INTERNATIONAL DESIGN CONFERENCE – DESIGN 2024
https://doi.org/10.1017/pds.2024.157

Requirements elicitation in board game design for children with developmental language disorder (DLD)

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Abstract

Developmental Language Disorders (DLDs) affects a significant number of children during early childhood. Speech and Language Pathologists (SLPs) are vital in providing the adequate treatment through Speech and Language Therapeutic Toys (SALTTs) including board games, which have substantial benefits for children undergoing therapy. However, designers require support in designing board games which specifically target child therapy. A framework is proposed to assist designers in designing more efficient, inclusive and usable games which in turn are aligned with therapy goals defined by SLPs.

Keywords: design activities, board game design, user experience

1. Introduction

It is estimated that *Developmental Language Disorder* (DLD) affect approximately 7% of the child population (Laasonen et al., 2018). These disorders, even though they exist primarily in children, can endure throughout adulthood, thereby affecting the child's development in terms of social, educational, behavioural and emotional growth. *Speech and Language Pathologists* (SLPs) intervene to offer treatment to such impacted population, thus playing a vital role in treating speech and language disorders and assisting in child development (Law et al., 2017). One significant intervention is through the use of traditional toys intended for use during therapeutic activities. Such toys, often termed as *Speech and Language Therapeutic Toys* (or SALTTs), offer various benefits to children (Balzan, et al., 2022), including the exposure to novel vocabulary and literacy socialisation (Sosa, 2015). While conventional toys, like articulation cards, storybooks, and sound/letter flashcards, are often highly valued by SLPs, research has also demonstrated the effectiveness of incorporating alternative serious toys, such as board games, in aiding children with DLDs during intervention (Noda et al., 2019). However, tangible and commercially available SALTTs for use during therapy are not readily available on the market. This can be the result of a limitation of design knowledge amongst designers who developed such specific SALTTs (Fikar et al., 2018).

Within this context, this paper aims to address the following research question *"What are the key requirements to design board games aimed specifically to be used for speech and language therapy?"* A preliminary framework developed on the identified requirements is also presented. This work is a continuation of Balzan et al. (2021), which sought to identify the needs of designers at the early design stages when developing physical therapeutic toys. The rest of this paper is organised as follows: Section 2 presents an overview of the related work in the field of SALTTs and game based therapy. Section 3 delineates the SALTT potential model, characterised by a set of twelve elements to guide designers with explicit knowledge on eliciting requirements for a conventional SALTT. Section 4 outlines the methodology adopted in this research study, whilst Section 5 presents a summary of the key findings

following a thematic analysis, leading to the development of a preliminary framework for board games designed for DLD intervention. Section 7 discusses the strengths and limitations of the results obtained. Lastly, Section 8 draws the conclusions of the current study whilst making a number of recommendations for future work.

2. Related work

A review of literature was conducted to explore existing design support frameworks and tools supporting designers during the design of board games intended for speech and language therapy. The research question supporting the focus of this review seeks to understand the way requirements vary between conventional toys and board games when designing SALTTs for treating DLDs. A number of approaches were examined, and several key findings emerged during the literature review.

2.1. Differences between conventional toys and board games as SALTTs

Specific therapy goals often determine the nature of SALTT which SLPs use during therapy. Board games are often used to improve speaking performance (Wong & Yunus, 2021), improve inter-personal interactions amongst board game users, and increase the child motivation during the therapeutic exercise (Noda et al., 2019), whilst engaging children in a wide variety of environments (O'Neill & Holmes, 2022). Meanwhile, conventional toys such as flashcards and puzzles, are also seen to increase effective communication children (Jadi, 2019), whilst electronically-enhanced conventional toys can often lead to adverse effects during therapy, such as a reduction in the lexical diversity of the child's spoken language. (Venker & Johnson, 2022). A number of differences can therefore be formulated when SLPs decide on whether to opt for conventional toys or board games as part of their prescribed treatment activity:

- **Child Interaction** – Whilst conventional toys are primarily intended to be used in various ways within open-play settings, they are frequently considered a solitary SALTTs in order to encourage the enhancement of the child's creativity and improve their imagination. Meanwhile, board games are designed to be played in a multi-user fashion as their main purpose is to encourage learning through social play.
- **Physical Design** – Since children behave differently when interacting with certain materials such as wood, fabric or plastic, conventional toys often incorporate a range of materials together with several interactive elements (such as lights, sounds and moving components) in order to trigger a variety of expressive skills and thus address the disorder which the child is experiencing. In board game design, the latter is typically intended to be achieved through the use of playing pieces, playing board, dice and cards in order to achieve the same outcome as achieved with traditional SALTTs.
- **Playing Experience** – Whilst traditional toys rely on the physical functionality of the SALTT to allow children to use their imagination and creativity, children playing board games, follow sets of rules or strategies in order to accomplish specific tasks in a structured and more competitive manner in conjunction with the treatment they are undergoing.

2.2. Existing frameworks and tools towards board game design

Research has shown that serious games may have a myriad of positive effects on children experiencing DLDs and treatments (Ahmad Zaki et al., 2017; Elo et al., 2022). These observations are also extended to the therapeutic benefits associated with the use of board games and tabletop games in clinical settings (Noda et al., 2019). A number of frameworks have been proposed to guide designers in designing engaging and clinically effective serious games within the context of game-based learning and education. For instance, Kiili (2005) proposed an experiential gaming model to promote effective game-based learning based around experiential learning theories and game design theories. Kiili suggests that the provision of feedback, the formulation of clear goals and challenges which align with the user's abilities lead to meaningful, significant and immersive educational experiences for the user. Kiili's framework makes use of flow theory to design serious games, including board games, which are calibrated to the level of player's ability in order to maintain a state of flow in game users.

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This makes the framework somewhat unpredictable to follow since maintaining consistency in achieving flow is often rather challenging. To address these weaknesses, an Adaptive Digital Game-Based Learning (AGBL) framework was proposed by Tan et al. (2007), who identified a set of four elements vital for serious game design aimed at improving the learning abilities of serious game users and board game players. These elements are thus based on the design framework for edutainment environment, the adopted interaction cycle for games, the engaging multimedia design model for children, and also the game object model framework by Tan et al. (2007). The authors stress the importance of addressing pedagogical elements in design, such as psychological and cognitive developmental needs and the user's learning behaviour throughout the game, making the latter customised for the target audience playing the game. Tan et al.'s (2007) AGBL framework makes various recommendations on the incorporation of a variety of design features in serious games. These include multi-modal feedback, tasks and elements which are useful to address enhance player and engagement, highlighting in particular the importance of maintaining player outcomes and feedback central to the design.

Other researchers working in board game design research also sought to make a variety of suggestions in terms of game design elements and features, central to promote game based education and learning. Tahir and Wang (2018) proposed a hierarchical framework, referred to as LEAGUE. Tahir and Wang intend to provide a roadmap to designers and researchers by proposing six central elements to serious game design, these being *learning*, *environment*, *affective-cognitive reactions*, *game factors*, *usability*, and *user*. Similarly, Silpasuwanchai et al. (2016) target cognitive engagement by proposing a framework oriented towards gamification for reflective learning. Behavioural, emotional and cognitive dimensions of engagement are measured in view of the user's learning outcomes in terms of skill acquisition and skill transfer. Targeting board game development in the context of AI research, Gaina et al. (2020) developed a Tabletop Games framework (TAG) which allows for the logging of existing tabletop games into a dedicated module whose purpose is to achieve an in-depth analysis of such games. The designer is then able to conduct parameter optimisation and adaptive learning of game mechanics in order to define new game states and representations by means of a set of learning algorithms for the definition of novel tabletop games. Nevertheless, this framework relies of log data of existing games and does not take into considerations typical user requirements and profiles in order to make predictions of design elements and parameters. Board games are also frequently regarded as vital tools aiding in teaching and education. Sousa's (2023) *MBGTOTEACH* framework focuses on the adaptation of exiting games into board games for use in game-based learning activities. The intention is to transform educators into board designers, however the latter become the sole contributors towards the design of the board game, which is a somewhat restrictive approach towards design as it overlooks other requirements from other vital stakeholder, such as caregivers and SLPs.

In view of research oriented towards serious game design and the positive impact that this has on users in skill acquisition and cognitive development, it is evident that existing frameworks and models have made noteworthy contributions in recent years. Nonetheless, within the domain of board games design targeting DLDs, more specialised guidance is required to assist designers in addressing the individualised learning profiles of children and to promote their overall speech and language development.

3. The speech and language therapy potential model

In a previous study by Balzan (2022) a set of twelve elements were identified which provide designers with explicit knowledge regarding the considerations which should be done when eliciting requirements for a conventional SALTT. Balzan et al. (2022) argue that each element is vital for the design of a SALTT and an absence of any of the components will negatively impact the effectiveness and usefulness (referred to as the *potential*) of an artefact being designed for use in DLD therapy. Figure 1, depicts a high-level representation of the speech and language therapy potential model (SALT-PM) developed by Balzan et al. (2022).

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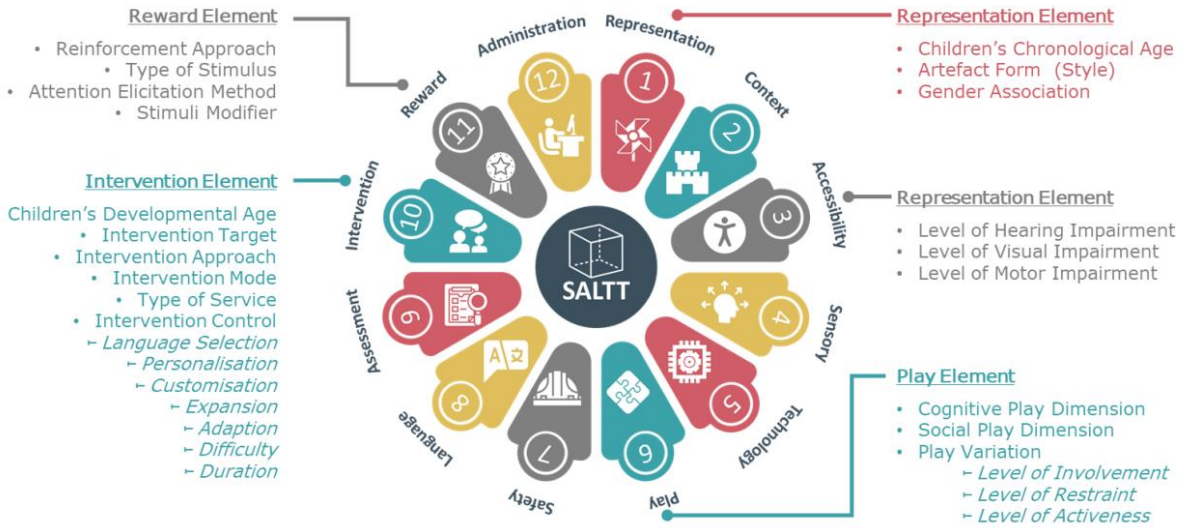

Figure 1. SALT-PM model and the corresponding elements. Adopted from Balzan et al. (2022)

The number of elements which the designer manages to realise during the design stages of the SALTT determines the artefact's intrinsic potential. The SALT-PM model is intended mainly for speech and language therapeutic toys and is highly dependent on the end user of the product. For instance, if an artefact is being designed specifically for children with DLDs, this may not suit other children who are diagnosed with cerebral palsy, unless this has been directly considered in the *Accessibility* element. Table 1, presents a description of the different elements (***E1*** to ***E12***) and their relevance during the design process of SALTTs.

Table 1. The twelve elements comprising the SALT-PM model

Element		Description
E1	**Representation**	*Priority is given to the product's visual appeal, it's purpose in aiding communication, and the age-appropriate appearance*
E2	**Context**	*Determines the environmental use of the artifact in order to understand better the therapeutic needs*
E3	**Accessibility**	*Defines any DLDs and other disorders across a variety of categories, which range from mild up to severe*
E4	**Sensory**	*Promotes the consideration of stimulating qualities in SALTTs to designers in order to prioritise attractiveness and also practicality*
E5	**Technology**	*Provides a categorisation of artifacts into low-tech and high-tech. There is also the possibility to include accessories for low-tech SALTTs*
E6	**Play**	*A classification of play is made into cognitive play - Practice, symbolic, constructive and rule-based play; and social play - Solitary, parallel, associative and cooperative play.*
E7	**Safety**	*Designers determine safety standards adherence of SALTTs to prevent the child's harm from any small components, sharp edges, exposure to chemicals, and also falls, burns, electric shocks etc.*
E8	**Language**	*A consideration is made on the language in which the SALTT artifact will operate*
E9	**Assessment**	*An evaluation is made on the of occurrence of speech and/or language disorders together with the nature and severity of the DLD*
E10	**Intervention**	*Considerations on the nature of intervention is made in view of the severity of the disorder and the category of intervention control*
E11	**Reward**	*Promotes the incorporation of features which permit SLPs and caregivers to customise the nature of reward the child*
E12	**Administration**	*Provision of the designer in view of administrative utilities which effectively support the therapeutic sessions*

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The elements within the SALT-PM model are equally vital for the design of efficient and effective SALTTs for use in serious gaming settings. A certain level of interdependence exists between the elements since the SALTT will always be used in specific contexts aimed at providing a custom experience to the child. For instance, a specific might be used in a clinical setting rather than a home setting. Consequently, this will affect the type of Administration given to the child, creating a level of interdependence between ***E2*** and ***E12***.

The SALT-PM model by Balzan et al. (2022) is a useful way to measure the potential and suitability of a SALTT in view of the child user. Although the model's main benefit is to provide a foundation in the design of SALTTs, it does not specifically target the design of board games intended for children with DLDs. Thus, it becomes evident that an adaptation should be made to the SALT-PM model in order to ensure the successful design and development of effective and engaging board games. This expansion will assist designers into creating more innovative and targeted serious games which serve as educational and therapeutic tools, ultimately benefiting users experiencing a variety of DLD in a positive way.

4. Methodology

In order to understand the main underlying requirements of board games users and therapists working with children experiencing DLDs, a focus group was held in order to gather diverse perspectives and bring together individuals with various background together with potential users. An initial design of a board game concept intended for use with children aged 5-8 years experiencing DLDs was presented to participants with diverse backgrounds. The focus group helps in generating and brainstorming ideas in terms of the effectiveness of various board game design elements and features.

4.1. Participants

A total of 5 participants were recruited to the focus group as listed in Table 2. Krueger & Casey (2014) remark that in qualitative research where non-statistical data is gathered and where the main purpose of the study is to uncover prevalent trends related to the participant's opinions and thoughts, a sample size of between five to eight participants is generally preferred. Participants thus included two board game users, two SLPs and a design engineer with experience in product design for rehabilitative and assistive therapy. Krueger & Casey (2014) also comment that larger sizes would be suitable in the case of participants whose topic is of minor concern related to their work, however in this study all recruited respondents worked directly either with children experiencing DLDs or had direct experience in designing or using board games. A mix of random sampling and convenience sampling methods was used to recruit participants. Random sampling involved the selection of candidates from a larger pool of potential candidates. Meanwhile, convenience sampling involved approaching individuals who meet the inclusion criteria set for the focus group. This ensured a good mix of participants to represent the intended population for the concept board game being designed.

Table 2. List of recruited participants, background expertise and country of origin

	Background	Country
P1	Board game user	*Malta*
P2	Speech & Language Pathologist	*Malta*
P3	Speech & Language Pathologist	*Malta*
P4	Board game user	*Malta*
P5	Design engineer	*Malta*

4.2. Procedure

Prior to conducting the focus group, the aim of the study was explained to the participants whilst asking all individuals to fill in a pre-design form in order to collect data regarding participant expertise and background information. The underlying design of the conceptual board game being designed was then presented to the participant (Figure 2). This involves users moving towards an objective (finish line)

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whilst undergoing various activities and accomplishing several tasks along the way. A number of therapeutic activities are held at various milestones, which will exercise the child's speech and language skills.

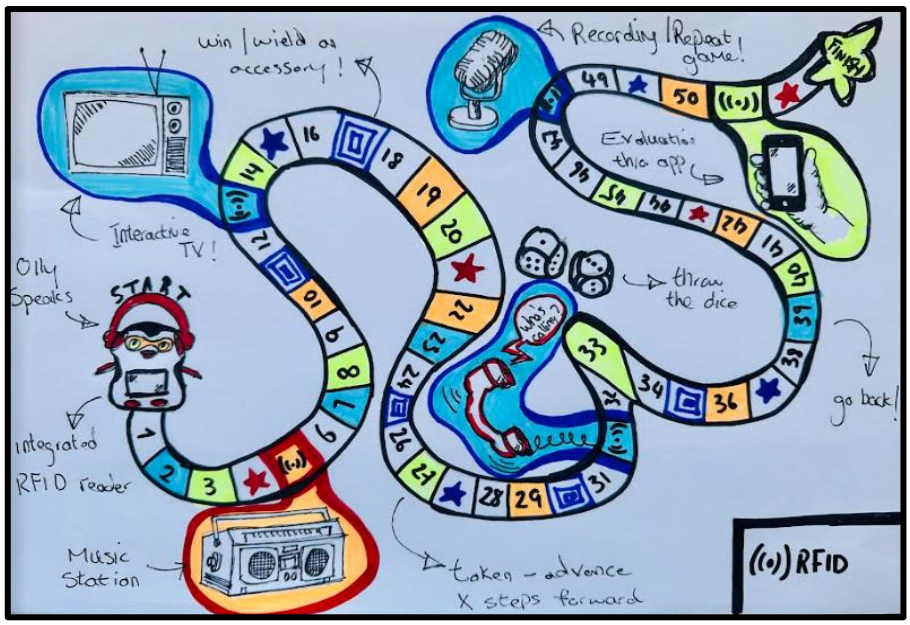

Figure 2. A board game concept supporting DLD intervention presented to participants

Subsequently, a post-design survey with all participants was held collectively in order to understand the participant's opinions about the ongoing design process of the presented board game concept. A survey transcript was distributed asking participants to rate the current design processes adopted in board game design, to provide feedback on the applicability of the presented concept, and to suggest any improvements which might be made to the board game design. Meanwhile, an effort was made to collect information related to the user and design requirements for the board game design process.

The duration of the focus group and the post interview was approximately 90 minutes, whilst the entire session was recorded and transcribed verbatim to facilitate data analysis. A pilot study was conducted before hand with one academic researcher and adjustment in terms of terminology for the pre- and post-design surveys were made. Questions were added in particular to understand the participant's thoughts on existing board design processes, and eventual commercialisation of such games. A thematic analysis adhering to the guidelines by Braun & Clarke (2006) was carried out on the qualitative data collected from the focus group. A set of codes were generated to develop a set of themes which would assist in the development of a board game design framework. The coding scheme included the following codes generated: *User Engagement*, *Board Game Design Elements*, *User Experience*, *Board Game Commercialisation*, and *Therapeutic Game Design*. A set of themes were then identified as a result of the outcomes of the focus group. The findings were used as the basis for the development of a framework intended to support board game designers in developing serious-games intended for children aged 5-8 experiencing DLDs.

4.3. Limitations

One of the primary constraints encountered in this study pertained to the absence of board game designers among the participants. This limitation stemmed from the challenges associated with recruiting individuals specifically employed in the field of therapeutic board game design. Furthermore, efforts to engage board game designers were met with reluctance, primarily due to concerns regarding the confidentiality of their ongoing design practices. Another limitation arose from the difficulty in recruiting participants therapists experienced in using board games during therapy sessions, resulting in a relatively small sample size of participants. To mitigate this limitation, extensive efforts were made to ensure a diverse mix of participants in the study. The qualitative research methods, including the focus

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group and post-design surveys were chosen were chosen to gather in-depth insights not fully captured by quantitative approaches.

5. Identifying requirements for the design of therapeutic board games through a mixed-methods approach

As part of the thematic analysis carried out, a set of 5 themes were identified based on the findings generated from the focus group.

5.1. Theme 1: User-centred engagement

Participants agreed that user engagement should be prioritised during the design of board games, primarily by considering the willingness of children to play games in view of the treatment. This is achieved by aligning the design of the board game with the preferences, background, abilities and interest of the children whilst integrating tactile features and elements of modularity. In turn, these will benefit the child-user in *"completing the activities during therapy and helps maintain their attention"* (P2). P2 and P3 also remarked that board game content should specifically ensure alignment of the therapeutic goals of the SLP with the educational objectives of the child and their guardians and caregivers.

5.2. Theme 2: Enhancing user experience

Board games should offer the opportunity to children experiencing DLDs to work in teams and compete against each other, promoting teamwork and communication. P1 commented that board games allow for *"the retention of attention, adding a competitive element and can even encourage a team work during gameplay"*. This ensures that SLPs establish a good basis to address the challenges of attention and cooperation issues through the game. P1, P2, P3 and P5 agreed that these challenges are addressed by designing auditory and visual features which provide incentives and customisation options to the children in order to maximise the UX of both the user-child, SLPs and caregivers.

5.3. Theme 3: User-friendly design

The theme of user-friendliness and simplicity emerged as a central theme to the focus group, since this is regarded as the basis of child interaction with the SLP and the treatment being given. By customising and tailoring board games towards the needs of children, designers can adapt the game towards addressing specific skill sets and cognitive competences. This is achieved by developing easy-to-use and easy-to-navigate games (P1 and P4) and adapting the game's difficulty levels to fit the children's requirements.

5.4. Theme 4: Incorporating key elements

Participants highlighted that board games should be appealing to the target audience by making the game fun, enjoyable and as relevant to the child's daily life. P2 remarked that the UX of the child-user is improved and enhanced by *"having auditory features, incentives throughout the game and the ability to modify ability levels"*. Board games of this nature should therefore resonate with the child-user whilst meeting the primary objectives of the game.

5.5. Theme 5: Market viability

All participants agreed that board game design should involve a robust market and pricing strategy based on the user's willingness to invest in serious games. In this case, given the primary users are child-users, market viability is highly related to the willingness of secondary users such as parents, guardians or caregivers of children to understand the game's potential and invest in the product. Designers should prioritise continuous development such as by designing expansion packs for game cards and player pieces in order to meet the evolving requirements of the users and maintain the product's relevance on the market.

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6. BOARDER: A boardgame design framework towards DLD intervention

In view of the above themes and requirements generated based on the feedback obtained from a variety of stakeholders, a user-centered framework is being proposed supporting the design of board games oriented towards DLD treatment in children aged 5-8 years. The **BOAR**dgame **DE**sign f**R**amework (BOARDER) (Figure 3) is proposed for beginner and experienced game designers who design board games with the purpose of incorporating these products into speech and language therapeutic tasks. The adoption of BOARDER shall assist designers to develop board games which are primarily enjoyable and engaging for children undergoing therapy, but which also promotes inclusivity and adaptability during play; thereby making such artefacts significantly valuable for use in educational therapy. The BOARDER framework is primarily centred around understanding the potential of board games based around the consideration of child-user needs during the use-phase of the product. This determines the board game's suitability for speech and language therapy, with a particular focus on the child behavioural skill sets and cognitive development, since children may outgrow board games during their growth. In this case, based on the various elements of the SALT-PM model proposed by Balzan et al. (2022), a board game with a high potential for speech and language therapy is a type of SALTT which grows with the child as they undergo therapy. This is achieved by making several considerations related to the elements of *user friendliness, UX enhancement, user engagement, design customisability* and *market viability* during the design process.

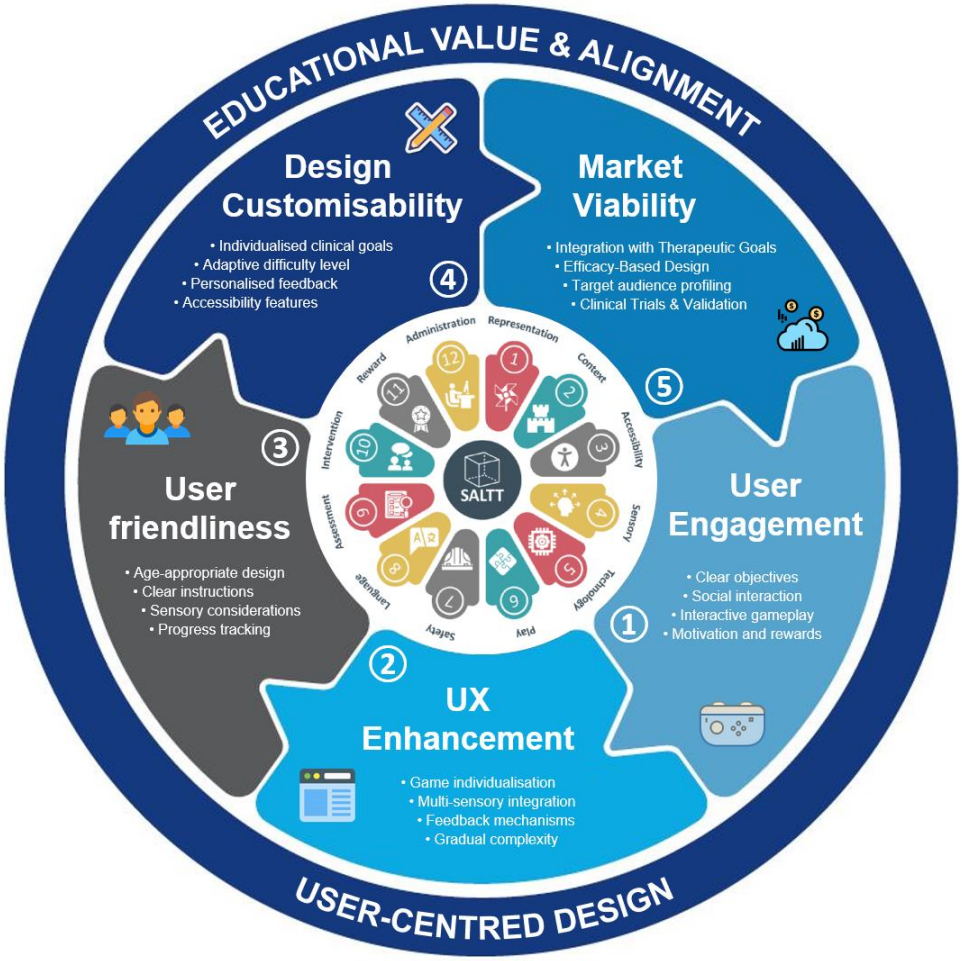

Figure 3. BOARDER – A BOARdgame DEisgn fRamework towards DLD intervention

Once the potential of the board game is understood, the designer is encouraged to make various recommendations around the user friendliness of the game being designed. Elements of UX and user

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engagement are addressed by maximising personalisation and in-game social interaction (refer to sector ① and ② of the framework). Games which incorporate varying level difficulties and which provide modifications in rules and challenges promoting peer-to-peer interactions with other children are seen to have a positive impact on the therapeutic improvement of the child user (Allen & Kelly, 2015). Meanwhile, game effectiveness should be validated through research and prototype testing by conducting pilot studies and user testing with both typically developing (TD) and atypically developing (AD) children, whilst feedback should be collected in order to make the required game adjustments based on the collected results.

The aspect of user-friendliness should be central to the design process in that board games should be designed age-appropriately to allow SLPs to devote special attention to the child educational, behavioural and cognitive abilities (refer to sector ③). Clear instructions should be given to guide both child-users but also SLPs and caregivers in using the game properly to ensure maximum effectiveness of the therapeutic outcomes. Incorporating sensory considerations also create more engaging and inclusive experiences for children. Well-designed visual sensory elements ensure that play experience is enjoyable and value adding. This is achieved through ensuring that the right balance of colour and contrast exist in game components, text and other illustrations, that fonts are legible to accommodate all players, and that design clutter and complexity in design is avoided so as to reduce confusion with players experiencing various types of DLDs. The incorporation of auditory factors like sounds and audio play a vital role in ensuring accessibility to the child user during play. Meanwhile, objective metrics should be incorporated in order to track the progress of the child-user undergoing treatment. Quantifiable metrics related to the game's objectives and player performance (like tasks accomplished, incentives achieved or resources acquired) and also game state visualisation and feedback systems also ensure a positive player experience (Kloep et al., 2023).

Board game designers can benefit by making a number of considerations in customising various design features and elements to promote the type of therapy being prescribed to the child (refer to sector ④). By understanding the severity of the user's impairment and abilities, like dexterity, game pieces like, flashcards, boards, and tokens can be designed to accommodate the user in terms of material, shape, form and component size. Reinforcement and elements which encourage repetition, such as naming objects, describing actions and practicing specific words, is to be encouraged in collaboration with input from SLPs. The BOARDER framework allows the designer to place the design focus on primarily collecting and analysing data from primary users specifically in view the treatment's effectiveness, usability and efficiency in order to maximise the market viability of the product. It facilitates the elicitation of requirements from different stakeholders in to design board games aimed at child-users experiencing DLDs. The framework thus is useful in guiding designers to consulting with researchers and therapists in the field of speech and language rehabilitative therapy. Designers are also assisted in developing marketing strategies which target parents, SLPs and caregivers working with children experiencing DLDs. BOARDER also stresses the need to promote the provision of supplementary educational resources for parents and therapists, including instruction manuals and clinical practice guides.

7. Conclusions and future work

This paper discussed various arguments related to the need for designers to have more support in board game design processes, particularly in understanding stakeholder requirements better. The focus group created a sound basis on which the BOARDER framework was developed making board game design considerations in view of multiple stakeholders, primarily, SLPs, product designers and board game players. As future work, a computer-based support tool will be developed which supports designers in the requirements elicitation process of the board game design process. The computer tool will also be evaluated with designers working in the field of board game design and their feedback will be used as a basis to make the necessary improvements to the tool.

Acknowledgement

This work was supported by the Malta Council for Science and Technology (MCST), through the Smart Cities Programme 2022 (SCP-2022-007). The authors would like to thank all participants who contributed in this study.

https://doi.org/10.1017/pds.2024.157 Published online by Cambridge University Press

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