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Designing gamified connected tools for bilingual language therapy and education

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This research contributes to the growing field of technology-enhanced learning by demonstrating how gamification and connected technologies can address gaps in bilingual education and language therapy. It investigates the design, development, and evaluation of Olly's Adventures: The City of Two Languages, a novel, gamified language intervention tool for bilingual Maltese-English-speaking children aged five to eight. The tool merges a physical board game with a companion mobile application, creating an engaging phygital experience that supports language acquisition across clinical, educational, and home settings. Developed by a multidisciplinary team, the tool was iteratively refined through a user-experience-driven process involving speech and language pathologists, caregivers, educators, design engineers, and children. Mixed-methods data were gathered via focus groups, observations, surveys, and a case study. Findings highlight the tool's potential to foster language development and increase motivation, with users reporting high levels of engagement, satisfaction, and relevance. Despite limitations related to sample size and the need for clinical validation, the study demonstrates the promise of user-centered connected tools in delivering inclusive, motivating, and linguistically responsive interventions.

KEYWORDS

user-experience, gamification, bilingual, language development, connected technologies, speech and language pathologists, educators, iterative

1 Introduction

In early childhood, difficulties with comprehending and/or using words may be a warning signal for language disorders that persist across the lifespan. While some children eventually catch up, others may continue to have significant difficulties in the absence of a known or obvious biomedical cause beyond the age of 5, leading to a diagnosis of Developmental Language Disorder (DLD) (Perry et al., 2023). DLD is characterised by marked difficulties in understanding language, following complex instructions and expressing ideas clearly. Restricted vocabularies and grammatical errors are often accompanied by literacy difficulties (Marrus and Hall, 2017). Importantly, the difficulties concerning DLD are solely related to language processing and are not brought about by other medical or developmental conditions (Reilly et al., 2014). DLD persists into adulthood, affecting social, emotional, intellectual and economic aspects of life, regardless of the potential improvements available through therapy and natural development (Leonard, 2014). While DLD is not caused by identifiable biomedical conditions, a family history of language difficulties is considered a risk factor, suggesting a heritable component. Lower socioeconomic levels also increase the risk of a lifelong DLD diagnosis. Assessment and diagnosis of DLD are carried out by speech and language

pathologists (SLP), who also provide personalised intervention which takes into account factors such as chronological age, developmental skills, areas of language strengths and weaknesses, as well as language background and exposure (Ebbels et al., 2019). Intervention can assist children with DLD in coping with the language challenges posed by the academic curriculum.

Children's exposure to more than one language affects their development in specific ways. A child exposed to two languages from birth consistently would be considered simultaneously bilingual (Ray-Subramanian et al., 2011). In contrast, a sequential bilingual individual would acquire their second language (L2) after having acquired the first language (L1) (Bedore et al., 2010). The upsurge in globalisation has resulted in increased immigration (Dixon et al., 2012), prompting growing numbers of individuals (namely migrants) to learn the language of the host country as a second language.

Continually, assessment and intervention for bilingual children with DLD present unique challenges for SLPs. This is mainly because they must navigate the complexities of two languages and their developmental trajectories, facing obstacles such as the lack of appropriate tools, and possibly insufficient data about the child's particular language/s (Teoh et al., 2018). These challenges apply to both simultaneous bilinguals, who typically present with difficulties in both languages, and sequential bilinguals, whose difficulties may appear more prominent in their second language but generally affect both to varying degrees. The use of bilingual materials offers several advantages to bilingual children. Namely, because they acknowledge the child's linguistic reality (i.e., that they would be exposed to both languages) and avoid the artificial separation of their languages by requiring spontaneous translation from one language to the other during use (De Anda and Friend, 2020). In a similar vein, bilingual toys and games are also relevant to foreign children struggling to learn the language of the classroom because of limited exposure to it. By incorporating both languages being received by the child into the classroom and in therapy, educators and SLPs can capitalise on the potential for cross-language transfer, as highlighted by Dam and Pham (2023), where gains in one language transfer over to the other. This phenomenon has been observed in typically developing bilingual children and may also apply to those diagnosed with DLD (Nair et al., 2023).

The initial aim of this research project was to examine the process of creating and evaluating a connected Speech and Language Therapeutic Toy (SALTT) for bilingual Maltese English-speaking children aged between 5 and 8 years old. This tool was designed for Malta's bilingual context, where Maltese and English are both recognised as official and majority languages, (Mifsud and Vella, 2018; Paggio and Gatt, 2018). In accordance with this, Maltese children may be raised as simultaneous or sequential bilinguals. Seeing as they may be exposed to both languages from birth or else when they start schooling since Maltese and English are the languages of education in the country. Thus, apart from acquiring their home language, foreign children attending school in Malta are typically expected to learn both English and Maltese as part of the national curriculum. While this reflects the broader educational context, it should be noted that children included in this study were required to have functional ability in both Maltese and English.

The tool, dubbed "Olly's Adventures: The City of Two Languages," takes the form of a board game and a companion application designed

to target various aspects of language intervention for children identified with DLD and for children struggling to learn their second (or third) language.

In "Olly's Adventures: The City of Two Languages," 2 to 4 players take on colour-coded penguin personas to race and make their way to the city centre. The city centre is located at the end of the board's path; therefore, players must cross through four unique locations familiar to children (i.e., Playground, School, Restaurant and Clothes shop). To cross through these four locations, players are required to complete a variety of language tasks found on scannable game cards. Each game card is linked to a particular linguistic activity and once players are able to complete it, they earn points which enable them to move their player forward on the board's path. Through multiple rounds, players can advance across the board and compete against each other to reach the city centre. The game concludes when the first player reaches the city centre, hence securing victory. Thus, "Olly's Adventures: The City of Two Languages" provides a gamified channel through which children may receive language instruction and/or intervention.

As shown by Abela et al. (2024), bilingual board games encourage language practise, structured social interaction and turn-taking using a naturalistic play-based format. Unlike other conventional toys, which may promote solitary play, board games employ rules, objectives and an element of competition. Hence fostering a group setting that innately stimulates motivation and communication. Therefore, through the use of such board games, educators and speech and language pathologists could be able to work on specific language targets while enhancing each child's interpersonal skills in an interactive setting.

The first potential re-direction in the research aim was from a purely Speech and Language Therapeutic Toy design for "Olly's Adventures" toward a more versatile composition, which would also take typically developing children acquiring their second language into account.

Thus, through iterative development and prototype testing, "Olly's Adventures" grew beyond its initial scope, also proving relevant to second language (L2) learning. Prototype testing pointed out the game's potential for enhancing L2 learning by providing gamified exercises that are consistent with the enhancement of skills that support first and second language acquisition. These features provide engaging opportunities for practise and generalisation of (newly acquired) language skills, boosting confidence and proficiency in bilingual settings. Its gamified, user-centred design strategy further promoted collaboration between the game's intended users (Children, Caregivers, and Therapists/Educators) along with the experts working behind the scenes to build the resource (i.e., Speech and Language Pathologists, Engineers, and App Developers). "Olly's Adventures" is innovative in its presentation, given that it incorporates technological elements into its physical components. The board game is connected to a specifically designed companion mobile app, through QR codes displayed on game cards each linking the user to a particular language task which may be played flexibly in only one of the two supported languages (at the time of writing) or in a combination of both, depending on the players' choice. Additionally, while the application's user interface adopts child-friendly aesthetics, the configuration settings are intended to be managed by a responsible adult, be it the child's caregiver,

educator or SLP. The app's configuration options for the various games also provide users with the option to select difficulty levels, before they start the game and as they are working their way through the activities. In educational and therapeutic contexts, apps can facilitate a broad array of possibilities in language learning. For instance, apps can serve as a feedback aid for educators, enable students to practise independently, increase the intensity and frequency of carryover at home, and improve learners' motivation (Leinweber et al., 2023; Biffi et al., 2015; Jadi, 2019). Despite the copious information available about the use of digital means in speech and language therapy as well as education, the use of connected technologies is still in its infancy when compared to traditional means of instruction and purely digital tools.

Connected technologies or phygital products are physical objects that can connect to the internet or other digital networks, thus, allowing them to communicate with their environment and other products through the use of built-in features. Overall, connected technologies are produced to try and increase worker efficiency within the environment in which they are used (Kelly et al., 2020). The primary professionals mentioned in this study (i.e., SLPs and educators) have experienced a surge in digital use across their professions. However, they are still required to use traditional methods for particular aspects of their work, even though these methods (e.g., data collection regarding student performance) have the potential to be interwoven with technological modernization (Frendo Wirth, 2020).

While gamified tools for language learning have received considerable attention, most existing approaches are fully digital and do not incorporate physical components. This study focuses on connected technologies that merge physical and digital interaction, a modality that remains relatively underexplored, particularly for young children and in bilingual or language intervention contexts. Prior research (e.g., Goretti et al., 2020; Chan et al., 2022; Sami and Tarek, 2025) supports the potential of such hybrid environments, though few have explicitly addressed their use in bilingual or therapeutic applications. This distinction positions Olly's Adventures as a novel contribution within the broader domain of connected, multisensory learning tools.

2 Methodology

This study was rooted in a UX-based approach (UX), aligning it with the principles of user-centred product design. Seeing as this foundational perspective guided the development and evaluation of the product at hand, it was crucial that the methods and analyses used were inherently focused on addressing the needs of the end users.¹ The investigation unfolded across multiple phases of data collection, with a variety of sample pools to ensure that a

comprehensive understanding of individual experiences, needs and opinions would be gathered. Hence, the heterogeneity of the user groups required the integration of qualitative and quantitative insights to be obtained. Therefore, a mixed-methods approach towards data collection was undertaken, to reflect the diverse nature of the participants involved and the multifaceted nature of the research objectives.

As Bressan et al. (2017) highlight, three distinct types of mixed-methods research may be considered when planning a research study. Firstly, there are exploratory mixed methods, in which qualitative elements precede and help develop the quantitative tools that follow. Oppositely, explanatory mixed methods are formulated with quantitative data driving the qualitative investigation. The last option is that of convergent mixed methods in which the qualitative and quantitative data are collected and analysed during a similar timeframe (Fetters et al., 2013).

A convergent mixed methods approach was selected as the research approach for this investigation. As is common with mixed methods designs, the data obtained through surveys and observations was analysed and interpreted using both quantitative and qualitative procedures (Robson, 2011; Suleman and Hopper, 2016). Likert scales were utilised for the collection of quantitative data and observation forms were used for the annotation of observed findings (Hall et al., 2016). Open-ended sections of questionnaires/transcribed discussions were subjected to qualitative analytical approaches (Braun and Clarke, 2006). The main reasoning behind this design being chosen for this study was that neither single technique could address the entire range of research objectives; whereas mixed approaches, or multi-strategy designs, could inherently do so while increasing the validity of results by correlating both qualitative and quantitative data (Robson, 2011; Suleman and Hopper, 2016). Moreover, this strategy offered a more thorough perspective of the study's concerns and could result in more significant implications from the findings because it can balance out each approach's shortcomings by maximising its advantages (Robson, 2011).

A user-centred design (UCD) is a methodology that prioritises the needs, wants, and behaviours of users throughout the entire design process (Lior, 2013). As opposed to traditional design methods which may solely focus on aesthetics or technical possibilities, a user-centred approach makes sure that the product or service under study is designed around the people who will be using it (Borthwick et al., 2022).

This approach requires a deep understanding of users, including their aim/s, motivation, frustration and the context in which they will interact with the product. Through user research, interviews, surveys and usability testers, designers can gain crucial insight into UXs (Lewis and Sauro, 2021). These insights then guide design decisions to ensure that the product is intuitive, possesses ease of use and ultimately meets the needs of its target audience. Thus, by putting the user at the centre of the design process, designers can fabricate products that not only satisfy functional necessities but also provide positive and meaningful experiences for end users (Millet, 2018).

In line with the user-centred approach, this study's data collection process was divided into five distinct phases, each tailored to capture the integral insights of a diverse group of participants

¹ While the long-term goal is for the tool to also support language intervention for children with DLD, this part of the study focused on assessing usability and engagement. The UX-based approach was therefore intended to evaluate user interaction and experience, not clinical efficacy. Clinical validation of the tool's therapeutic impact will be further pursued in subsequent research phases.

which would provide helpful feedback towards the design and evaluation process. These phases necessitated the recruitment of a range of professionals and individuals, including SLPs, caregivers (CGs), educators who were also parents, design engineers and, importantly, children who lie at the core of the game's development. Each group participated for purposes which aligned with their unique experiences and roles, thus contributing to the holistic comprehension of the product's evaluation and cyclical design process.

2.1 Phase 0: face-validity study with professionals

To ensure the validity of the original data-collection tools used in this study, namely self-administered questionnaires, smile-o-metre scales, and observation forms, a face-validity study was carried out. Face validity evaluates whether posed questions effectively measure their intended objectives, enhancing overall reliability and clarity (Leon et al., 2022).

In this phase, five SLPs reviewed the tools, providing feedback about them through quantitative and qualitative methods. This process was conducted in January 2024, and it allowed for the refinement of the tools before their use in the subsequent phases of data collection. The feedback received revealed the need for minor adjustments to the presentation of the questions in the self-administered questionnaires. Amendments were consequently carried out where necessary. It should be noted that only the revised versions of the self-administered questionnaires were used for data analysis. The initial versions were discarded following feedback and amendment.

2.2 Phase 1: focus group discussion with speech and language pathologists about the concept of the game

To develop the initial BETA-Prototype of "Olly's Adventures," expert feedback from SLPs was sought through a remote focus group discussion. This aimed to align the tool's evidence-based knowledge with practise-based insights, thus further improving the tool before its evaluation sessions.

Initially, participants completed a pre-interview questionnaire to share their experiences and beliefs (Haukås and Tishakov, 2024). The group's discussion was then moderated through open-ended questions, providing a platform for the SLPs to critically assess the game's ALPHA prototype (Figure 1; Moser and Korstjens, 2018). Ultimately, post-discussion, the participants completed another questionnaire to complement the group discussion's insights with subjective feedback (Harris and Brown, 2019). This holistic approach allowed for comprehensive feedback, enabling the formulation of design recommendations for the BETA prototype (Figure 2).

2.3 Phase 2: evaluation observations of typically developing children and educator/caregiver groups

The iterative, user-centred approach adopted in this study was exemplified in Phase two of data collection, which focused on observing interactions between typically developing children and their caregivers while using the BETA-Prototype of the "Olly's Adventures" board game and companion app. The BETA-Prototype of the "Olly's Adventures" board game (Figure 2) was



FIGURE 1
ALPHA prototype of "Olly's adventures."



FIGURE 2
BETA prototype of "Olly's adventures."

designed following the opinion gathered from Phase 1, hence leading to a variety of changes meant to enhance its overall design.

In Phase 2, a total of 115 participants including children, caregivers, and educators who were also parents, were involved. They were required to interact with the prototypes of the board game and companion app under observation, to then provide subjective feedback after gameplay. Observations took place in public child-friendly spaces, such as the public library to capture naturalistic interactions between the adults and children. As stated, this phase of data collection incorporated observations from the first author's perspective, to ensure robust data collection and achieve triangulation of data. Drawing on ethnographic methods as described by [Cotton et al. \(2010\)](#), the first author participated in gameplay sessions, making neutral observations and taking notes during these interactions. Observing gameplay was integral to the study, given that the tool's novel nature required the first author's involvement for effective use by the participants. To minimise potential biases brought forth by the first author's agendas (as one of the creators

of "Olly's Adventures") and preserve the authenticity of the data, the real-time observations were documented using previously validated observation forms. This provided the first author with the opportunity to annotate events in a structured manner as they occurred naturally and organically amongst participants.

The participants recruited in this phase of data collection formed part of two distinct sample populations. The first group of participants was comprised of typically developing children aged 5–8 years old. The second group, on the other hand, was made up of the respective caregivers of the children.

These two overarching groups of participants were further divided into five subdivisions of participant pools. The child participants were categorised into three sub-groups, whereas the adult participants were categorised into two.

The child participants were classed as either active viable child participants, active non-viable child participants or spectating child participants. On the other hand, the adult participants were categorised as either active adult participants or spectating adult participants. The following table outlines the defining criteria for

TABLE 1 Different types of participants in phase 2.

Participant type	Number of participants	Participant description
Active viable child participants	53	Active viable child participants were those child participants who interacted with the tool's prototype while fitting into the proposed chronological age range and possessing reported typical development.
Active non-viable child participants	9	Active non-viable child participants were child participants who interacted with the tool's prototype; however, they either did not fit within the proposed chronological age range or had reported atypical development. The term 'atypical development' refers to any reported developmental diagnoses or speech and language difficulties requiring therapeutic intervention, including but not limited to DLD.
Spectating child participants	3	Spectating child participants were those children who attended the gameplay sessions with active child participants but did not interact with the tool.
Active adult participants	36	Active adult participants were the adult participants who interacted with the tool's prototype. These participants attended the gameplay sessions to accompany the child participants as their caregivers.
Spectating adult participants	14	Spectating adult participants were those adults who attended the gameplay sessions but did not interact with the tool's prototype.

participant categorisation. It should be noted that the participant groupings in Table 1 were used for descriptive purposes only and were not subjected to statistical comparison.

For each group (i.e., adult and child participants), once the adult participant read through the provided information letter and signed the attached consent form, the participants were guided towards the physical versions of the BETA Prototype of the “Olly’s Adventures” (Figure 2). They then interacted with the prototype for periods ranging between 30 and 45 min.

As Hess (2012) defines it, a prototype is an approximation of a product along one or more of its dimensions. Therefore, the prototype would be an assimilation of the envisaged final product but may not be functional. However, opposing what Hess (2012) stated, the “Olly’s Adventures” BETA prototype was fully functional to prove its concept, but it simply did not look like the final tool (i.e., the images used were stock images and the design was still not finalised).

Throughout the participants’ interactions with the prototype, the observing first author completed an observation form of her design. The observation form was aimed at eliciting feedback about:

- 1 Participants’ engagement metrics
- 2 Game interaction metrics
- 3 User satisfaction metrics
- 4 Participants’ feedback

As aforementioned, this observation form encouraged the first author to stick to a standard protocol of observation. It thus encouraged the gathering of higher quality feedback, as opposed to the input which could have been gathered in an unstructured fashion (Beck Dallaghan et al., 2018). Consequently, after the participants’ interactions with the tool and the completion of the observation forms by the first author, the adult participants were asked to complete a self-report questionnaire regarding each child’s participation. To reduce observer influence, the researcher stepped out during questionnaire completion and reflection activities.

This questionnaire aimed to elicit information about:

- 1 The child’s background (i.e., age, linguistic background, educational background etc.)
- 2 Opinions about the game’s features regarding the effectiveness and satisfaction of users.
- 3 Perspectives about the tool’s gameplay and use (if it was readily available to caregivers).
- 4 Participants’ opinions on the activities presented in the tool.
- 5 Opinions about the overall game’s properties.
- 6 Participants’ thoughts on the game’s design
- 7 Game metrics
- 8 Personal feedback

Thus, these tools gathered comprehensive data about the use of the game with typically developing children aged 5–8 years and their active interacting caregivers, a substantial 20% per cent of whom reported themselves as educators. This percentage of experienced early-years, primary, and secondary educators were able to provide insight into how the “Olly’s Adventures” board game and companion app could be introduced in classroom settings; this will be further delved into in this study’s discussion of results.

2.4 Phase 3: focus group discussion with speech and language pathologists about the BETA prototype

Based on the user-centred design methodology used throughout this study, it was necessary to take into consideration the possible end-user requirements throughout every phase of product development. To meet the tool’s innovation goals as extensively as possible, as much end-user input as feasible needed to be obtained (Liem and Sanders, 2011).

An end goal for the “Olly’s Adventures” tool would be implementation into local speech and language sessions. As Hysong et al. (2013) discuss, in the context of implementation, professionals serve not only as a source of data but also as stakeholders and

resources that ensure the success of any new technique's implementation. In the present study, this was made possible by holding gameplay workshops for SLPs. Nudel et al. (2023) found DLD to be critically underdiagnosed in Danish hospital registers, prompting this study's first author to gauge that accessibility to this research population would be somewhat limited (Newington and Metcalfe, 2014). Therefore, the decision to separate the evaluations made by SLPs and children with DLD was made. Seeing as the input elicited from these SLPs would still be considered vital for the study's progression, even though gathered in the absence of children with DLD.

It was encouraging that 12 speech and language pathologists were recruited to evaluate the BETA prototype of the "Olly's Adventures" tool (Figure 2) during this phase of data collection, particularly given rising work demands and the time of clinicians becoming increasingly valuable. However, only 10 attended the workshops on the scheduled day. Despite this, the interest from clinicians was a positive sign for the future of the "Olly's Adventures" tool. Indeed, Hysong et al. (2013) assert that clinician engagement with novel concepts will support the future implementation of the tool in clinical settings.

The focus group held with the 10 participating SLPs encouraged structured discussion about the BETA prototype which was further bolstered using individual mini-surveys to gain further insight into their subjective thoughts and opinions regarding the "Olly's Adventures" tool. The surveys focused on the exploration of domain-related cases to fulfil both the first author's and participants' expectations and achieve a pre-defined interest (Ørngreen and Levinson, 2017). For the research team, which is made up of Speech and Language Pathologists, Engineers and App Developers, the aim was to produce reliable and valid data regarding clinicians' perspectives on the following:

- 1 Game features
- 2 Gameplay and use
- 3 Activities presented
- 4 Game design
- 5 Personal opinions

Continually, attending clinicians had the opportunity to gain exposure to innovative tools and gain more knowledge about the potential implications that connected technologies could have within their profession. In doing so, they also contributed to its user-experience-based design since the input received from those 10 SLPs then served as a channel through which further design recommendations were formulated for the creation of the Pre-Production version of the "Olly's Adventures" tools.

2.5 Phase 4: clinical evaluation of the "Olly's adventures" tool

In Phase 4, a case study-based approach was employed to observe a child diagnosed with DLD's interaction with the BETA Prototype of the tool (Figure 2) alongside his main caregiver (a self-reported primary education learning support educator) and SLP. Similar to Phase 2's research design, caregiver-report questionnaires along with observations were taken on in Phase 4. However, Phase 4 employed a smaller scale of participants when compared to Phase 2. Therefore, a

mixed methods-based design was used in this data collection phase. Quantitative input was gathered using caregiver-report questionnaires and clinician observation forms. Qualitative input was gathered through the annotations gathered during the session observation when the "Olly's Adventures" tool was used in the clinical setting.

Given the limitations in recruitment, only one child diagnosed with DLD could trial the tool in therapy. Hence, limiting the generalizability of findings, and larger-scale validation studies will be required to assess the tool's clinical effectiveness more robustly. To maximise efforts, a case study-based approach was adopted in this phase's design. As Huby et al. (2011) describe it, the case-study approach is beneficial when a study requires an in-depth analysis of a phenomenon of interest as it occurs in its natural, real-life context. Furthermore, Stake (1995) work is particularly influential when defining the case-study approach, characterising three main types of case studies: intrinsic, instrumental and collective. In this study's case, an intrinsic case study was undertaken, as we attempted to learn about a unique phenomenon. The distinguishing factor of this case lies in the fact that the child, diagnosed with DLD, utilised the "Olly's Adventures" tool in therapy. Documentation of language as elicited using the "Olly's Adventures" tool was unprecedented, as no other child with a similar developmental profile had ever used this tool before.

In addition to the scarcity of children diagnosed with DLD who wished to participate in the study, the case-study approach was also chosen to explore the implementation of the "Olly's Adventures" tool in the clinical setting in depth. Thus, as Crowe and Sarma (2022) highlight, in contrast to experimental designs, which aim to test a specific hypothesis by deliberately manipulating the environment, the case study approach is well-suited for exploring explanatory questions like "how," "what," and "why." For example, it can address questions such as, "How is the intervention being implemented and received by the client?"

To once again achieve data triangulation, observations from the first author's perspective were undertaken to better understand the presented situation. To maintain a standard operation protocol regarding observations, notes were taken using an observation form purposefully designed for this study. To further ensure the reliability of results, the participating clinician was also tasked with completing the same observation form as the first author.

Continually, feedback from both the SLP and the caregiver was required given the study's user-experience-based design. Therefore, post-experience questionnaires were still handed out to both participants.

Given that the child's literacy skills were still in the process of developing, they could not be presented with a questionnaire such as the ones disseminated to the adult participants. In light of this, a smile-o-metre was presented to the child after each activity.

Ultimately, the clinical evaluation held in phase 4 highlighted the tool's potential as an engaging and effective tool to support language development in children diagnosed with DLD. Regardless of the limited sample size, the feedback gathered from the caregiver and SLP, along with the observational data, emphasised its usability and adaptable nature in the clinical setting. Hence, this suggests that the tool's gamified and customizable design is scalable to broader therapeutic and educational contexts, making it a promising resource for bilingual and diverse learning environments.

2.6 Preliminary feedback from board game designers and planned future phases

Following the gathering and analysis of the above-mentioned data from Phases 1–4, a new prototype (pre-production prototype) was created. Consequently, a preliminary round of feedback (Phase 5) was conducted with 20 board game designers at the SPIEL 2024 convention in Essen; this phase aimed to gather impressions on the game's design, playability and perceived educational value.

The designers were given some time to interact with the pre-production prototype of the game, and after engaging with the game, they were asked to complete an opinion-based questionnaire exploring themes such as:

- Game mechanics and replayability
- Therapeutic and educational potential
- User-centred design
- Market viability

While these early insights contributed meaningfully towards game mechanic improvements, this phase is not included in the formal statistical analysis due to its limited scope. The aim was to inform

design refinement from a playability standpoint before broader validation studies were carried out.

Moving onwards, upcoming data collection phases will involve more structured evaluations of the pre-production prototype. Including further clinician evaluation with the same clinicians involved in Phase 3 to allow for a direct comparison of their experiences with the BETA and Pre-Production versions. Additionally, further testing with educators and in-classroom evaluations may be carried out to gather broader feedback about the game's integration in educational contexts. In parallel, further evaluations with the clinical population through in-situ observations will need to be carried out, given the initial limited sample elicited in Phase 4. These steps will be critical to ensure that the final version of the game is both effective and appropriate for its diverse user groups (Figure 3).

3 Results

This section aims to provide an account of the data gathered across all the phases of data collection in this study. An interpretation of the qualitative data obtained throughout will be provided. The statistical tests employed for the analysis of the quantitative data will also be accounted for.

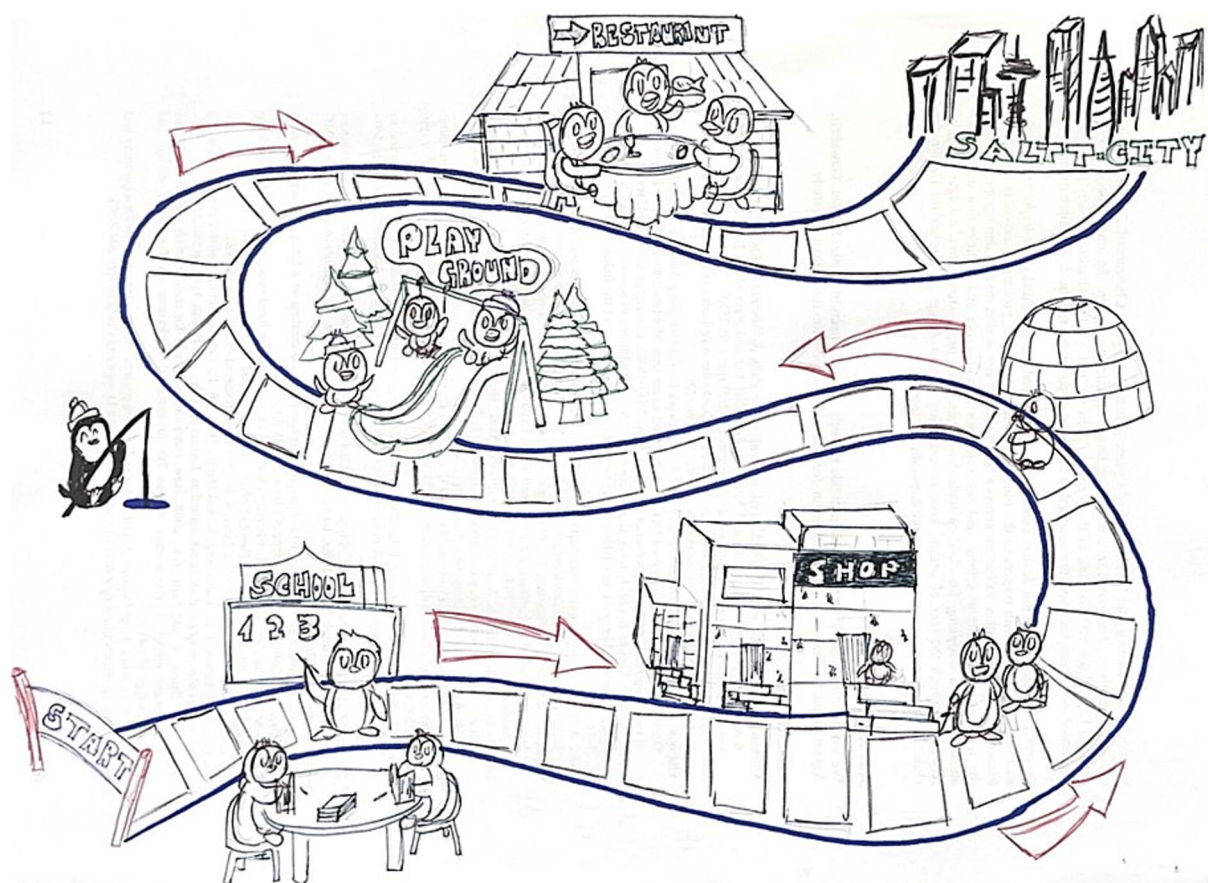


FIGURE 3

Sketch of the pre-production prototype of "Olly's Adventures." It should be noted that the illustration provided is a conceptual sketch of the design used in Phase 5's evaluation. This is to ensure that the intellectual property of the visuals is safeguarded before the game's public release, which at the time of writing is pending.

As previously outlined, this study was conducted in five distinct phases, each generating an extensive amount of qualitative data which collectively revealed a variety of interconnected themes and sub-themes. Rather than exploring each phase's findings as separate entities, a combined analysis was undertaken to ensure that the phenomenon at hand was understood comprehensively. This integrative approach is reflective of the study's iterative nature, where each phase of data collected was informed and built upon the previous, hence, allowing for the insights to be placed in a broader context.

By synthesising data from all the phases, the subsequent results capture the complexity and interrelationships amongst themes which, if considered in isolation, may have remained fragmented. Guided by the principles of thematic synthesis presented by [Thomas and Harden \(2008\)](#), this systematic approach integrated diverse data sources to create overarching themes with nuanced interpretations. Similarly, [Nicholson \(2022\)](#) outlines the value of such syntheses when it comes to identifying themes which are meant to lead to actionable messages, emphasising that it enhances the relevance and applicability of findings across various end-users. Hence, the richness of the data was further amplified through the identification of these synergies between findings from different phases, enabling the generation of guidelines which resonated with diverse audiences, in this case, the intended users of “Olly’s Adventures.”

Therefore, the unified results being presented aimed to facilitate the practical application of the diverse perspectives gathered throughout the study. The unified data was coded systematically and then the codes which shared common reference points, and a high degree of transferability were united into a complementary theme ([Vaismoradi and Snelgrove, 2019](#)). Overall, five main themes of data were elicited which were subsequently divided into 14 sub-themes. The five main themes resulting from the data are outlined in this section, however, the subsequent sub-themes are further discussed in the discussion section of this article.

3.1 A theme 1: elevating play

The theme of “Elevating Play” outlined the emphasis placed on the role that engaging and well-thought-out designs play in attracting and maintaining children’s interest in educational materials. The data gathered revealed that through the combination of attractive visual aesthetics and apt gameplay mechanics, immersive learning experiences tailored to the target audience’s needs can be created. Participants also noted the impact of the tool’s use of thematic elements and appealing characters, which innately enhance the “fun” aspect of the tool and further contribute to sustained engagement.

A recurring insight from the data was the value of prioritising UXs through continuous feedback loops, hence, underscoring the importance of designers being responsive towards users’ evolving needs and preferences. Additionally, effective pricing and marketing strategies were identified as influential factors towards improving accessibility and the promotion of the tool’s widespread adoption. Together, these elements formed a comprehensive approach towards elevating play in a way which would maximise the potential impact of such an educational tool.

Theme 1 elicited the following sub-themes:

- *Subtheme 1:* Design and Visual Appeal.
- *Subtheme 2:* Gameplay and Mechanics.
- *Subtheme 3:* Audience and Engagement.
- *Subtheme 4:* character and theme.
- *Subtheme 5:* user experience and feedback.
- *Subtheme 6:* marketing and pricing.

3.2 Theme 2: navigating the uncommon

The theme of “Navigating the Uncommon” explores the unique opportunities and challenges associated with the introduction of an innovative tool within the local context (in this study’s case that is the Maltese context), where similar design and the use of gamification as an educational and therapeutic channel is relatively unfamiliar. The data outlined mixed responses from local caregivers, educators and SLPs toward the tool’s use of connected technologies. While some participants displayed enthusiastic and open-minded responses, others highlighted scepticism and/or a lack of understanding towards its applications and benefits.

This section sheds light on the novelty of the study, highlighting the tool’s potential to transform therapeutic practises by offering uncommon ways to support therapeutic goal targeting. However, the data also underscored the importance of providing education and support to SLPs, to address their gaps in knowledge and foster confidence towards the adoption of such techniques. These steps would be crucial towards the tool’s successful integration within the local context.

Theme 2 elicited the following sub-themes:

- *Subtheme 7:* Understanding and Adopting New Technologies.

3.3 Theme 3: revealing future possibilities

The third theme “Revealing Future Possibilities” explores the scalable potential of the tool, emphasising its versatility beyond its primary application in speech and language pathology. Despite being designed for therapy, the collected data suggested that the tool also holds major promise as an educational resource for the mainstream classroom. This potential, particularly regarding its data-handling capabilities, supports effective use across diverse contexts.

Consequently, findings also highlighted the tool’s capacity to facilitate the carry-over and follow-up of language practise in the home environment. Thus, bridging the gap between formal instruction and daily life, the tool offers a seamless way through which educators may ensure continued progress in practise. Overall, this dual functionality, between therapeutic and educational contexts, placed the tool as a valuable innovation with wide-reaching implications.

Theme 3 elicited the following sub-themes:

- *Subtheme 8:* Educational potential and purpose.
- *Subtheme 9:* App functionality and data handling.
- *Subtheme 10:* Carry-over and follow-up.

3.4 Theme 4: language learning

The tool's adaptability to fit children's particular needs establishes its value in delivering personalised language instruction. The gathered data highlighted the tool's unique features, which actively support language acquisition by accommodating varied learning styles and abilities. A key point of importance for the participants was the tool's bilingual functionality, enabling its use in both Maltese and English, either independently or simultaneously. This flexibility broadens its applicability across diverse linguistic contexts. Furthermore, the gameplay evaluations revealed varied interaction and instruction techniques, highlighting the tool's dynamic and engaging approach to bolstering language development. The data affirmed the game's potential as an innovative resource for language learning both in therapy, in the classroom, and at home.

Theme 4 elicited the following sub-themes:

- *Subtheme 11: User-centric adaptations.*
- *Subtheme 12: Language and bilingual elements.*

3.5 Theme 5: addressing the negative views towards gamification

The final theme elicited from the data examines the concerns and criticisms towards the integration of connected technologies and gamification in therapy/educational materials. Certain individuals across the data collection phases revealed scepticism regarding the effectiveness and appropriateness of gamification in the therapeutic and educational contexts, hence, reflecting a broader hesitation towards such innovations.

The prototype evaluations further emphasised these challenges, since the presented difficulty levels were inadequate for certain children, showing the need for continued refinement to ensure the tool meets its diverse users' needs. Another critical finding was that a few participants found that the BETA prototype (Figure 2) had an absence of cultural elements, which could lead to limited relevance and acceptance within the local community. By bringing these concerns to light, thoughtful design adjustments can be made before production and community engagement with the tool can be maximised.

Theme 5 elicited the following sub-themes:

- *Subtheme 13: Concerns and Negative Views.*
- *Subtheme 14: Cultural Elements.*

Overall, these themes encapsulate the key findings and provide a structured framework for readers to better understand the gathered data.

3.6 Statistical results obtained from phases 2 and 3 of data collection

The statistical analysis of Phases 2 and 3 of data collection complements the preceding qualitative insights by highlighting

empirical evidence that detects patterns and relationships not captured through qualitative means, thereby strengthening the overall findings (Guetterman et al., 2015). While qualitative data captures detailed user experiences (UXs), quantitative analysis provides objectivity, particularly when comparing user groups such as caregivers (CG) and speech-language pathologists (SLPs), as is done in the subsequent analysis (Law et al., 2014). This mixed-methods approach not only reinforces the qualitative findings but also enhances the rigour and generalizability of the research, leading to richer, replicable insights (Johnson et al., 2020).

Statistical measures of distribution and central tendency were first used to summarise key characteristics of the dataset. Variables such as age, gender, language exposure, and developmental status were reported for descriptive purposes only, in order to contextualise the participant sample; no inferential testing was conducted on these demographic variables.

Although Likert-scale responses are often summarised using means and standard deviations, these data are ordinal in nature, and this was taken into account when selecting appropriate analytical techniques (Bishop and Herron, 2015). To compare responses from CGs and SLPs regarding tool usability and engagement, non-parametric tests, specifically, Mann-Whitney U and Chi-square tests, were employed, given the ordinal scale of the data and the small, non-normally distributed sample. While no formal null hypotheses were stated, each test was used to evaluate whether statistically meaningful differences existed between the two participant groups.

a. Data from the Questionnaire given to the Caregivers of Typically Developing Children during BETA-Prototype Evaluations.

In Table 2, the descriptive statistics presented, focus on the age of the typically developing (TD) child participants from the BETA-Prototype Evaluation held during Phase 2 of data collection. The sample consists of 48 children, with a mean age of 6.57 years ($SD = 11.16$), ranging from a minimum of 5.01 years to a maximum of 8.11 years.

Table 3 further elaborates on the distribution of TD children across several demographic variables. In terms of gender, 56.3% of the children were female ($n = 27$), while 43.8% were male ($n = 21$). The sample is also divided by school type, with 47.9% attending church schools ($n = 23$), 14.6% in private schools ($n = 7$), and 37.5% in public schools ($n = 18$). Geographically, 50% of the children were from Malta Centre ($n = 24$), while 14.6 and 35.4% came from Malta North ($n = 7$) and Malta South ($n = 17$), respectively.

Regarding language background, 39.6% of the children ($n = 19$) had an approximately balanced use of both English and Maltese, 25% ($n = 12$) predominantly spoke English, and 35.4% ($n = 17$) predominantly spoke Maltese. In terms of language exposure, 54.2% of the children ($n = 26$) were exposed primarily to Maltese, while 27.1% ($n = 13$) experienced balanced exposure and 18.8% ($n = 9$) were exposed predominantly to English. The distribution by game language reveals that 56.3% of the children ($n = 27$) played the game in English, and 43.8% ($n = 21$) played it in Maltese. Finally, the children were

TABLE 2 Frequency distribution of TD children based on age.

Variable	n	Mean	SD	Minimum	Maximum
Age (years)	48	6.57	11.16	5.01	8.11

TABLE 3 Frequency distribution of TD children based on specific background variables (i.e., gender, school type, geographic location, language background, language exposure, game language, and level of difficulty).

Variable	Group	Frequency	Percentage
Gender	Female	27	56.3
	Male	21	43.8
School type	Church	23	47.9
	Private	7	14.6
	Public	18	37.5
Geographic location	Malta Centre	24	50
	Malta North	7	14.6
	Malta South	17	35.4
Language background	Both Maltese and English, in approximately balanced proportions	19	39.6
	Predominantly English	12	25
	Predominantly Maltese	17	35.4
Language exposure	Both Maltese and English, in approximately balanced proportions	13	27.1
	Predominantly English	9	18.8
	Predominantly Maltese	26	54.2
Game language	English	27	56.3
	Maltese	21	43.8
Level of difficulty	Level 1	10	20.8
	Level 2	14	29.2
	Level 3	10	20.8
	Level 4	14	29.2

TABLE 4 Central tendency indicators of TD children group based on variables related to the tool's effectiveness in making language learning fun and maintaining the child's attention during gameplay.

Variable	n	Mean	SD	Median	Mode
Effectiveness of the games in making language learning fun for your child	48	4.52	0.618	5	5
Efficiency of the activities in gaining the children's attention when playing the game	48	5	0.512	5	5

distributed evenly across difficulty levels, with each level being chosen by approximately 20–30% of the sample.

Table 4 provides central tendency measures for two variables, scored according to the opinions of the TD children's caregivers. The mean score for the *effectiveness of games in making language learning enjoyable* is $M = 4.52$ ($SD = 0.618$), with a median and mode of 5. The *efficiency of activities in gaining children's attention* had a mean score of $M = 5.00$ ($SD = 0.512$), and both the median and mode were also 5.

- b. Data from the Observation Form for Typically Developing Children (Filled in by Observing first author).

Table 5 outlines the game duration and activity replay frequencies for TD children as noted by the observing first author during the evaluation sessions. Most children (44%, $n = 22$) played the game for 45 min, followed by 40 min (28%, $n = 14$), 35 min (14%, $n = 7$), and 30 min (14%, $n = 7$). Game completion was achieved by 96% of the children ($n = 48$), with only two children (4%) not completing the game.

The replay frequencies for various activities are also detailed. For “Activity 1: Categories,” 80% of the children ($n = 40$) did not replay the activity, while 14% ($n = 7$) replayed it once and 6% ($n = 3$) replayed it between 2 and 5 times. Similar patterns are observed for “Activity 2: Odd One Out,” with 80% of children not replaying it, 16% replaying it once, and 4% replaying it more than five times. For “Activity 3: Matching Pairs,” 88% did not replay, while 10% replayed once, and 2% replayed 2–5 times.

3.7 Further results obtained through parametric testing

Parametric tests rely on assumptions like normal data distribution and homogeneity of variances, but with small and unequal sample sizes, these assumptions are often violated, risking invalid statistical inferences (Yu, 2012). Due to the characteristics of this dataset, non-parametric testing was chosen instead. To ensure comparability, the caregiver sample was equalised by dividing the original sample by age range and randomly selecting participants using randomisation software (Xiang, 2016).

TABLE 5 Frequency distribution of TD children based on gameplay variables (i.e., game duration, game completion, and desire to replay).

Variable	Category	Frequency	Percentage
Game duration	30 min	7	14
	35 min	7	14
	40 min	14	28
	45 min	22	44
Game completion	No	2	4
	Yes	48	96
Replay activity 1: categories	0 times	40	80
	1 time	7	14
	2–5 times	3	6
Replay activity 2: odd one out	0 times	40	80
	1 time	8	16
	More than 5 times	2	4
Replay activity 3: matching pairs	0 times	44	88
	1 time	5	10
	2–5 times	1	2
Replay activity 4: Let us guess	0 times	32	64
	1 time	16	32
	2–5 times	2	4
Replay activity 5: possessive pronouns	0 times	47	94
	1 time	3	6
Replay activity 6: adjectives	0 times	45	90
	1 time	4	8
	2–5 times	1	2
Replay activity 7: actions	0 times	40	80
	1 time	8	16
	2–5 times	2	3
Replay activity 8: describe	0 times	33	66
	1 time	14	28
	2–5 times	2	4
	More than 5 times	1	2

Non-parametric tests, which rank data rather than rely on distribution assumptions, offer greater flexibility for small, unequal samples, reducing the risk of Type I and II errors (Nahm, 2016). Non-parametric methods were used due to the small sample size ($n < 30$) and as Ghasemi and Zahediasl (2012) note, such methods are appropriate when normality cannot be assumed. These tests were applied to compare UXs between caregivers and speech-language pathologists (SLPs) and evaluate performance scores provided by both caregivers and the first author through observation forms. This test provides a more reliable and holistic understanding of UXs, enhancing the validity of the analysis.

3.7.1 Board game features

The results in Table 6 compare the board game features between two groups CG and SLP, using the U Mann–Whitney test. The results demonstrate significant differences in several aspects. For the “effectiveness of the design of the board game in attracting the child’s attention,” CG had a higher mean rank (18.43) compared to SLP (9.65), with a significant U -value of 45.500 ($Z = -3.079$, $p = 0.002$).

This suggests that CG found the design more effective in capturing the child’s attention.

Additionally, the “effectiveness of the reward system and incentives” yielded an even larger difference between CG (mean rank = 20.10) and SLP (mean rank = 6.30), $U = 8.000$, $Z = -4.362$, $p < 0.001$. This significant result implies that CG viewed the reward system more positively.

Similarly, other aspects such as “satisfaction of the parent/guardian in view of the child’s progress” ($U = 17.000$, $Z = -4.132$, $p < 0.001$) and “perceived satisfaction of the child using the board game” ($U = 16.500$, $Z = -4.155$, $p < 0.001$) showed significant differences, with CG reporting higher levels of satisfaction.

The “satisfaction of using the companion app” also differed significantly, with CG having a mean rank of 19.83, indicating greater satisfaction compared to SLP (mean rank = 6.85), $U = 13.500$, $Z = -4.261$, $p < 0.001$.

3.7.2 Game use

Table 7 shows the comparison between CG and SLP regarding game usage frequency. The mean ranks reveal a

TABLE 6 U Mann-Whitney comparison between CG and SLP considering the board game features.

Board game features	Group	N	Mean rank	<i>U</i>	<i>Z</i>	<i>p</i> -value
<i>Effectiveness of the design of the board game in attracting the child's attention</i>	CG	20	18.43	45.500	−3.079	0.002
	SLP	10	9.65			
<i>Effectiveness of the reward system and incentives used in the board game</i>	CG	20	20.10	8.000	−4.362	0.000
	SLP	10	6.30			
<i>Satisfaction of the parent/guardian in view of child's progress</i>	CG	20	19.65	17.000	−4.132	0.000
	SLP	10	7.20			
<i>Perceived satisfaction of the child using this concept as a learning tool</i>	CG	20	19.68	16.500	−4.155	0.000
	SLP	10	7.15			
<i>Satisfaction of using the companion app</i>	CG	20	19.83	13.500	−4.261	0.000
	SLP	10	6.85			

The values highlighted in bold outline statistically significant results at <0.05 .

TABLE 7 U Mann-Whitney comparison between CG and SLP considering the game use.

Game use	Group	N	Mean rank	<i>U</i>	<i>Z</i>	<i>p</i> -value
How often would you use the board game with your child if this was available at home? (CG) vs. If the board game was available at your clinic, how often would you use the board game during therapy? (SLP)	CG	20	17.68	56.600	−2.045	0.041
	SLP	10	11.15			

The values highlighted in bold outline statistically significant results at <0.05 .

TABLE 8 U Mann-Whitney comparison between CG and SLP considering the board game properties.

Board game properties	Group	N	Mean rank	<i>U</i>	<i>Z</i>	<i>p</i> -value
<i>Board game quality</i>	CG	20	16.25	85.000	−0.777	0.437
	SLP	10	14.00			
<i>User-friendliness</i>	CG	20	17.65	57.000	−2.068	0.039
	SLP	10	11.20			
<i>Time efficiency</i>	CG	20	19.00	30.000	−3.217	0.001
	SLP	10	8.50			
<i>Strategic value</i>	CG	20	18.10	48.000	−2.608	0.009
	SLP	10	10.30			
<i>Player interaction</i>	CG	20	16.70	76.000	−1.365	0.172
	SLP	10	13.10			
<i>Fun factor</i>	CG	20	16.08	89.500	−0.627	0.531
	SLP	10	14.35			
<i>Satisfaction</i>	CG	20	17.30	64.000	−1.966	0.049
	SLP	10	11.90			
<i>Directions for use</i>	CG	20	17.75	55.000	−2.174	0.030
	SLP	10	11.00			
<i>Visual design</i>	CG	20	15.43	98.500	−0.083	0.934
	SLP	10	15.65			

The values highlighted in bold outline statistically significant results at <0.05 .

significant difference, with CG having a mean rank of 17.68 and SLP having a mean rank of 11.15 ($U = 56.600$, $Z = -2.045$, $p = 0.041$). This indicates that CG participants were more likely to use the board game frequently compared to SLP participants.

c. Board game properties

In Table 8, the Mann-Whitney U test compares the perceived board game properties between CG and SLP. There was no significant difference in the perceived “board game quality” ($U = 85.000$, $p = 0.437$).

TABLE 9 Crosstabulation—group * do you feel the game mechanics are easy to follow?

U Mann Whitney crosstabulation			Do you feel the game mechanics are easy to follow?		Total
			Yes	No	
Group	CG	Count	20	0	20
		Expected count	18.0	2.0	20.0
	SLP	Count	7	3	10
		Expected count	9.0	1.0	10.0
Total		Count	27	3	30
		Expected count	27.0	3.0	30.0

TABLE 10 Chi-Square tests.

The Pearson Chi-Square test	Value	df	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson Chi-Square	6.667 ^a	1	0.010		
Continuity correction ^b	3.750	1	0.053		
Likelihood ratio	7.288	1	0.007		
Fisher's exact test				0.030	0.030
Linear-by-linear association	6.444	1	0.011		
N of valid cases	30				

^aTwo cells (50.0%) have expected count less than 5. The minimum expected count is 1.00. ^bComputed only for a 2 × 2 table. The values highlighted in bold outline statistically significant results at <0.05.

TABLE 11 U Mann-Whitney comparison between CG and observation form considering the number of mistakes.

Number of mistakes	Group	N	Mean rank	U	Z	p-value
How frequently did you observe your child make mistakes during gameplay? (CG) vs. How frequently did you observe the child make mistakes during gameplay (OF)?	CG	20	25.70	96.000	−3.202	0.001
	OF	20	15.30			

The values highlighted in bold outline statistically significant results at <0.05.

However, “*user-friendliness*” demonstrated a significant difference, with CG having a higher mean rank (17.65) than SLP (11.20), $U = 57.000$, $Z = -2.068$, $p = 0.039$.

Furthermore, the attribute “*time efficiency*” had a large and significant difference (CG = 19.00, SLP = 8.50, $U = 30.000$, $Z = -3.217$, $p = 0.001$), suggesting that CG found the game to be more time efficient. “*Strategic value*” also differed significantly, with CG reporting higher satisfaction ($U = 48.000$, $Z = -2.608$, $p = 0.009$). “*Player interaction*,” “*fun factor*,” and “*visual design*” did not show significant differences between the groups. The “*satisfaction*” ($U = 64.000$, $Z = -1.966$, $p = 0.049$) and “*directions for use*” ($U = 55.000$, $Z = -2.174$, $p = 0.030$) attributes, however, yielded significant differences, favouring CG.

d. Board game mechanics

Table 9 presents a crosstabulation comparing whether participants felt the game mechanics were easy to follow. CG reported that all 20 participants found the game mechanics easy to follow, whereas, in the SLP group, 7 reported ease of use while 3 did not. The Pearson Chi-Square test presented in Table 10 was significant ($\chi^2 = 6.667$, $p = 0.010$), indicating that the ease of following game mechanics was

significantly higher for CG. Fisher’s exact test confirmed this result with $p = 0.030$.

e. Number of mistakes

In Table 11, the Mann–Whitney U test compares the number of mistakes observed during gameplay. The CG group (*mean rank* = 25.70) reported significantly more mistakes compared to the OF group (*mean rank* = 15.30), with $U = 96.000$, $Z = -3.202$, $p < 0.001$. This result highlights that OF participants observed fewer mistakes during gameplay, indicating a smoother UX for the group.

4 Discussion

In this section, each of the elicited sub-themes will be further delved into, hence, offering a deeper insight into the key findings of the study. These subthemes offer an account of particular elements within each theme, highlighting the multifaceted nature of the study’s data when compared to existing literature. Furthermore, relevant quotes from participants across all five phases of data collection are

included in the discussion to further exemplify and strengthen its analysis.

4.1 Subtheme 1: design and visual appeal

Aesthetics are crucial in the effectiveness of pedagogical tools, as highlighted by Page and Thorsteinsson (2017), who state that toys similar to “Olly’s Adventures” need to balance visual appeal and educational value. The findings align with this, as caregivers consistently praised the design during evaluation sessions. For example, one caregiver described it as “*very stimulating and fun*,” while another commented, “*It’s very attractive in terms of the design and all of that, it’s very appealing*.” Heljakka (2019) advocates for “wow factors” to enhance the long-term play value of toys, a sentiment reflected in feedback from an SLP during the clinical evaluation: “*Children tend to love and be motivated to use board games, which is very appealing*.” Feng (2024), however, emphasises the importance of incorporating innovative play modes and materials to foster healthy cognitive development.

From the gathered data, “Olly’s Adventures” was deemed highly attractive, with one caregiver noting, “*The board and the pieces are very appealing*.” Another caregiver, whose child was diagnosed with DLD, highlighted its relatable design: “*The board game is very colourful, and children can relate to the background of the game as it shows places that they would normally visit*.” These findings suggest that the game successfully integrates visual appeal with engaging and relatable elements, creating an attention-grabbing and motivating environment.

4.2 Subtheme 2: gameplay and mechanics

The delivery of language instruction stands to be enhanced through the use of game-based elements that provide well-designed and interactive gameplay. *Olly’s Adventures* benefits from intuitive and captivating mechanics that balance developmental goals with an enjoyable experience. As outlined by Qiu (2024), the combination of digital and traditional play promotes parent–child interactions, which when paired with effective language exercises, as Saeedi et al. (2022) suggest, could lead to streamlined and supportive learning. One SLP emphasised the importance of purposeful game design, stating, “*Exactly, but it’s specifically a language game so no matter what language goals are being targeted*.”

However, Piculo dos Santos et al. (2019) emphasise the need for designing inclusive games that accommodate diverse needs, ensuring equity in terms of accessibility. This is crucial for ensuring that children with varying abilities benefit equally from the game. Additionally, Jiang et al. (2018) suggest that aligning designs with children’s preferences encourages greater use and sustained interest. One caregiver noted during the evaluation session, “*Since we are in a world of using technology, it’s nice to have something to learn from it as well*.”

The integration of both physical and digital elements also received praise from an SLP, who said, “*It would be very useful in*

our clinics because children need that digital aspect these days, and the included physical aspect would help for better explanations from the SLP.” This feedback highlights the value of combining traditional play with digital elements, fostering a comprehensive and engaging approach to language therapy.

4.3 Subtheme 3: audience and engagement

Effective engagement, whether in a clinic, classroom, or home setting, requires a deep understanding of how to capture and maintain attention. Educators must tailor their approach to diverse learning styles and employ strategies to grab and sustain focus (Arifadah et al., 2020). Similarly, toy designers must create products that are appealing and engaging for different children. One caregiver highlighted the immediate appeal of *Olly’s Adventures*, noting, “*The fact that it has an app, it grabs the child’s attention immediately*.” However, as with any tool, maintaining attention over time remains a challenge. As another caregiver pointed out, “*If the game takes too long, young users start losing interest*.”

Family-centred approaches emphasise the importance of involving parents in children’s learning and play (Law et al., 2019). *Olly’s Adventures* fosters this inclusion by offering an interactive environment that engages both children and adults. One caregiver appreciated this aspect, stating, “*I liked that the children could play together, but also the adults*.”

When designing board games for language therapy, a balance between complexity and simplicity is essential. Observations from the evaluation workshops highlight this need for balance: “*It should be noted that the child’s attention was fleeting at times, and she had to be redirected to the game on multiple occasions*.” This emphasises the importance of designing games that are not only engaging but also adaptable to various attention spans and developmental stages. Customizable gameplay, including tiered rules and adaptable components (as is found in the pre-production version of “*Olly’s Adventures*”), can cater to different skill levels and developmental needs.

4.4 Subtheme 4: character and theme

The *Olly’s Adventures* tool utilises animated penguin characters in its design to appeal to its younger potential users. Character design, particularly for younger audiences, plays a crucial role in capturing attention and enhancing learning experiences. Features like larger eyes and rounder faces can make characters more appealing (Carter et al., 2016). Feedback from caregivers and observations during the evaluation sessions support this, with one caregiver noting, “*My son really liked the penguins!*” and another observing that, “*Both girls were mostly attracted to the game because of the penguins, they are their favourite animals*.”

Thematic choices, such as using animal protagonists and prosocial themes, can significantly impact children’s engagement and development (Hejazi, 2023; Larsen et al., 2018). This aligns with insights from board game designers, who emphasise the importance of blending popular themes with humour and

relatability: “To make board games truly relevant to children, blend trending themes, like Paw Patrol or Disney, with seasonal or cheeky humour that resonates with their everyday experiences, making play both fun and impactful.” This was reflected in the evaluation, where one caregiver remarked, “Love the colours and penguins.”

Such design choices not only captivate children but also support their cognitive and emotional growth. However, some caregivers suggested that integrating the penguin’s environment into the gameplay could further enhance engagement: “It would be nicer to match the games to the ambient where the penguin of the respective player is.” This feedback suggests that creating more contextually immersive environments for the characters could deepen the connection children feel with the game.

4.5 Subtheme 5: user experience and feedback

User feedback is crucial in designing effective and engaging toys. By gathering input from users throughout the design process, developers can ensure that the final product meets the needs and preferences of the target audience (Pagano and Bruegge, 2013; Fotrousi et al., 2014). Iterative design, involving prototyping, testing, and refinement, allows for continuous improvement of the UX (Bernhaupt, 2015). This approach is particularly important in game development, where creating fun and engaging experiences is a primary goal. Feedback from the evaluation sessions highlighted the need for refinement. For example, one speech-language pathologist (SLP) suggested, “To add the points onto the app, to have one path instead of 4 in order to be less time consuming, it’s a very fun game and very stimulating.” Another SLP recommended, “To combine the areas on the board to make it one complete path,” aiming to streamline gameplay and reduce complexity. In accordance, this was incorporated into the pre-production design.

Understanding the dual requirements of functionality and enjoyment is key to designing toys that resonate with users (Roto et al., 2009). By considering factors such as the Quality of Experience (QoE), designers can identify areas for improvement and create products that delight users (Le Callet et al., 2013; Fotrousi et al., 2018). This balance is especially critical in therapeutic games. One SLP emphasised the need to reduce playtime, stating, “Decrease playing time. A 40-min game is too long for most 5-8-year-olds (especially those with additional challenges).”

4.6 Subtheme 6: marketing and pricing

Effective pricing and marketing strategies are crucial for the successful implementation of “Olly’s Adventures” in healthcare clinics and classrooms. Pricing strategies must be carefully considered to appeal to both professionals and at-home users. Transparent, relevant, and engaging pricing, coupled with effective marketing, can significantly influence product acceptance (Ali and Anwar, 2021). Understanding buyer behaviour and incorporating customer feedback into the product development process is essential, particularly in healthcare, where products directly impact patient outcomes (Ballanger, 1996).

For tools like *Olly’s Adventures*, additional factors such as content quality, perceived value, and innovation influence pricing decisions. Offering high-quality components, expansion packs, and adaptable gameplay can enhance product appeal and long-term engagement. As

noted by a board game designer who participated in Phase 5 of data collection “When determining a pricing strategy for therapeutic board games, consider the value you are offering—are users getting what they expect for the price, while ensuring innovation, high-quality content, and a truly exceptional product?” Expansion packs, in particular, can enhance playability and replayability by introducing variance, increasing difficulty, and addressing gameplay issues in the core game: “Expansion packs may not be essential, but they enhance playability and replayability by introducing variance, increasing difficulty, and fixing gameplay issues in the core game.”

However, caregivers emphasise the need for a balanced pricing approach. One caregiver noted, “It requires a lot of money to be able to ‘publish’ this and put it on the market, so it cannot be put at a high price, but at the same time if it is very expensive people will not buy it even though it is fun to play.” Therefore, the importance of finding a pricing strategy that reflects both the value of the product and the financial limitations of potential users.

4.7 Subtheme 7: understanding and adopting new technologies

The integration of new technologies in speech and language therapy has the potential to transform clinical practise, enhancing data collection, assessment, and treatment (Pierrakeas et al., 2006; Garrett, 2013; Chen et al., 2016). However, many free-to-download apps lack empirical support or may not align with evidence-based principles, which raises concerns about their adoption (Furlong et al., 2018). The success of technology adoption in speech and language therapy is heavily influenced by the perceived usefulness and ease of use, as highlighted by early technology acceptance models (Davis, 1989). Clinicians must see the technology as beneficial and easy to integrate into their workflows (Albudoor and Peña, 2021).

Challenges to adoption include technical issues, such as network reliability, and individual barriers, like clinician familiarity with the technology (Zakerabasali et al., 2021). SLPs in the evaluation workshops emphasised the importance of flexibility in design to address these barriers. One therapist noted, “I wish we could have the ability to use it without the app (due to potential connectivity issues in district clinics).” Another expressed concern over the complexity of the design, suggesting, “I would simplify the process by removing the app and having the instructions on flashcards.”

Despite these challenges, many clinicians recognised the tool’s potential to enhance therapy. One therapist stated, “I do believe it could augment therapy in terms of variety and interest.” The visuals and customizable features of the game, such as different levels of difficulty, also contributed to its appeal, with one therapist remarking, “The colours, the characters, they are really interesting and I liked that it wasn’t like the normal sorting or labelling.”

4.8 Subtheme 8: educational potential and purpose

The potential for collaboration between education and speech-language therapy is promising. Both fields share the common goal of improving language skills, albeit with distinct focuses. Gamification, as explored by Zhang and Hasim (2023), offers a potential avenue for shared resources. By adapting educational materials, such as

game-based learning, for therapeutic use, more engaging and motivating interventions can be developed for children with SLCN (Speech, Language and Communication Needs). For instance, feedback from caregivers, who were also educators, highlighted the versatility of such tools. One participant noted that *“it could be introduced in literacy classes where students are practising without noticing; it could also be used in complementary classes, CCP, Prince Trust, and also as a means to assess speaking.”* Another participant suggested extending the use of these resources to *“other subject areas across the curriculum.”* This feedback underscores the potential for integrating game-based tools into various educational contexts. However, as highlighted by Mathers et al. (2024), clear guidelines and frameworks are needed to facilitate collaboration and optimise resource sharing. Involving learning support educators (LSEs) in this process is crucial to ensure effective implementation. By building on the strengths of both fields and addressing the identified challenges, a more efficient and effective system of language support for children regardless of language abilities can be created.

4.9 Subtheme 9: app functionality and data handling

The companion app has the potential to revolutionise healthcare by generating valuable patient-generated health data (PGHD) (Pulimamidi, 2024). For example, as one SLP suggested, *“having data collected would help for progress notes and to track progress.”* Personalised experiences can further enhance user engagement and adherence to therapy (Omaghomi et al., 2024). Feedback from SLPs emphasised the importance of customization, such as the ability to create individual client profiles to track performance and facilitate carryover at home. One SLP proposed, *“including profiles for clients which can be accessed by carers at home. SLPs can set goals for the client on the app to facilitate carryover at home. Data related to performance (at home and during the session) could be stored on profiles on the app.”*

However, some concerns were raised about the potential complexity and impact on workflow. As another SLP reflected, *“I personally would not like that because it really takes away from the fun of it. It becomes much more complicated. If it's integrated as something that you have to do, it's like you cannot get away from it.”* These contrasting perspectives highlight the need to balance functionality with usability to ensure the app remains a helpful tool rather than an added burden.

Additionally, rigorous attention to data privacy, security, and quality is essential (Omaghomi et al., 2024; Ohaleté et al., 2024). Addressing the digital divide is also crucial to ensure equitable access and outcomes for all users (Ohaleté et al., 2024; Adebisi and Lucero-Prisno, 2022). By addressing these challenges and incorporating user feedback, the app can become a powerful tool for both therapy and data-driven decision-making.

4.10 Subtheme 10: carry-over and follow-up

The board game and companion app can significantly enhance language therapy outcomes by fostering therapeutic carryover and supporting follow-up practise at home. By supplementing in-person therapy and lessons with structured exercises, immediate feedback, and additional practise opportunities, the app can help address the

common challenge of maintaining consistent practise outside the professional setting (Okolo et al., 2024; Orehovački et al., 2017). As one SLP noted, *“It would augment therapy, rather than solve, I think. It would make it more interesting and varied. It would also help carryover if parents purchase it too.”*

The inclusion of app features like user profiles, which caregivers can access at home, was highlighted during the evaluation. These profiles could enable professionals to set goals and monitor performance both in class or clinic and at home, supporting a more integrated approach to learning. One caregiver reflected on her experience, saying, *“It used to be very difficult for me to try and get my son to sit and work on the carryover activities the SLP provided. If I had had something like this, I could have potentially instructed my child in a better way.”*

While the tool holds great potential, addressing user privacy, data security, and sustained engagement remains critical to its success (Okolo et al., 2024). By integrating these considerations, the tool can serve as an engaging and effective extension of therapy, bridging the gap between clinic and home.

4.11 Subtheme 11: user-centric adaptations

Person-centred care (PCC) is a cornerstone of speech and language therapy, emphasising personalised interventions that address individual needs and preferences (DiLollo and Favreau, 2010; Forsgren et al., 2022; Bellon-Harn et al., 2017; Mahomed-Asmail et al., 2023). While balancing individualisation with caseload demands is challenging (Binns et al., 2022), adaptable tools offer solutions, particularly for diverse clinical populations (Mahomed-Asmail et al., 2023).

The tool's multiple difficulty levels and customization options exemplify this adaptability. As one board game designer noted, *“Customising a board game for different cognitive abilities is all about adjusting the rules to match each child's language and cognitive skills, making the game more engaging and tailored to their level.”* This flexibility was also appreciated during evaluation sessions, where a caregiver remarked, *“I liked the fact that she was able to play the same game as an older child but the questions were tailored for their ages, respectively.”* These features ensure that children of varying developmental abilities can meaningfully engage, enhancing inclusivity.

Incorporating physical and tangible elements, collaborative tasks, and adaptable visuals enhances accessibility and engagement. A board game designer emphasised that *“board games should enhance UX by combining team engagement with customisation ensuring motivation and inclusivity for all users.”* Balancing difficulty is also crucial, with designers noting the importance of games being *“challenging enough to motivate, but not so hard, complex, or lengthy that the child loses interest.”*

By combining flexibility, personalization, and thoughtful design, the tool supports PCC principles, fostering engagement and accessibility across therapeutic and clinical contexts.

4.12 Subtheme 12: language and bilingual elements

Bilingual materials, as highlighted by Li (2023), can enhance language understanding and use by reflecting the child's linguistic reality, fostering cultural identity, and identifying strengths and weaknesses across both languages (Dam and Pham, 2023; Nair et al.,

2023). One caregiver noted the value of the tool, stating that children “can use it in both Maltese and English and also that they will learn something from the game.”

The tool’s potential applicability was further demonstrated during evaluation workshops. For instance, Austrian children fluent in English, German, and Russian played the game in English, with one child translating instructions into German for his younger sister. Their Maltese-speaking nanny noted that the game could also serve as a base for learning French, which the children were studying. Similarly, a Hungarian mother commented on its utility in contexts where English is not widely taught. Another session highlighted flexibility in language preferences: a child initially played in Maltese to accommodate his grandmother but later switched to English, requiring the moderator to translate for the grandmother to continue participating. A feature which at the time of writing has been included in the pre-production version of the companion app, thus no longer requiring spontaneous translation as the app offers the ability to change the game’s language during play. These examples underscore the potential of bilingual materials not only for therapeutic use but also for broader educational applications, particularly in diverse linguistic settings. While individual needs and clinician expertise remain critical, tools like “Olly’s Adventures” can bridge gaps in multilingual education and therapy.

It should be noted that this study was intentionally limited to Maltese and English-speaking children, as it served as an initial exploration of the tool’s potential within a bilingual context. Malta is officially bilingual, and both Maltese and English are used widely in education and everyday communication (Mifsud and Vella, 2018). While the tool is designed to be adaptable, future research will be necessary to assess its application in other linguistic settings.

4.13 Subtheme 13: concerns and negative views

While digital gamification shows promise in language therapy and education, its adoption faces several challenges, including therapist/educator concerns and user apprehensions. The comfort levels users have with technology is a significant barrier; less tech-savvy professionals may hesitate to adopt new tools without proper training (Gustafsson and Edberg, 2017). Additionally, concerns about effectiveness persist, as evidence supporting gamification outcomes continues to emerge (Gentry et al., 2019; Melcarne et al., 2023).

Therapists also express concerns about accessibility and usability for diverse populations. As one therapist noted, “*Could prove difficult to use with those with limited fine motors and clients with aggressive behaviour*,” which could be due to the smaller physical pieces included in the board game and also the possibility that the child may not win the game in the end, whereas another highlighted the need for practical solutions: “*Accessibility for children with access issues could be managed with advice + a communication board to navigate using partner-assisted scanning, for example*.” Simplification was also suggested to address cognitive and usability barriers: “*I would simplify the process by, for instance, removing the app and having the instructions on flashcards and presenting fewer items at any given time*.”

For users, privacy concerns related to data sharing and the complexity of learning new systems can also hinder adoption (De Cremer et al., 2017; Gustafsson and Edberg, 2017). Older adults or individuals with limited tech literacy may find the tools intimidating, and some professionals remain sceptical about their reliability compared to traditional methods.

Addressing these barriers requires comprehensive training for SLPs, evidence-based demonstrations of effectiveness, and robust privacy measures. By building trust and providing tailored support, digital gamification can better realise its potential to enhance language therapy outcomes.

4.14 Subtheme 14: cultural elements

Using culturally appropriate therapy materials is essential for effective intervention with diverse populations. Culturally relevant content enhances client engagement, builds rapport, and improves outcomes by respecting clients’ values and beliefs, which significantly influence their perceptions of therapy (McLeod et al., 2017). Ignoring these factors risks miscommunication and undermines care quality.

Culturally tailored materials also help reduce power imbalances by showing respect for clients’ backgrounds, fostering trust, and promoting collaboration, particularly with marginalised populations (Stubbe, 2020). As one SLP remarked during the evaluation, “*It would be a shame to lose the Maltese element as it is something that makes the game unique, and since it is a bilingual game that includes Maltese as one of the main languages, I think it would make it stand out*.”

Feedback from caregivers echoed this sentiment, suggesting that the tool could be “*more Maltese-centric*” or include culturally iconic features, such as “*the luzzu*” (a known Maltese icon) or activities linked to popular locations like “*Ta’ Qali National Park*” (a location in Malta). Suggestions also included replacing the penguins with “*another animal typical of Malta*.”

While some professionals may resist shifting from traditional methods (O’Connor and Pettigrew, 2009), professional development and exposure to culturally responsive tools can ease this transition. As Verdon et al. (2015) note, a “one-size-fits-all” approach is inadequate. By embracing cultural awareness, SLPs can create stronger connections and foster improved outcomes, making tools like “Olly’s Adventures” both impactful and inclusive.

4.15 Limitations

While this study provides promising insights into the potential of “Olly’s Adventures” as a therapeutic and educational language intervention tool for children, several limitations need to be acknowledged.

One of the limitations encountered was that of the study’s small sample size, which limits the generalisability and statistical power of its findings, particularly in terms of recruiting children diagnosed with DLD and SLPs. This limitation restricted the broader representation of the population and the variability in needs across different demographics. Additionally, the single-session clinical evaluation prevented the assessment of long-term impact when using “Olly’s Adventures” in its intended way. Therefore, despite the tool being designed with DLD in mind, this phase focused on initial development

and testing. The DLD-related findings are exploratory and should not be interpreted as clinical validation. Further targeted research needs to occur prior to clinical implementation.

Continually, subjective interpretation was another key limitation, as the study relied heavily on feedback from caregivers, clinicians, and other stakeholders, which stood to introduce elements of observer bias and personal interpretation. These differing responses highlight the importance of context when evaluating educational tools. SLPs and caregivers/educators reported different levels of usability and satisfaction. SLPs tended to assess the tool in terms of therapeutic alignment, structure, and language intervention potential. In contrast, CGs appeared to focus more on practical aspects such as engagement, ease of use, and integration into daily routines. These divergent perspectives likely reflect the users' distinct roles, expectations, and experiences with language support tools.

The BETA prototype of the tool (Figure 2) also revealed functional limitations within the tool's concept. Seeing as, the randomised prompts included in the app led to inconsistent practise of certain language structures, when repetition is essential towards acquisition. Furthermore, despite proving effectively engaging, the reward system included in the game allowed for rapid game completion, which detracted from children's sustained focus on the linguistic targets. Hence, a balance in the mechanics needed to be struck to not shift the child's focus from educational objectives to gameplay completion, potentially diminishing the effectiveness of the therapeutic/educational intervention provided.

Challenges in terms of ease of use were also reported by caregivers (from the non-educator pool) when it came to using the companion app, contrasting the clinicians and educators who found it effective for data collection. This discrepancy suggests that improved accessibility and intuitive design are necessary to support all types of users, ensuring that anyone can confidently engage in language reinforcement outside professional settings.

Despite the significant amount of progress that was made in these phases, further data collection remains ongoing at the time of this article's writing, underscoring the iterative and detailed design nature of this research study.

4.16 Implications

"Olly's Adventures" shows strong potential as a bilingual educational and therapeutic tool. Its adaptable design supports language development in classroom and clinical settings, benefitting both bilingual children who have language difficulties, as a result of impaired language processing or of limited exposure to a second language, and those with typically developing language.

The tool's dual-language format encourages cross-linguistic transfer, whereby improvements made in one language may positively influence the other, fostering holistic bilingual development. Furthermore, the integration of gamification with physical and digital components encourages engagement with the tool in a playful, evidence-based approach towards language learning. Its customizable features such as the language tasks, adjustable difficulty levels and QR-code-based interactivity ensure that the tool is inclusive towards diverse learning needs, extending its applicability beyond its Maltese English origins to other contexts.

Continually, another sector that stands to benefit from the creation of such tools is design engineering. Given the cyclical adaptive approach adopted to designing "Olly's Adventures" the design engineering aspect

was able to showcase how gamification principles can address complex educational and therapeutic challenges. Which, in turn, created an opportunity for the potential development of a Knowledge Discovery in Data (KDD) model. Based on collected data, a Knowledge Discovery in Data (KDD) model could be developed to support board game designers in the specialised fields of speech and language therapy and second-language education, with a focus on bilingual applications. Building on principles originally used for therapeutic toy design, this adapted model would address the specific requirements of board game design for children acquiring their second language and those diagnosed with language and communication difficulties. When providing the KDD model with predictive insights into the potential effects of game elements, such as language complexity, types of interaction and gameplay mechanics, designers can anticipate engagement levels, emotional responses and learning outcomes. Thus, allowing for acute, data-driven adjustments that better align gameplay with individual learning goals. A simplified user interface could further aid designers by focusing on key parameters such as age, language background, and emotional engagement, with flexibility for both toy and board game design contexts. Additionally, by using demographic-driven inputs and predictive analytics, the model's applicability could extend beyond itself as a valuable resource in therapy, and educational settings and as a recreational game design. In doing so, this framework has the potential to bridge the gap between therapeutic/educational requirements and practical design, supporting the development of games that effectively enhance cognitive, emotional, and linguistic growth in children. Ultimately, the modular framework allows for its possible global scalability, through its adaptability towards different language pairs and other cultural settings.

Future research should explore the tool's long-term use in both clinical and educational settings to gauge its effectiveness across diverse contexts. Additionally, the incorporation of emerging technologies such as AI could further enhance the tool's personalization abilities.

These innovations, combined with the tool's scalability, demonstrate how connected technology can bridge gaps in resources and foster inclusivity, positioning the tool as a model for advancing bilingual education.

5 Conclusion

This study introduced "Olly's Adventures: The City of Two Languages," a gamified tool for bilingual language education and intervention. By integrating physical and digital components, the tool bridges the gaps present between traditional and digital methods. Thus, offering an engaging solution adaptable to clinical, educational and home environments.

It is concluded that the main contribution of this paper lies in demonstrating how a user-centred, iterative design approach can productively integrate gamified and connected technologies into bilingual language learning. The tool notably merges evidence-based therapeutic practises from speech and language pathology with a flexible interface that supports cross-language transfer. Consequently, it sets a benchmark for scalable and inclusive resources for language teaching.

Despite the existing constraints, such as the small sample sizes used in evaluations, this tool serves as a platform for future research to be extended into the linguistic and contextual applications of "Olly's Adventures." Thus, this study represents a significant step towards the

development of innovative, effective and engaging tools for bilingual education and therapy.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by University of Malta UREC (University Research Ethics Committee). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants legal guardians/next of kin.

Author contributions

DS: Writing – original draft, Writing – review & editing. DG: Writing – review & editing. HG: Writing – review & editing. PF: Writing – review & editing. EA: Writing – original draft, Writing – review & editing.

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