patterns in the games uncovered the presence of temporal, monetary, and psychological dark patterns to varying extents. Aesthetic manipulations and paywalls were identified as prominent, impacting the gameplay experience and potentially influencing purchasing behaviour. Although social dark patterns were absent, other categories were prevalent, indicating the need for careful consideration of the design elements in these games. Moreover, aesthetic manipulation was identified as a particularly complex dark pattern in the

sample – visually enticing locked content, and deceptive paywall mechanisms. It creates a sense of desire and dissatisfaction, coercing players into making purchases or completing collections. Periodic rewards, although not classified as loot boxes, exhibited similarities to gambling elements. Additionally, personalised plans with pricing manipulation were employed to encourage subscriptions. These strategies mainly targeted adult users.

Advertising strategies and engagement tactics were observed in the games, with pop-up advertisements and cross-marketing approaches being employed. These strategies aimed to increase engagement and attract players, but they also posed challenges for young children' to navigate the game without clicking on them. Parental control mechanisms related to in-app purchases were present, offering a small number of safeguards. Despite this, the results of the analysis conducted point to the pressing need for continuous monitoring and parental involvement - without this support, children may engage in negative play experiences that do not address their learning, stimulation and entertainment necessities. Hence, it is still not clear how these patterns can promote an adverse gaming experience, triggering feelings of frustration, incapacity, and other aggressive behaviours (Kahila et al., 2022).

Overall, the study emphasises that the primary literacy needs in children's engagement with mobile games lie with the adults who facilitate or supervise their interactions. Along with media and digital literacy, adult game literacy is essential for supporting children's online play effectively. Therefore, promoting adults' game literacy can enhance children's learning, critical thinking, and gaming experience. The concept of "creative game literacy" (Zagalo, 2010), which encompasses understanding and designing games, might provide a framework for developing the necessary skills among parents and educators, in various educational contexts.

The other crucial factor of this discussion is how the issues of addiction and other problems commonly associated with gaming can be attributed not only to the child, their family, or supervisory factors but also to the game design itself. In other words, the obtained results highlight how the responsibility for creating a healthier and less risky relationship between children and games lies not solely with the child's literacy, adult game literacy or families/educators' decision-making, but also with the game designers and developers. Moreover, it is important to rethink these practices in light of existing business and monetization models, making families and educators aware of the implicit costs and impacts of free games such as the ones analysed.

Furthermore, the study raises important questions about managing associated risks while fostering critical and empowering approaches, particularly when considering dark patterns within the context of early childhood. Re-contextualizing dark patterns and associated literacy practices within the developmental characteristics and maturity levels of young children seems crucial. Balancing the promotion of critical thinking and agency with the responsible management of risks requires further exploration and consideration, in order to enrich the literature, and to identify and disseminate good practices that can be replicated, both in the context of video game producers, but also in the context of adults with educational responsibilities..

4.1 Limitations and Future Directions

Despite the valuable insights provided by this research regarding the presence of dark patterns in mobile games for young children, there are several limitations that need to be considered. Firstly, the study's sample size was limited, focusing on a small selection of popular MDGs for young children. While efforts were made to choose representative games, the findings may not be generalizable to the entire population of games targeting this age group. Future studies could expand the sample size, include a wider range of games and consider other providers to obtain a more comprehensive understanding of the prevalence and impact of educational elements and dark patterns.

Secondly, the categorization and assessment of dark patterns involved a degree of subjectivity, despite adopting a standardised evaluation framework. Different researchers may interpret and assign scores to dark patterns differently, potentially leading to variations in the analysis. To enhance the reliability and validity of dark pattern assessments, future research could involve multiple evaluators and employ inter-rater reliability measures. Comparing children's and adult's gameplay experiences could also provide rich insights to critically analyse the perceptions and impacts of dark patterns.

Another limitation is the inconsistency in age ratings and app store classifications. The analysis revealed that the assigned age ratings were paradoxical and often conflicting, making it challenging for educators and families to determine the suitability of games for their children. However, the study did not investigate the actual impact of these inconsistencies on children's gameplay experiences or parental decision-making. Further research could explore how misleading age ratings and classifications affect children's engagement and parents' choices regarding game selection.

Having this in mind, conducting longitudinal studies that value children's voices, would provide valuable insights into the long-term effects of mobile games on young children's development. By tracking children's gameplay experiences, their behaviours, learning and competencies over an extended period, researchers can better understand the impact of both educational elements and dark patterns on their cognitive, social, and emotional outcomes.

By shining a light on these dark patterns, this research study aims to contribute to a broader discussion on responsible and ethical game design practices. It encourages researchers, developers, families, and educators to reflect on the impact of these design strategies on children's well-being, literacy development, and overall digital experiences. Ultimately, the goal is to promote the creation of more inclusive, engaging, and ethically designed digital experiences for young children.

Future studies should also aim to delve into the intricacies of game monetization strategies in a more detailed manner. One particular area of interest could be the comparison between free and paid games and their respective target audiences. This research could become particularly relevant with the recent expansion of game platform subscription services to mobile devices, for example, with Apple Arcade.

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