Universidade Estadual de Londrina

PATRICIA EITERER

DESENVOLVIMENTO E AVALIAÇÃO DO JOGO DIGITAL KAHALA PARA ENSINO DE "ATENDER ÀS NECESSIDADES DO OUTRO" A CRIANÇAS AUTISTAS

Londrina
2025

Universidade Estadual de Londrina

Centro de Ciências Biológicas

Departamento de Psicologia Geral e Análise do Comportamento

Programa de Pós-graduação em Análise do Comportamento

Patricia Eiterer

DESENVOLVIMENTO E AVALIAÇÃO DO JOGO DIGITAL KAHALA PARA ENSINO DE "ATENDER ÀS NECESSIDADES DO OUTRO" A CRIANÇAS AUTISTAS

Londrina

2025

Patricia Eiterer

DESENVOLVIMENTO E AVALIAÇÃO DO JOGO DIGITAL KAHALA PARA ENSINO DE "ATENDER ÀS NECESSIDADES DO OUTRO" A CRIANÇAS AUTISTAS

Tese apresentada ao Programa de Pós-Graduação em Análise do Comportamento, do Departamento de Psicologia Geral e Análise do Comportamento, da Universidade Estadual de Londrina como parte dos requisitos para obtenção do título de Doutora em Análise do Comportamento.

Área de concentração: Análise do Comportamento.

Orientadora: Profª. Drª. Silvia Regina de Souza Arrabal Gil

Palavras-chave: empatia; comportamento empático; programação de ensino; jogo educativo

Londrina

2025

O presente trabalho foi realizado com apoio e bolsa da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Código de Financiamento 001.

Ficha de identificação da obra elaborada pelo autor, através do Programa de Geração Automática do Sistema de Bibliotecas da UEL

E36d Eiterer, Patricia.
Desenvolvimento e avaliação do jogo digital Kahala para ensino de \"atender às necessidades do outro\" a crianças autistas / Patricia Eiterer. - Londrina, 2025.
164 f. : il.

Orientador: Silvia Regina de Souza Arrabal Gil.
Tese (Doutorado em Análise do Comportamento) - Universidade Estadual de Londrina, Centro de Ciências Biológicas, Programa de Pós-Graduação em Análise do Comportamento, 2025.
Inclui bibliografia.

1. empatia - Tese. 2. jogos digitais - Tese. 3. programação de ensino - Tese. 4. crianças autistas - Tese. I. Regina de Souza Arrabal Gil, Silvia. II. Universidade Estadual de Londrina. Centro de Ciências Biológicas. Programa de Pós-Graduação em Análise do Comportamento. III. Título.

CDU 159.9

PATRICIA EITERER

DESENVOLVIMENTO E AVALIAÇÃO DO JOGO DIGITAL KAHALA PARA ENSINO DE "ATENDER ÀS NECESSIDADES DO OUTRO" A CRIANÇAS AUTISTAS

Tese apresentada ao Programa de Pós-Graduação em Análise do Comportamento, do Departamento de Psicologia Geral e Análise do Comportamento, da Universidade Estadual de Londrina como parte dos requisitos para obtenção do título de Doutora em Análise do Comportamento.

BANCA EXAMINADORA

_____

Orientadora: Profª. Drª. Silvia Regina de Souza Arrabal Gil
Universidade Estadual de Londrina

_____

Drª Maria Clara de Freitas
Universidade Estadual de Londrina

_____

Dr Guilherme Bracarense Filgueiras
Universidade Estadual de Londrina

_____

Dr Pedro Bordini Faleiros
Universidade Metodista de Piracicaba - Unimep

_____

Drª Izadora Ribeiro Perkoski
Universidade Federal de São Carlos

Londrina, 28 de novembro de 2025

AGRADECIMENTOS

A conclusão desta tese representa o fim de um processo intenso e desafiador, mas também muito frutífero e transformador. Sou imensamente grata àqueles que me cercam porque nunca permitiram que essa jornada fosse solitária. Expresso aqui minha eterna gratidão a todos que, de diferentes formas, contribuíram para a realização deste sonho.

No plano pessoal, minha maior gratidão vai para minha família. Aos meus pais, por serem a base de tudo, pelo amor, incentivo e todos os sacrifícios feitos para que eu chegasse até aqui. Aos meus tios, que sempre me incentivaram a ser questionadora e valorizar o conhecimento científico. Ao meu marido, por sua paciência e compreensão, por ser meu refúgio nos momentos de esgotamento, tribulações e dúvidas. Obrigada também por mover mundos e fundos para me incentivar e acompanhar no período de doutorado sanduíche, sendo meu porto seguro a todo momento.

Agradeço a todos os meus amigos que me ofereceram ombro, ouvidos e risadas, essenciais para me ajudar a manter a sanidade e motivação ao longo desse período. De forma particular, agradeço à Poliana Sanches por nossa incrível parceria para nos acolhermos mutuamente nesse processo, mas também para levarmos o Kahala para o mundo juntas.

Em especial, agradeço à professora Drª Silvia Souza por caminhar comigo ao longo dessa jornada. Obrigada por ser mais do que uma orientadora, tendo sido uma amiga e fonte de acolhimento inesgotável, por sua orientação exemplar, rigor científico e apoio incondicional. Seus ensinamentos transcendem o âmbito acadêmico e são fundamentais para minha formação como pesquisadora e como pessoa.

Agradeço imensamente aos membros da banca examinadora pela leitura atenta e pelas contribuições inestimáveis que qualificaram significativamente a versão final deste trabalho.

Minha gratidão também se estende ao corpo docente do Programa de Pós-Graduação em Análise do Comportamento da Universidade Estadual de Londrina e às minhas colegas do LADEJE, com quem compartilhei momentos de grande aprendizado, colaboração e amizade. Igualmente, agradeço ao professor Dr. Thomas Higbee e aos membros do programa ASSERT por me receberem na Utah State University e fornecerem o apoio necessário para a execução da minha pesquisa.

Evidencio, ainda que esta pesquisa só foi possível graças ao apoio financeiro da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Código de Financiamento 001. Sou imensamente grata pela oportunidade de participar do programa de Doutorado Sanduíche e pelo recebimento da bolsa de doutorado, que viabilizou a minha dedicação integral a esta pesquisa. Agradeço também a todo o corpo técnico e administrativo da Universidade Estadual de Londrina pela disposição em esclarecer minhas dúvidas e fornecer as orientações necessárias sempre que solicitadas.

A todos vocês, muito obrigada!

Eiterer, Patricia. *Desenvolvimento e avaliação do jogo digital Kahala para ensino de "atender às necessidades do outro" a crianças autistas*. 2025. 164f. Tese (Pós-graduação em Análise do Comportamento) – Universidade Estadual de Londrina, Londrina.

Resumo

A empatia é um comportamento social abrangente que, uma vez aprendido, pode funcionar como cunha comportamental para outros repertórios. Ensinar comportamentos empáticos às crianças pode contribuir para a aprendizagem de outros comportamentos sociais, bem como diminuir lacunas no repertório social de indivíduos autistas. Jogos podem ser usados para ensinar novos comportamentos e melhorar aqueles já aprendidos. Jogos podem contribuir para melhorar o engajamento de quem os usa e, consequentemente, o desenvolvimento de suas habilidades. Para desenvolvimento do jogo Kahala, foram aplicados princípios de Análise do comportamento, usabilidade e design iterativo. Após ser considerado apropriado ao público-alvo, o jogo digital foi avaliado com três autistas norte-americanos com idades entre 8 a 14 anos. O primeiro estudo descreve a construção do jogo digital Kahala, utilizando os princípios da Análise do Comportamento para ensinar "atender às necessidades do outro" a crianças autistas. O jogo é ambientado em uma cidade pós-apocalíptica, onde os jogadores devem ajudar personagens não-jogadores (NPCs) identificando suas necessidades e compartilhando recursos. As missões são organizadas em quatro conjuntos, cada um focado em um comportamento-alvo. O jogo foi desenvolvido em JavaScript e pode ser acessado via navegador. Os jogos precisam ser divertidos e promover engajamento por meio de reforço natural, mesmo que tenham função educativa. Pesquisadores da área de Games User Research propõem a análise de aspectos relacionados à jogabilidade e ao engajamento do jogador. Considerando isso, os participantes jogaram a versão digital do Kahala em quatro sessões de intervenção. Nas condições de pré e pós-teste, foram utilizados o QACEC, o jogo de tabuleiro Caçadores de Arco-íris e a situação avaliativa de colorir. O objetivo do segundo estudo foi avaliar a experiência do jogador em relação à jogabilidade e ao engajamento. Durante as sessões com o jogo Kahala, foram registrados e analisados os comentários dos participantes e os níveis de assistência necessários. Os resultados mostraram que os participantes apresentaram uma diminuição das dificuldades de jogabilidade ao longo do tempo. Indicadores positivos de engajamento foram mais frequentes do que os negativos, e os comentários dos participantes indicaram interesse e imersão no jogo. No entanto, alguns elementos precisam de refinamento, como melhoria na apresentação da história e inclusão de um tutorial prático. Apesar da necessidade de ajustes, houve engajamento dos jogadores durante o jogo e ele se mostrou adequado ao público-alvo. O terceiro estudo teve como objetivo avaliar a eficácia do jogo Kahala no ensino da classe "atender às necessidades do outro". Foram analisados os dados decorrentes das sessões de jogo e do pré-teste em comparação com os do pós-teste. Os resultados mostraram um aumento nas pontuações do QACEC de dois dos três participantes, que também demonstraram um melhor desempenho na Situação de Colorir e no jogo Caçadores de Arco-íris. Os dados indicam que o jogo digital Kahala é eficaz no ensino de "atender às necessidades do outro". No entanto, ainda são necessárias melhorias no design do jogo para aumentar o engajamento e a compreensão da história, além de ajustes nos critérios de progressão para refletir melhor o aprendizado dos jogadores.

Palavras-chave: empatia, jogos digitais, programação de ensino, condições para desenvolvimento de comportamentos, crianças autistas

Eiterer, Patricia. *Development and Evaluation of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs.* Doctoral Thesis. 2025. 164f. (PhD in Behavior Analysis) – Universidade Estadual de Londrina, Londrina – PR.

Abstract

Empathy is a comprehensive social behavior that, once learned, can function as a behavioral cusp to other repertoires. Teaching empathetic behaviors to children can contribute to the acquisition of other social skills, as well as reduce gaps in the social repertoire of autistic individuals. Games can be used to teach new behaviors and improve those already learned. Games can contribute to improving the engagement of those who use them and, consequently, their skill development. For the development of the Kahala game, principles of Behavior Analysis, usability, and iterative design were applied. Once considered suitable for the target audience, the Kahala computer game was evaluated with three American autistic children aged 8 to 14 years. The first study describes the development of the Kahala computer game, using the principles of Behavior Analysis to teach "meeting others' needs" to autistic children. The game is set in a post-apocalyptic city, where players must help non-player characters (NPCs) by identifying their needs and sharing resources. Quests are organized in four sets, each focused on a target behavior. The game was developed in JavaScript and can be accessed via a browser. Games need to be fun and promote engagement through natural reinforcement, even when they have an educational purpose. Games User researchers propose analyzing aspects related to playability and player engagement. The participants played the digital version of Kahala in four intervention sessions. For the pre- and posttest conditions, the QACEC, the board game Rainbow Hunters, and the coloring assessment activity were used. The second study evaluated the player's experience of the Kahala computer game regarding playability and engagement. During the Kahala game sessions, participants' comments and the assistance levels were recorded and analyzed. Results showed that participants had fewer difficulties over time. Positive indicators of engagement were more frequent than negative ones, and participants' comments indicated interest and immersion in the game. However, some elements need refinement, such as improved story presentation and inclusion of a practical tutorial. Despite the need for adjustments, the game was considered engaging and suitable for the target audience. The third study evaluated the effects of Kahala computer game to teach autistic children to meet others' needs according to a specific context. Data from the game sessions and pre-test were analyzed in comparison with the posttest. Results showed an increase in QACEC scores for two of the three participants, who also demonstrated better performance in the Coloring Situation and the Rainbow Hunters board game. The data indicates that the Kahala digital game is effective in teaching the class "meeting others' needs". Nevertheless, further improvements in game design are necessary to enhance engagement and understanding of the story, as well as adjustments to progression criteria to better reflect players' learning.

Keywords: empathy; empathic behavior; computer games; programming learning; programming of conditions to development of behaviors; autistic children

LISTA DE FIGURAS

Study 1

Study 2

Study 3

Annexes

LISTA DE TABELAS

Study 1

Study 2

Study 3

Appendices

Annexes

SUMÁRIO

Overview

Empathy is a complex and comprehensive social behavior that, once learned, can function as a behavioral cusp for other repertoires (Del Prette & Del Prette, 2005; Eiterer et al., 2023a; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992). The relevance of teaching empathetic behaviors to children is recorded in the literature. Teaching these behaviors can contribute to learning other social behaviors, as well as decrease gaps in social repertoires in autistic individuals (Del Prette & Del Prette, 2005). Among empathy's prerequisites, “meeting others' needs” is the least comprehensive behavior class to “responding verbally and non-verbally according to the specific context” (see Eiterer et al., 2023a). This class of behavior is a prerequisite and precursor to most behaviors that constitute empathy (Eiterer et al., 2023a). Like other empathetic prerequisite behaviors, learning to “meet others' needs” can function as a behavioral cusp to develop other social behaviors (Del Prette & Del Prette, 2005). Teaching autistic children to meet others' needs helps them in everyday social functioning and increases the likelihood of developing friendships (Argott et al., 2017).

Games can be used to teach new behaviors and improve existing repertoires (e.g., Gris & Souza, 2016; Perkoski et al., 2018; Perkoski & Souza, 2015; Suzuki & Souza, 2022). Games can improve engagement with activities and, consequently, the skill development of those who use them (Gris & Souza, 2016; Linehan et al., 2009; Perkoski & Souza, 2015). The Kahala game (Eiterer & Souza, 2021) was developed using behavior-analytic principles. The first version was a board game designed to teach eight prerequisite empathy behaviors, but it was too complex for the target audience (Eiterer, 2021). Therefore, a new version was designed to teach the behavior class “meeting others' needs”. However, there were still few studies that evaluated its effectiveness for teaching empathetic behaviors to autistic children.

Evaluating educational games requires a multidisciplinary approach (Bruckman, 1999; Drachen et al., 2018; Gris et al., 2018; Perkoski & Souza, 2015). Since they have an educational purpose, it is necessary to evaluate their effectiveness in teaching target behaviors (Bruckman, 1999; Gris et al., 2018; Suzuki & Souza, 2022). However, games need to be fun and promote engagement through natural reinforcement, even if they have an educational function (Bruckman, 1999; Panosso et al., 2015; Suzuki & Souza, 2022). To evaluate player's experience, game-user researchers propose analyzing playability and player engagement (Drachen et al., 2018; Korhonen, 2016).

This paperwork, composed of three studies, addresses the development and evaluation of the Kahala computer game. Study 1 describes the development of the Kahala computer game, using behavior-analytic principles to teach the behavior class “meeting others' needs” to autistic children. The game's scenario is set in a post-apocalyptic city, where players must identify the needs of non-player characters (NPCs) and share resources with them. The quests are organized into four sets, each focused on a specific target behavior. The game was developed in JavaScript and can be accessed via an internet browser. Study 2 evaluated the players' experience in terms of playability and engagement. Three autistic children participated in four playtest sessions. The results indicated that playability difficulties decreased over time and that participants showed interest and immersion in the game, although some elements need refinement. Study 3 evaluated the effectiveness of the Kahala game in teaching the class “meeting others' needs”. Three children participated in four intervention sessions, with positive results in posttest activities compared to pretest, indicating that the game is effective in teaching its target behaviors. However, improvements in the game design are suggested to increase engagement and understanding of the story.

Study 1: Development of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs[1]

[1] This study was developed in co-authorship with doctoral student Poliana Fernandes Mesquita Sanches from the Programa de Pós-graduação em Análise do Comportamento at the Universidade Estadual de Londrina

Eiterer, P. (2025). *Desenvolvimento do Jogo Digital Kahala para Ensino da Classe de Comportamentos "Atender às Necessidades do Outro" a Crianças Autistas.* Tese. Programa de Pós-graduação em Análise do Comportamento, Universidade Estadual de Londrina – PR.

Resumo

A classe "atender às necessidades do outro" é pré-requisito e precursora da maioria dos comportamentos que constituem a empatia. Aprender a "atender às necessidades do outro" pode funcionar como cunha comportamental para desenvolver outros comportamentos sociais. Ensinar crianças autistas a atender às necessidades dos outros auxilia em seu funcionamento social diário e aumenta a probabilidade do desenvolvimento de amizades. Jogos têm se mostrado ferramentas eficazes para ensinar comportamentos sociais, podem contribuir para melhorar o engajamento dos aprendizes e o desenvolvimento das respectivas habilidades-alvo. Após revisar o jogo Kahala (Eiterer & Souza, 2021), uma nova versão foi desenvolvida para ensinar a classe de comportamentos "atender às necessidades do outro". Este estudo descreve o desenvolvimento do jogo digital Kahala para ensino dessa classe. O jogo foi criado com base nos princípios da Análise do Comportamento para ensinar comportamentos empáticos a crianças autistas. Para tanto, o jogador deve completar missões dadas por personagens não-jogadores (NPCs), que requerem identificar as necessidades dos NPCs e compartilhar recursos adequadamente. As missões são organizadas em quatro conjuntos, cada um focado em um comportamento-alvo específico. O cenário do jogo é uma cidade pós-apocalíptica, onde o jogador deve coletar recursos como água, comida, roupa e medicamento para ajudar os NPCs. O progresso é monitorado por uma barra de confiabilidade, que aumenta ou diminui com base nas ações do jogador. O jogo foi desenvolvido em JavaScript usando o framework Phaser 3. Por isso ele é acessível via navegador e sua distribuição é facilitada. A estética e a mecânica do jogo foram projetadas para serem intuitivas e semelhantes a outros RPGs, o que ajuda a reduzir a curva de aprendizado dos jogadores. Jogos digitais podem auxiliar na introdução do ensino de habilidades sociais e pode facilitar a posterior transição para a intervenção interpessoal. Validar um jogo digital para ensino de comportamentos sociais pode ser especialmente vantajoso na intervenção com crianças autistas.

Palavras-chave: empatia; jogos digitais; programação de ensino; programação de condições para desenvolvimento de comportamentos; game design

Eiterer, P. (2025). *Development of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs.* Doctoral Thesis. PhD in Behavior Analysis, Universidade Estadual de Londrina, Londrina – PR.

Abstract

The behavior class "meeting others' needs" is a prerequisite and precursor to most behaviors that constitute empathy. Learning to "meet others' needs" can function as a behavioral cusp for developing other social behaviors. Teaching autistic children to meet others' needs helps in their daily social functioning and increases the likelihood of developing friendships. Games have proven to be effective tools for teaching social behaviors and can contribute to improving learner engagement and developing their respective target skills. After reviewing the Kahala game (Eiterer & Souza, 2021), a new version was developed to teach the behavior class "meeting others' needs". This study describes the development of the Kahala computer game to teach this class. The game was created based on Behavior Analytic principles to teach empathetic behaviors to autistic children and requires the player to complete missions given by NPCs (non-player characters), which involve identifying the NPCs' needs and sharing resources appropriately. The missions are organized into four sets, each focused on a specific target behavior. The game's scenario is set in a post-apocalyptic city, where the player must collect resources such as water, food, clothing, and medicine to meet the needs of the NPCs. Progress is monitored by the Trust Bar, which increases or decreases based on the player's actions. The game was developed in JavaScript using the Phaser 3 framework, making it accessible via an internet browser and facilitating its distribution. The game's aesthetics and mechanics were designed to be intuitive and similar to those of other role-playing games (RPGs), thereby reducing the learning curve for players. As a precursor to interpersonal interventions, digital games can enhance early social skills training. Validating a digital game for teaching social behaviors can be particularly advantageous in interventions with autistic children.

Keywords: empathy; empathic behavior; computer games; programming learning; programming of conditions to development of behaviors; game design

The Kahala (Eiterer & Souza, 2021; Eiterer et al., 2023b) is an educational game designed to teach children empathetic behaviors. Among empathy's prerequisites, “meeting others' needs” is the least comprehensive behavior class to “responding verbally and non-verbally according to the specific context” (see Eiterer et al., 2023a). This class is a prerequisite and precursor to most behaviors that constitute empathy (Eiterer et al., 2023a). Learning to “meet others' needs” can function as a behavioral cusp to develop other social behaviors (Del Prette & Del Prette, 2005). Teaching autistic children to meet others' needs helps them in everyday social functioning and increases the likelihood of developing friendships (Argott et al., 2017). Games have been demonstrated as effective tools to teach social behaviors (Almeida et al., 2019; Benevides & Souza, 2020; Gresham, 2016; Perkoski, 2015; Sanches, 2024; Skaraas et al., 2018; Sosnowski et al., 2021; Wu et al., 2020). They can contribute to improving the engagement of those who use them and, consequently, their skill development (Gris & Souza, 2016; Linehan et al., 2009; Perkoski & Souza, 2015). Kahala’s first version was a board game designed to teach eight prerequisite empathy behaviors (see Eiterer, 2021). However, it was considered too complex for the target audience by the Eiterer’s (2021) examining board, as it had too many stimuli and aimed to teach many behaviors simultaneously. Therefore, a new version was designed. This study describes the development of the Kahala computer game to teach the behavior class “meeting others' needs” to autistic children.

Eiterer et al. (2023a) found 46 empathetic behaviors, which were grouped into two comprehensive behaviors: (1) Evaluating a specific context; and (2) Responding verbally and non-verbally according to a specific context. Annex A presents the decomposition diagram made by Eiterer et al. (2023a). Considering the existence of materials available for teaching behaviors related to “evaluating the specific context” (e.g., Almeida et al., 2019; Sosnowski et al., 2021), the present study focused on prioritizing the prerequisites of

“responding verbally and non-verbally according to the specific context” when selecting the game's target behaviors.

“Meeting others' needs” is the least comprehensive class in “responding verbally and non-verbally according to relevant characteristics of the specific context” (Eiterer et al., 2023a), and it has two prerequisite behaviors: “identifying others' needs” and “sharing resources with others according to the specific context” (Eiterer et al., 2023b). Social behaviors are complementary and can function as behavioral cusps for each other, facilitating the learning of more comprehensive behaviors (Del Prette & Del Prette, 2005). For example, a child who can identify others' needs and share relevant items will likely be more capable of resolving conflicts during playtime, engaging in collaborative activities, and forming meaningful relationships with peers.

When designing teaching programs, target behaviors should progress from the least to most comprehensive (Cortegoso & Coser, 2011; Skinner, 1968/2003). So, successive approximations are reinforced until the final target behavior is acquired (Cortegoso & Coser, 2011; Skinner, 1968/2003). To demonstrate the more comprehensive behaviors from the class “responding verbally and non-verbally according to relevant characteristics of the specific context”, the individual should first learn its less comprehensive behaviors. Due to a lack of programs to teach these behaviors (Sanches et al., 2024), it is still necessary to develop a program that targets the less comprehensive behaviors.

Learning this behavior class is especially important to autistic children, because their diagnosis includes persistent deficits in social communication and social interaction in multiple contexts (American Psychiatric Association [APA], 2022). Considering that empathy is learned through social interaction (Del Prette & Del Prette, 2005; Eiterer et al., 2023a), it is expected that autistic individuals may have gaps in their empathetic repertoire (Argott et al., 2017; Gena et al., 1996). Teaching them social behaviors in structured settings

has been demonstrated to be effective in reducing those gaps (Argott et al., 2017; Ng et al., 2016; Sivaraman, 2017; Vettorazzi et al., 2005; Yun et al., 2017).

Autistic individuals often struggle with understanding disguised mands and appropriately sharing items according to others' needs (Argott et al., 2017). Sometimes, these gaps can lead their peers to judge them as “inconsiderate” because, as listeners, they often don't know how to reinforce disguised mands (Argott et al., 2017). For example, when another child compliments an autistic child's toy, the autistic child might respond with a polite “thank you” instead of sharing it, which can be frustrating to the other child. Teaching autistic children to meet others' needs is not only relevant to everyday social functioning, but it also increases the likelihood of them bonding with those people they meet daily (Argott et al., 2017).

Using interactive tools in educational settings enhances children’s motivation and active participation in learning (Alotaibi, 2024; Sousa et al., 2023; Utami et al., 2025). Features such as game story, player's score, bonus, and instant feedback are effective in selecting and reinforcing target behaviors in educational settings (Gentile et al., 2009; Sousa et al., 2023; Utami et al., 2025). Interactive tools can help children in developing cooperation, empathy, problem-solving, and critical thinking skills (Alotaibi, 2024; Sousa et al., 2023; Utami et al., 2025).

Gresham (2016) observed that among the interventions to teach social skills, those involving cooperative games with autistic individuals had the most meaningful results. Other authors have noted that behaviors learned through cooperative games are more likely to generalize to other settings, as these types of games require social interaction (Castro et al., 2017; Kilmer et al., 2023; Salen & Zimmerman, 2004). Even though Kahala is a computer game, the player should share items with NPCs throughout all rounds. The whole gameplay is based on the player cooperating with characters that represent other human beings in the

game context. Therefore, Kahala has cooperative features, but contingencies to improve generalization to other contexts should still be planned.

Moreover, many hours of intervention are usually prescribed to autistic children, and they're not always able to receive the recommended amount (Hiniker et al., 2013). Due to financial and/or logistical issues, taking on a high-intervention workload can be unfeasible for their families as well (Choi & Limb, 2010; Hiniker et al., 2013). Games could be interesting tools to help supplement intervention hours (Choi & Limb, 2010; Hiniker et al., 2013). Games can be a less costly form of intervention, as they allow for teaching in contexts outside the clinic (Choi & Limb, 2010; Hiniker et al., 2013).

Different tools for teaching empathy's prerequisites have been used, such as: media resources, videos, and cartoons (Baron-Cohen, 2007; Parker, 2003); games (Franklin Learning Systems, 2006; Gardner, 2003); and illustrated books (Curtis, 1998). However, none of them were developed based on the science of Behavior Analysis. Educational materials based on Behavior Analysis can increase the probability of more effective skill development by considering behavior selection and maintenance operant principles for programming teaching conditions (Eiterer, 2021; Linehan et al., 2009; Perkoski et al., 2018; Souza et al., 2019).

The Kahala game (Eiterer & Souza, 2021) was developed using behavior-analytic principles, including pre-defined consequences for specific player responses, progressively increasing complexity, and immediate feedback. The first version was a board game designed to teach eight prerequisite empathy behaviors (see Eiterer, 2021). However, it was considered too complex for the target audience by the Eiterer's (2021) examining board, as it had too many stimuli and aimed to teach many behaviors simultaneously. Thus, it was modified, resulting in the second version (Eiterer et al., 2023b). This version was tested with

neurotypical Brazilian children, who showed improvement in empathy scores, fewer playability difficulties, and positive feedback (Sanches, 2024).

The board game version provided faster feedback on the game's effectiveness as a teaching tool, usability, and engagement. However, a computer-based version is easier to distribute and may be more acceptable among autistic individuals, who often struggle with in-person social skills training and may prefer virtual interactions (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). As a precursor to interpersonal interventions, digital games can enhance early social skills training and facilitate the transition to face-to-face interactions later. The results from Sanches (2024) indicated Kahala's suitability and the feasibility of developing a similar computer game for autistic children aged 8 to 14 years. The Kahala computer game was developed alongside the second board game version, which required more complex resources and a longer development time.

In summary, "meeting others' needs" is a relevant behavior class to be taught to autistic children (Argott et al., 2017; Del Prette & Del Prette, 2005; Eiterer et al., 2023b; Sanches et al., 2024). Games, especially those based on Behavior Analysis, are proven effective for developing social skills (Almeida et al., 2019; Benevides & Souza., 2020; Gresham, 2016; Perkoski, 2015; Sanches, 2024; Skaraas et al., 2018; Sosnowski et al., 2021; Wu et al., 2020). While Kahala board game showed positive outcomes for neurotypical children (Sanches, 2024), computer games could be a more reinforcing way to teach these skills to autistic children. Therefore, the purpose of this study was to describe the development of the Kahala computer game to teach the behavior class "meeting others' needs" to autistic children aged 8 to 14 years.

Game Design

Target Behaviors

The first step to developing an educational technological program is to define the target behaviors, final and intermediate ones (Botomé, 1980; Cortegoso & Coser, 2011; Kienen et al., 2013). The Kahala game (Eiterer et al., 2023b) focus on three target behaviors, the first and second ones are prerequisites to the last one:

1. Identifying others' needs (Behavior 29, Annex A);
2. Sharing resources with others according to the specific context (Behavior 30, Annex A);
3. Meeting others' needs according to the specific context (Behavior 31, Annex A).

All quests in the game were designed to require one of the three target behaviors. The Teaching Contingency Table (Appendix A) categorizes the quests according to each target behavior and describing them according to the three-term contingency. Table 1 shows an example of each target behavior. There are three main columns, each representing a contingency term: the first column describes the antecedent condition, with the quest presented by each NPC (non-player character); the second column describes the player's expected responses in front of each quest; and the third column describes the consequences that should be presented after the appropriate and the inappropriate response. The game contingencies were arranged according to the Teaching Contingency Table (Appendix A), ensuring that all players' responses result in consequences that guide them toward learning the appropriate responses. Table 1 also serves as a guide to maintain consistency in the teaching procedure, allowing others to replicate it with ease.

Table 1

Example of Teaching Contingency Table from Appendix A

Id.	Teaching Antecedent Condition (Quest in the game)	Expected responses from learners	Consequences to be ensured
	Target behavior: Identifying others' needs		
A1	In front of the NPC: "NPC – 'Ow! Ow! I think a spider bit me!'"	* Identify that the other person needs medicine; * Collect a Medicine Token around the board OR pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	* **Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you, I feel much better!"), and +1 point in the Trust Level * **Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
	Target behavior: Sharing resources with others according to the specific context (e.g.: information, knowledge, items)		
B1	In front of the NPC: "NPC – 'I'm thirsty! Could you share some water with me?''	* Collect a Water Token from the board OR pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	* **Appropriate response** Receives a Story Fragment, a Hit Consequence ("Ow, thank you! This is going to help me!"), and +1 point in the Trust Level * **Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
	Target behavior: Meeting others' needs according to the specific context		
C1	In front of the NPC: "NPC – 'Ouch! I tripped during the blackout and hurt my leg! I can't walk.'"	* Identify that the other person needs medicine; * Collect a Medicine Token from the board OR pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	* **Appropriate response** Receives a Story Fragment, a Hit Consequence ("It was really nice of you to do that. Thank you!"), and +1 point in the Trust Level * **Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

The Kahala consists of 24 quests, distributed into four sets, with each set designed to teach one of the target behaviors. These sets were designed according to the Principle of Small Steps (*Princípio dos Pequenos Passos* - Botomé, 1980; Cortegoso & Coser, 2011). The behaviors were arranged to start with the least comprehensive behavior (Set 1) and progress to the most comprehensive (Sets 3 and 4) to minimize the likelihood of errors and increase teaching effectiveness.

There are no topographical differences for the player's action across the sets. The main difference between the sets lies in the way the quests' content was designed. While the quests in Sets 1 and 2 are more concise and focus on identifying and sharing items, the quests in Sets 3 and 4 require a higher level of interpretation. Set 1 was designed to require the behavior “identifying others' needs”. Its quests consist of concise sentences designed to highlight whether a non-player character (NPC) is in need. Set 2 required the player to “share resources with others according to the specific context”. The item to be shared with each NPC is explicitly mentioned in the quest. Sets 3 and 4 were both designed to require the player to “meet others' needs according to the specific context”. Since this is the most comprehensive target behavior, its quests are presented twice to allow for more exposure to the teaching condition. These quests are longer excerpts in which the NPC contextualizes what happened to them, and the player should interpret which item would be most suitable to meet the NPC's needs according to the context described.

Quests were designed to function as the antecedent stimulus for target responses in all sets. The player can respond in three different ways when they get a quest: share the correct item, share the incorrect item, or ignore the quest. NPC’s quest is the in-game stimulus that sets the occasion for the appropriate response to occur. As the player interacts with the game, it is expected that the frequency of sharing the correct item increases. Three

consequences were designed to increase the correct response. When they share the correct item, the player gets one point of trust, a Hit Consequence (e.g., “Thank you! I feel much better!”), and a Story Fragment (e.g., “People started disappearing! But the authorities did nothing.”), as provided in the Teaching Contingency Table (Appendix A). These should function as reinforcement for the correct response, thus increasing its frequency. There are also two corrective consequences to reduce incorrect responses. When the *item is incorrect*, the player gets the Error Consequence, which results in losing one point of trust and receiving the Error message (i.e., “Oops! I don't need that now”). When the player *ignores the quest*, they get the Attempt Consequence, losing one point of trust and receiving the Attempt message (i.e., “It seems like you're busy and can't help me now”). These two types of corrective consequences should function as a punitive stimulus for incorrect responses, thus decreasing their frequency.

Player's Experience

Nielsen's Heuristics, including visibility of system status, alignment with real-world interaction, and consistency, guided decisions in player's experience design (Nielsen, 1994/2024; Nielsen & Molich, 1990). These principles help optimize visual elements for player-game interaction. The Kahala game features user interface elements, including the Quest Board, Trust Bar, and Inventory (Figure 1), to enhance the player's experience.

In the Quest Board (Figure 1, Item A), located on the screen’s left border, the last status of each quest is recorded. Those that have already been completed are marked in green, and those that still need to be completed are marked in red. If the player clicks on an NPC from the Quest Board, the last information that NPC said in the round is played again. Additionally, the Trust Bar (Figure 1, Item B), which ranges from 0 to 10, tracks the player's

trust level. Every correct response increases the Trust Bar by one point, and every incorrect response decreases it by one point. Using the Quest Board and Trust Bar to display game status can enhance player engagement by providing their quest progress and facilitating strategic planning to complete the main quest (Nielsen, 1994/2024; Nielsen & Molich, 1990).

Figure 1

Sample of a quest assigned by an NPC in the computer game (D) and flagging other game elements: Quest Board (A); Trust Bar (B); and Inventory (C)

The collectible items (i.e., water, food, clothing, and medicine) are designed to resemble everyday objects, thus ensuring that game elements are intuitive and easily recognizable to the player. This correspondence improves the game's approachability, since the player doesn't need to learn the function of each game element from scratch (Nielsen, 1994/2024; Nielsen & Molich, 1990). For example, when the player sees an apple, they can easily understand that it is something people eat when they are hungry.

Integrating features from other role-playing games (RPGs) helps users manage the difficulties of approachability. Displaying NPC dialogues at the bottom of the screen, using keyboard arrows to move the character around the map, and inventory mechanics are usually essential features of digital RPGs that were implemented in the Kahala computer game. Players with experience in this kind of game can quickly identify similarities and guess some game rules even when they are not explicitly stated. This consistency enables users to generalize their learned responses across systems (Catania, 1998/1999; Cooper et al., 2020; Nielsen, 1994/2024). Generalization prevents errors and shortens the user's learning curve when accessing a system for the first time (Catania, 1998/1999; Cooper et al., 2020; Nielsen, 1994/2024).

Technology

Phaser 3 was used to develop the Kahala computer game. It is an HTML5 game development framework based on JavaScript. Choosing the technology was mainly motivated by the benefits associated with accessibility and customization of specific game features.

Accessibility

Phaser is available for free download, and its documentation can be found online on the official website. Moreover, games developed with Phaser can be played directly in the browser, and there is no need to download a specific executable file. This eliminates the need for complex URL structures and simplifies hosting the game in the cloud. This favors the game's distribution for use in various settings, such as clinics or at home.

Customization

Developing the game in JavaScript means coding every game mechanic from scratch. This is beneficial because pre-configured platforms (e.g., RPG Maker) are limited in what can be customized. While other tools with a high degree of customization exist, they also require a lot of practice, which makes them unfeasible for the scope of this study. For educational games, specific customizations could enhance teaching effectiveness. Customization was key in developing the Kahala computer game to closely match its board analog version. Using Phaser made it feasible to implement user interface features like the Quest Board, Trust Bar and Inventory, which are essential to enhance the player's experience.

Kahala Computer Game

Story

The game map simulates a city in a post-apocalyptic scenario to highlight the benefits of maintaining a good relationship with others. The game's post-apocalyptic scenario was triggered by a series of events, including global warming, increased rainfall, and droughts. In the game context, all these events had a significant impact on food production, resulting in food shortages for a large portion of the population. Then, some authorities, called “world leaders”, formed the Global Forces Alliance (GFA) to solve the issues related to global warming and climate change. Following a long period of hunger and mysterious disappearances of people, the GFA launched a space expedition to take the population to Mars. Once there, the living conditions on Mars improved and became better than on Earth, but only very rich people were sent to Mars. Most of the population remained on Earth suffering from food scarcity. Because of this, the remaining population became outraged, and their revolt led to a space war between humans who were on Earth and those who were on Mars. This war between humans lasted three years, until the day a missile hit the Sun,

causing a solar storm. This storm caused an electrical blackout on Earth, which ended almost all means of communication.

The solar storm caught the attention of extraterrestrials from other galaxies, and armies began to arrive from all parts of the universe to colonize the planets of our solar system. After a period of resistance, the extraterrestrials invaded the Earth. During the game's timeframe, there are bunkers where the characters can access resources and can be rescued by the GFA ships to live on Mars. In order to enter these bunkers, it is necessary that the player proves to the bunker managers that they are trustworthy.

During an apocalyptic scenario, significant changes occur as resources become scarce and fewer individuals remain to interact with. When talking about the hostile environment of everyday life, Sidman (1989) states that "we pay specialists to act as buffers between us and nature" (p. 33). In a post-apocalyptic scenario, survivors must manage resources without specialists and address new environmental challenges. For example, with food delivery apps, people are already used to having access to food without having to move or interact with other people. However, in a post-apocalyptic scenario, the player's character will need to go out looking for water, food, medicine, and clothing to help NPCs and win the game.

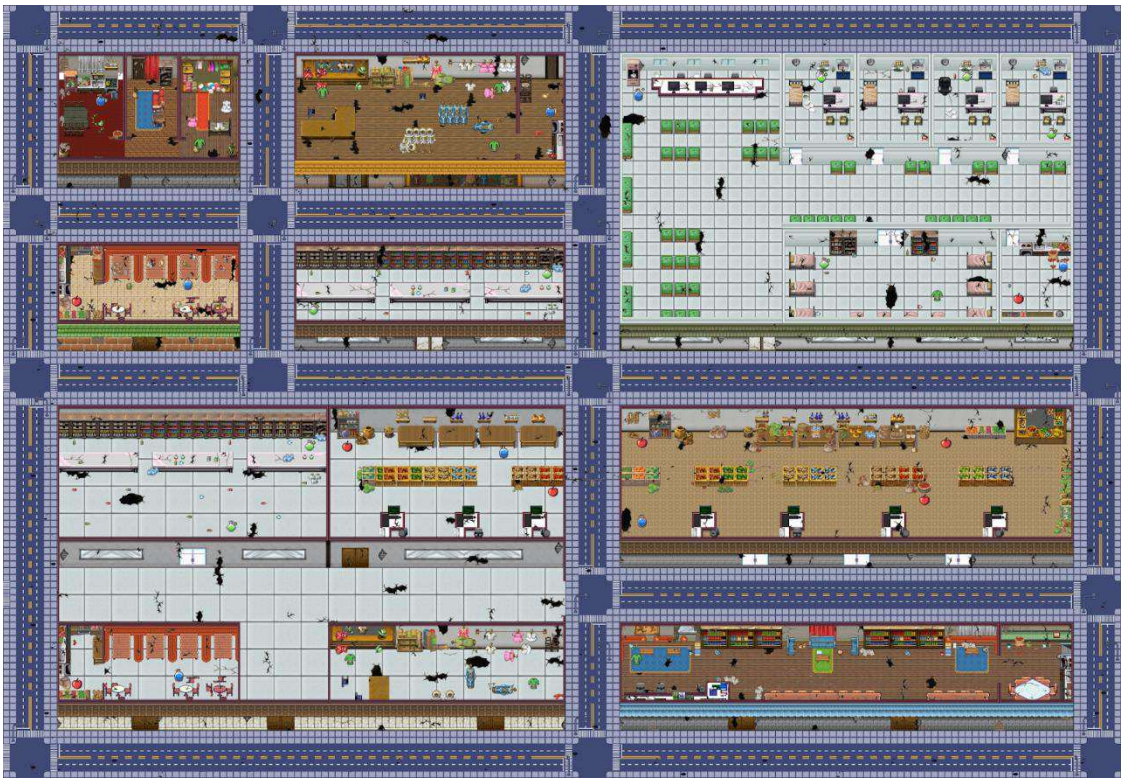
Throughout the gameplay, the player needs to act according to the game's target behaviors to help the people they meet along the way. The player will get a fragment of the game's story for completing the quests. Thus, they will have access to more of the narrative as they complete quests. The more they learn about the story, the more likely they will be able to understand the problems that the game characters are facing. This was arranged in such a way as to increase the likelihood of players sharing the required items with NPCs throughout the gameplay and learning to meet others' needs.

Aesthetics

The game map (Figure 2) consists of streets and abandoned buildings. It is positioned on the screen with a 1.5x zoom and always only shows the portion where the player's character is located. The buildings are: Hector's House (where the game begins), clothing store, pharmacy, cafe, hospital, grocery store, shopping mall, library, and bunker (where the game ends). The streets are filled with cracks, broken items, and signs of destruction. Some elements (e.g., walls, tables, chairs) function as obstacles for the player, so that they are forced to take alternative paths. Figure 2 shows the complete game map, with the collectible resources.

Figure 2

Kahala's map



Inside the buildings, there are places where the player can collect items (i.e., water, food, clothing, and medicine) according to the corresponding function of that place. For

example, in a hospital, there is a higher probability of finding medicine than clothing and food. In each round, there is a set of eight NPCs distributed throughout the map. All NPCs represent people who live in the city where the game's story takes place. When the player collects resources from the map, they are automatically stored in an inventory located at the top of the screen (Figure 1, item C).

Eight NPCs are automatically distributed throughout the map in each round, according to the set selected at the beginning of the session (i.e., Set 1, 2, 3, or 4). When the player approaches an NPC, an audio message is played with information about the quest that must be completed to meet that NPC's needs. Simultaneously, a written transcription appears on the screen containing the same information as the audio message (Figure 1, item D). The aesthetics of other NPC dialogues in the game are similar (e.g., Survivor Message, Error Consequence, etc.).

Technology

The game consists of: two player's characters (i.e., one male and one female); 24 NPCs, presented in three different sets of eight NPCs each; one Trust Bar; one inventory; 32 items (i.e., eight food, eight water, eight clothing, and eight medicine); and 77 pieces of information provided by the NPCs (Appendix B), including one Survivor Message, one Rules Message, 24 Quests, one Error Consequence, one Attempt Consequence, 24 Hit Consequences, 24 Story Fragments, and one End Game Consequence.

Mechanics

On the game's initial menu (Figure 3), the player can choose if they prefer to play with a female or male character and select the NPCs set to be played. To navigate in the game, the player moves the character around the map using keyboard commands. At the beginning of the round, the player hears the Survivor's Message:

"Hello? Over? Is anyone listening to me? Wow… it's great to be able to talk to you! ... This is Hector speaking… Are you at my house? I don't know if you remember… Yesterday we were playing outside when there was a very loud bang… no one knows what's going on! Lucas, Maria and I woke up in a bunker in the basement of the library… I didn't even know there was a bunker here… right in front of the mall… Radio waves, TV, and cell phones are all interfering… The service is spotty. It keeps going in and out. You can't trust communication means. Luckily, we were playing with walkie-talkies! One of the radios stayed there and the other one is with us. That's how we're able to talk! There are plenty of resources here… it seems like they were waiting for something to happen! There's food… water… medicine… clothing… And it seems like we're going to another place that's even safer! Come here too! We're waiting for you here… The people guarding the bunker door are suspicious of everyone, but I told them you were coming here! You just need to prove they can trust you… But come here soon, it's safe here! We're … waiting for you!"

Figure 3

Kahala's initial menu

After that, the Rules Message is played back by audio:

> “The bunker guards have created new rules for accepting people here. They are very suspicious, and you need to prove that you are worthy of entering. I will give you some instructions on what you need to do. To enter the bunker, you need to complete all the tasks. Each completed task increases your trust level, which is reflected in the Trust Bar. That's how the guards find out if they can trust you! So first you must complete all the tasks. Only afterward can you come to the bunker. This is a safer place inside the library. If a task is not completed immediately, use the time you need to complete it before starting another task. Remember to finish one task before you start another. If you try to start another task before completing the one you are working on, you will lose one point of trust. And if you can't complete the tasks, you'll also lose a point. The bunker guards are strict! Talk to the people you meet along the way! Each person has different types of problems, and you need to help solve them. And be smart… There are guards along the way… watching you. They are attentive to everything you do to see if they can trust you. Oh…To enter and exit places, don't go through walls and windows. You can't get hurt! Any injury can become a big problem now!”

After playing back both messages described above, the player's character is placed in Hector's House, surrounded by a bed and two walls. They can only exit in one direction, where they will for sure collect a clothing token. The player can start moving around the map by choosing to collect the remaining resources in Hector's House or by leaving through the door. When the player's character comes in contact with a resource on the map, that resource is automatically added to the player's inventory. The character cannot pass through walls, windows, or furniture. They must move through the corridors, streets, and doors

marked on the map. When the player's character walks in buildings where there are resources, the player can collect them or leave them on the map.

When the player's character comes in contact with an NPC, an audio message is played presenting a quest to be completed by the player. Simultaneously, the written transcription of the quest appears on the screen. To complete the quest, the player must collect the corresponding item on the map, click on the inventory where the item is located, and come in contact with the NPC again. When the selected item is correct, the quest is completed. When the resource is incorrect, the quest remains incomplete. All information provided by NPCs is automatically played in audio and simultaneously transcribed on the screen. As the player completes quests, the NPC picture on the Quest Board is automatically changed to green. Once all quests are completed, the player can direct their character to the bunker. To complete each quest, the player can (a) take the necessary item from their inventory and deliver it to the NPC, or (b) if they do not have it in their inventory, they can collect it on the map and deliver it to the NPC. Table 2 contains the quests and their identifications.

Table 2

Description of the Quests presented by the NPCs

Id.	Quests presented by the NPCs
A1	Ow! Ow! I think a spider bit me!
A2	My son isn't wearing a shirt, because after the blackout we ran out of the house to go to the Bunker. And he is getting sunburned. How can you help him?
A3	Wow, my mouth is so dry, I don't feel very well... Could you help me?
A4	It's been so long since I ate anything... My stomach is growling, and I'm feeling weak.
A5	I hurt myself in the last earthquake! I think I twisted my ankle. It hurts a lot!
A6	My clothes are all torn, and I'm getting sunburned. Can you help me?
A7	I'm so thirsty... I feel dehydrated... If only someone could help me!
A8	I haven't eaten anything since yesterday...

(to be continued)

Table 2 (continuation)
Description of the Quests presented by the NPCs

Id.	Quests presented by the NPCs
B1	I'm thirsty! Could you share some water with me?
B2	Could you give me some food? I haven't eaten for so long, I feel weak…
B3	I'm getting sunburned. I don't have enough clothes to protect myself. Could you give me some clothes?
B4	Wow… I have a fever and I feel sick. I think I ate something that was contaminated. Do you have any medicine to give me?
B5	Could you give me some water? I'm so thirsty!
B6	Wow, I'm hungry! Could you share some food with me?
B7	I'm feeling very hot. All my clothes are for cold weather. Do you have any clothes to give me?
B8	I tripped during the blackout! I scraped my knee, and I'm bleeding a lot. Could you give me some medicine?
C1	Ouch! I tripped during the blackout and hurt my leg! I can't walk.
C2	I need to go to the hospital and find my friends, but I can't walk! I'm feeling weak…
C3	Wow, after the blackout, a lot of people from Kahala disappeared. I'm looking for my friends, that's why I haven't gone to the bunker yet. If you could give me some food, I would be very grateful! I can't leave here, because I believe my friends are coming, and I don't want to lose them again!
C4	Can someone help me? I'm so thirsty!
C5	After the blackout, my house was destroyed. I couldn't go back there to get clothes… The sun is so hot during the day. Long-sleeved shirts would protect me from getting sunburned!
C6	Wow… I'm so weak and my mouth is so dry. My vision is getting blurry.
C7	When the blackout happened, I was at the pool with my friends. I couldn't go back home to get clothes, so I'm in a swim-suit! I'm getting sunburned. I can't stay like this!
C8	I got separated from my family. I've been looking for hours and can't find anyone. I think they're in this bunker. But my legs are hurting so bad… I can't even walk anymore.

The 24 NPCs are divided into three sets of 8 NPCs each (i.e., NPCs A, NPCs B, and NPCs C). NPCs A's quests refer to the target behavior "Identifying others' needs (e.g., information, knowledge, items)". NPCs B's quests are related to the target behavior "Sharing resources with others according to the specific context (e.g., information, knowledge, items)". NPCs C's quests are related to the target behavior "meeting others' needs according

to the specific context". Sets 1, 2, and 3 are respectively related to target behaviors A, B, and C. Set 4 is a replication of Set 3, so its quests are also related to the target behavior C.

Quests were planned so that all items were demanded an equal number of times throughout the game. At the end of the four rounds, six quests are completed with each type of item. The NPCs are positioned in places where the item needed to complete the quest is not present or is far away, so the player needs to move to collect it or remove it from their inventory. Table 3 presents: quests' distribution per round; NPCs' locations; and the resources needed to complete each quest.

Table 3

Distribution of quests by round and by location

Round	NPC's ID	NPC's Locations	Resource Needed
1	A1	Clothing Store	Medicine
	A2	Mall (Cafeteria)	Clothing
	A3	Hospital	Water
	A4	Mall (Pharmacy)	Food
	A5	Market	Medicine
	A6	Snack Bar	Clothing
	A7	Pharmacy	Water
	A8	Library	Food
2	B1	Pharmacy	Water
	B2	Hospital	Food
	B3	Mall (Corridor)	Clothing
	B4	Mall (Clothing Store)	Medicine
	B5	Library	Water
	B6	Clothing Store	Food
	B7	Market	Clothing
	B8	Snack Bar	Medicine
3	C1	Market	Medicine
	C2	Clothing Store	Food
	C3	Hospital	Food
	C4	Mall (Clothing Store)	Water
	C5	Mall (Pharmacy)	Clothing
	C6	Pharmacy	Water
	C7	Mall (Corridor)	Clothing
	C8	Library	Medicine

(to be continued)

Table 3 (continuation)

Distribution of quests by round and by location

Round	NPC's ID	NPC's Locations	Resource Needed
4	C1	Market	Medicine
	C2	Clothing Store	Food
	C3	Hospital	Food
	C4	Mall (Clothing Store)	Water
	C5	Mall (Pharmacy)	Clothing
	C6	Pharmacy	Water
	C7	Mall (Corridor)	Clothing
	C8	Library	Medicine

The player's main quest is to unlock the bunker after completing all NPCs' quests. The player wins and the round ends when they safely reach the bunker. The player is defeated and the round ends when the Trust Bar reaches zero level.

Discussion

Behavior-analytic research has demonstrated that games can contribute to improving engagement and behavior learning (Gris & Souza, 2016; Perkoski et al., 2018; Perkoski & Souza, 2015; Suzuki & Souza, 2022). Kahala's adherence to behavior-analytic learning principles has allowed the operant principles to guide the game's development and may contribute to increasing the likelihood of effectively teaching the target behaviors (Botomé, 1980; Cortegoso & Coser, 2011; Kienen et al., 2013).

The Kahala (Eiterer & Souza, 2021; Eiterer et al., 2023b) was planned in such a way that all behaviors were previously analyzed in the Teaching Contingency Table (Appendix A) and were described according to the three-term contingency (Eiterer, 2021). The quests in the game function as an antecedent stimulus for the player's response, and the consequences are foreseen both for correct and incorrect responses. Thus, all the player's actions are followed by immediate consequences that allow them to consistently identify the appropriateness or inappropriateness of their response to the context. This approach follows

the Principle of Immediate Verification (*Princípio da Verificação Imediata)* and enhances teaching effectiveness by minimizing persistent learner errors (Botomé, 1970; Cortegoso & Coser, 2011; Skinner, 1968/2003). Players need to properly complete all quests in each round to win the Kahala game. In this case, in addition to receiving differential consequences depending on their actions, the player also repeatedly comes into contact with the same antecedent stimulus until they respond appropriately. This repetition increases the likelihood of effectively developing target behaviors, as it is essential for the learner to engage in the correct response to advance in the teaching program (Botomé, 1980; Cortegoso & Coser, 2011; Skinner, 1968/2003).

It should also be noted that the quests in the game are categorized into sets, based on the targeted behavior they require. The game is designed such that players get access to one quest set at a time, which are presented according to their level of comprehensiveness. This structure follows the Principle of Small Steps (*Princípio dos Pequenos Passos*), which suggests a gradual increase in the difficulty of the tasks provided. The goal of this approach is to minimize the likelihood of errors by the learner throughout the learning process (Botomé, 1970; Botomé, 1980; Cortegoso & Coser, 2011; Skinner, 1968/2003).

Even though the player's actions are topographically identical in all sets, the quests were designed so that there would be variations in the information provided by NPCs. Quests from Set 1 are short sentences focused on showing the player that the NPC is in need, quests from Set 2 explicitly mention the item needed, and quests from Sets 3 and 4 are longer excerpts in which the NPC contextualizes what led them to be in need. It is expected that autistic individuals have persistent deficits in social communication (APA, 2022). The quests' progression gradually adds properties to the antecedent stimuli, contributing to teaching communication's nuances in small steps. It could minimize autistic children's

difficulties in understanding mands and disguised mands due to gaps in communication repertoires. Through these quests, it could be possible to teach both understanding others' mands and sharing items accordingly.

Teaching social behaviors to autistic children in structured settings has been demonstrated to be effective in reducing gaps in empathetic repertoire (Argott et al., 2017; Ng et al., 2016; Sivaraman, 2017; Vettorazzi et al., 2005; Yun et al., 2017). By programming teaching through the Kahala computer game, antecedent and consequent stimuli are delivered automatically as designed. This increases the likelihood of maintaining consistency in teaching across different instructors.

Validating a computer game that teaches social behaviors to this target audience can be especially favorable to the development of repertoires. Some autistic individuals report preferring virtual interactions, and others may have deficits in prerequisites for social interaction (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). Interventions with autistic individuals frequently include a focus on basic social behaviors related to eye contact and emotion recognition (Grossard et al., 2017; Sanches et al., 2024). While complex social skills training is also employed in the field, basic social responses often form the foundational target. With these individuals, starting the teaching with these skills in person could make the intervention aversive and unfeasible (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). Computer games could be an introduction to intervention and facilitate the transition to interpersonal intervention later. Social behaviors taught through digital games could function as a behavioral cusp for the development of prerequisite behaviors related to social interaction (Del Prette & Del Prette, 2005; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992). Therefore, as a precursor to interpersonal interventions, digital games can enhance early social skills

training. However, it is also necessary to systematically teach how to generalize those skills to interpersonal relationships (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023).

According to Programming Conditions for Behaviors Development principles, to affirm that a teaching program works for what it proposes to teach, learner responses should be compared before and after the learner using the program (Botomé, 1970; Botomé, 1980; Cortegoso & Coser, 2011; Kienen et al., 2013). The purpose of this study was to describe the development of the Kahala computer game to teach behavior class "meeting others' needs", but other studies are still needed to evaluate player's experience and effectiveness in teaching autistic children the target behaviors.

References

Almeida, L. M., Silva, D. P., Theodório, D. P., Silva, W. W., Rodrigues, S. C. M., Scardovelli, T. A., Silva, A. P., & Bissaco, M. A. S. (2019). ALTRIRAS: A Computer Game for Training Children with Autism Spectrum Disorder in the Recognition of Basic Emotions. *International Journal of Computer Games Technology*, *2019*(1), 1 - 16.

Alotaibi, M. S. (2024). Game-based learning in early childhood education: A systematic review and meta-analysis. *Frontiers in Psychology*, *15*, Article 1307881. https://doi.org/10.3389/fpsyg.2024.1307881

American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders* (5th ed., text rev.). Arlington, VA: American Psychiatric Association Publishing.

Argott, P. J., Townsend, D. B. & Poulson, C. L. (2017). Acquisition and Generalization of Complex Empathetic Responses Among Children with Autism. *Journal of Autism and Developmental Disorders*, 10(2), 107-117.

Baron-Cohen, S. (Director). (2007). The Transporters [DVD]. United Kingdom: Changing Media Development Ltd.

Benevides, R. R. & Souza, S. R. (2020). Desenvolvimento e avaliação do jogo educativo Space Ability: fazendo contato com Aliens: comportamentos sociais acadêmicos. *Revista Perspectivas em Análise do Comportamento*, *10* (2), 203-221. https://doi.org/10.18761/PAC.2019.v10.n2.02

Botomé, S. P. (1970). *Princípios básicos para programação de ensino*. Texto adaptado de um programa reproduzido com a permissão de "Teaching Machines Incorporated – a Division of Grolier Incorporated, instituição a quem pertence o original do qual foi feita a adaptação por Botomé, utilizada exclusivamente para fins didáticos. Texto não publicado.

Botomé, S. P. (1980). *Objetivos Comportamentais no ensino: a contribuição da Análise Experimental do Comportamento*. [Doctoral dissertation, Universidade de São Paulo]. Repositório da Produção USP. https://repositorio.usp.br/item/000710311

Castro, T., Castro, A., Lima, D., & Bjorn, P. (2017). Model Playground for Autistic Children: Teaching Social Skills through Tangible Collaboration. *IEEE 17th International Conference on Advanced Learning Technologies*, 441-445.

Catania, A. C. (1999). Aprendizagem: Linguagem, comportamento e cognição. Porto Alegre: Artmed. (Original work published 1998)

Choi, M. Y., & Limb, C. Y. (2010). *Interactive therapy system design for children with autistic spectrum disorders*. In Kansei Engineering And Emotion Research International Conference, p. 164.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior Analysis* [2ª ed.]. Pearsons.

Cortegoso, A. C, & Coser, D. S. (2011). *Elaboração de programas de ensino: material autoinstrutivo*. São Carlos: EdUFSCar

Curtis, J. L. (1998). *Today I feel silly: And other moods that make my day*. New York, NY: Harper Collins Incorporation

Del Prette, Z. A. P., & Del Prette, A. (2005). *Psicologia das habilidades sociais na infância: Teoria e Prática*. Petrópolis: Vozes.

Eiterer, P. (2021). *Descrição e Planejamento do Ensino de Comportamentos Pré-requisito do Empatizar*. [Master's thesis, Universidade Estadual de Londrina]. https://www.uel.br/pos/pgac/wp-content/uploads/2021/03/Patricia-Eiterer-Souza-Pinto-Descricao-e-planejamento-do-ensino-de-comportamentos-prerequisito-do-empatizar.pdf

Eiterer, P., Kienen, N., & Souza, S. R. (2023a). Sistematização de comportamentos intermediários do empatizar: revisão e proposta de uma sequência para o ensino. *Revista Brasileira de Terapia Comportamental e Cognitiva*, 25, 1–15. https://doi.org/10.31505/rbtcc. v24i1.1715

Eiterer, P., Sanches, P. F. M., & Souza, S. R. (2023b). Kahala (2nd ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Eiterer, P., & Souza, S. R. (2021). Kahala (1st ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Franklin Learning Systems. (2006). Escape from anger island [Game]. Westport, CT: Instant Help Publisher.

Gardner, R. A. (2003). The talking, feeling, & doing game [Game]. Cleveland, OH: Therapeutic Resources Company.

Gena, A., Krantz, P. J., McClannahan, L. E., & Poulson, C. L. (1996). Training and generalization of affective behavior displayed by youth with autism. *Journal of Applied Behavior Analysis*, 29, 291–304.

Gentile, D. A., Anderson, C. A., Yukawa, S., Ihori, N., Saleem, M., Kam Ming, L., Shibuya, A., Liau, A. K., Khoo, A., Bushman, B. J., Huesmann, L. R., & Sakamoto, A. (2009). The effects of prosocial video games on prosocial behaviors: International evidence from correlational, longitudinal, and experimental studies. *Personality and Social Psychology Bulletin*, *35*(6), 752–763. https://doi.org/10.1177/0146167209333045

Gillespie-Lynch, K., Kapp, S. K., Shane-Simpson, C., Smith, D. S., & Hutman, T. (2014). Intersections between the autism spectrum and the internet: Perceived benefits and preferred functions of computer-mediated communication. *Intellectual and developmental Disabilities*, *52*(6), 456-469.

Gresham, F. M. (2016). Social skills assessment and intervention for children and youth. *Cambridge Journal of Education*, *46* (3), 319-332. https://doi.org/10.1080/0305764X.2016.1195788

Gresham, F. M., & Elliott, S. (2008). *Social skills improvement system: Rating scales manual*. Minneapolis, MN: Pearson Assessments.

Gris, G., & Souza, S. R. (2016). Jogos educativos digitais e modelo de rede de relações: desenvolvimento e avaliação do protótipo físico do jogo Korsan. *Revista Perspectivas em Análise do Comportamento*, *7*(1), 114-132. https://doi.org/10.18761/pac.2016.003

Grossard, C., Grynspan, O., Serret, S., Jouen, A. L., Bailly, K., & Cohen, D. (2017). Serious games to teach social interactions and emotions to individuals with autism spectrum disorders (ASD). *Computers & Education*, *113*, 195-211.

Hiniker, A., Daniels, J. W., & Williamson, H. (2013, June). Go go games: therapeutic video games for children with autism spectrum disorders. In *Proceedings of the 12th international conference on interaction design and children* (pp. 463-466).

Kienen, N., Kubo, O. M, & Botomé, S. P. (2013). Ensino programado e programação de condições para o desenvolvimento de comportamentos: Alguns aspectos no desenvolvimento de um campo de atuação do psicólogo. Acta Comportamentalia, 21(4), 481-494. https://www.redalyc.org/pdf/2745/274528983006.pdf

Kilmer, E. D., Davis, A. D., Kilmer, J. N., & Johns, A. R. (2023). *Therapeutically applied role-playing games: The game to grow method*. Routledge.

Linehan, C., Roche, B., Lawson, S., Doughty, M., & Kirman, B. (2009). A behavioural framework for designing educational computer games. Vienna Games Conference: Future and Reality of Gaming.

Ng, A. H. S., Schulze, K., Rudrud, E., & Leaf, J. B. (2016). Using the teaching interactions procedure to teach social skills to children with autism and intellectual disability. American Journal on Intellectual and Developmental Disabili ties, 121(6), 501-519.

Nielsen, J. (1994). *Usability engineering*. Burlington, MA: Morgan Kaufmann.

Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 249-256). ACM Press.

Parker, K. (Producer). (2003). Barney: Happy, mad, silly, and sad [DVD]. New York, NY: WNET.

Perkoski, I. R (2015). Desenvolvimento e avaliação de um jogo educativo para ensino de comportamentos de prevenção do bullying escolar. [Dissertação de Mestrado,

Universidade Estadual de Londrina, Londrina]. Biblioteca Digital. Biblioteca Digital. https://www.uel.br/pos/pgac/wp-content/uploads/2016/01/Desenvolvimento-e 73 avalia%C3%A7%C3%A3o-de-um-jogo-educativo-para-ensino-de-comportamentos-de preven%C3%A7%C3%A3o-do-bullying-escolar.pdf

Perkoski, I. R., Gris, G., & Souza, S. R. (2018). Jogos Educativos: Aspectos Teóricos, Aplicações e Panorama da Produção Nacional por Analistas do Comportamento. In D L. O Vilas Boas, F. Cassas, H. L. Gusso, & P. C. M. Mayer, *Comportamento em Foco 7: ensino, comportamento verbal e análise conceitual* (vol. 7, pp. 50-67). São Paulo: Associação Brasileira de Psicologia e Medicina Comportamental (ABPMC). http://abpmc.org.br/arquivos/publicacoes/15200164548d97054097f6.pdf

Perkoski, I. R., & Souza, S. R. (2015). "O Espião": Uma perspectiva analítico comportamental do desenvolvimento de jogos educativos de tabuleiro. *Revista perspectivas em análise do comportamento*, *6*(2), 74-88. https://10.18761/pac.2015.020

Rezayi, S., Tehrani-Doost, M., & Shahmoradi, L. (2023). Features and effects of computer-based games on cognitive impairments in children with autism spectrum disorder: an evidence-based systematic literature review. *BMC psychiatry*, *23*(1), 2.

Salen, K. & Zimmerman, E. (2004). *Rules of play: game design fundamentals*. Cambridge, MA: MIT Press.

Sanches, P. F. M. (2024). Avaliação do jogo Kahala para ensino de comportamentos pré-requisito do empatizar a crianças. [Master's thesis, Universidade Estadual de Londrina]. https://www.uel.br/pos/pgac/wp-content/uploads/biblioteca/Dissertacao%20Poliana%20Fernandes%20Mesquita%20Sanches.pdf

Sanches, P. F. M., Eiterer, P., & Souza, S. R. (2024). Ensino de Comportamentos Pré-Requisito do Empatizar para Crianças Autistas: uma Revisão de Escopo. *Revista Brasileira de Educação Especial*, *30*(e0098), 1-18.

Sidman, M. (1989). *Coercion and its fallout*. Boston: Authors Cooperative.

Sivaraman, M. (2017). Using multiple exemplar training to teach empathy skills to children with autism. *Behavior Analysis Practice*, *10*(4), 337-346.

Skaraas, S.B., Gomez, J., & Jaccheri, L. (2018). Tappetina's empathy game: a playground of storytelling and emotional understanding. Proceedings of the 17th ACM Conference on Interaction Design and Children, 509-512. https://doi.org/10.1145/3202185.3210765

Skinner, B. F. (2003). *The technology of teaching*. Cambridge, MA: B. F. Skinner Foundation (Original work published 1968).

Sosnowski, D. W., Stough, C. O., Weiss, M. J., Cessna, T., Casale, A., Foran, A., Erwinski, M., Wilson, J., Farber, S. A., & Farber, M. A. (2021) Brief Report: A Novel Digital Therapeutic that Combines Applied Behavior Analysis with Gaze-Contingent Eye Tracking to Improve Emotion Recognition in Children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *52*(5), 2357 - 2366.

Sousa, C., Rye, S., Sousa, M., Torres, P. J., Perim, C., Mansuklal, S. A., & Ennami, F. (2023). Playing at the school table: Systematic literature review of board, tabletop, and other analog game-based learning approaches. *Frontiers in Psychology*, *14*, Article 1160591. https://doi.org/10.3389/fpsyg.2023.1160591

Souza, S. R., Perkoski, I. R., & Anjos, G. (2019). Desenvolvimento de jogos educativos para o ensino de comportamentos de prevenção contra o bullying: procedimento de design interativo. In A. L. & Faleiros, P. B. (Orgs.). *Jogos comportamentais: Análises e atuações em Contextos do dia a dia*, *1*, 39-58. Imagine.

Suzuki, B. M., & de Souza, S. R. (2022). Avaliação de um jogo de tabuleiro no ensino de palavras com encontros consonantais. *Acta Comportamentalia: Revista Latina de Análisis de Comportamiento*, *30*(1), 29-50. https://www.redalyc.org/articulo.oa?id=274570459002

Utami, R. D., Yufiarti, & Hapidin. (2025). The impact of interactive game-based media on enhancing positive discipline in preschool children. *Journal of Neonatal Surgery*, *14*(2), 110–120.

Vettorazzi, A., Frare, E., Souza, F. C., Queiroz, F. P., De Luca, G. G., Moskorz, L., & Kubo, O. M. 75 (2005). Avaliação de um programa para ensinar comportamento empático para crianças em contexto clínico. *Interação em Psicologia*, *2*(9), 355–369. http://dx.doi.org/10.5380/psi.v9i2.4780

Walker, H. M., Irvin, L., Noell, J., & Singer, G. (1992). A construct score approach to the assessment of social competence: Rational, technological considerations, and anticipated outcomes. *Behavior Modification*, *16*(4), 448-474. https://doi.org/10.1177/01454455920164002

Wu, L., Kim, M., & Markauskaite, L. (2020). Developing young children's empathic perception through digitally mediated interpersonal experience: Principles for a hybrid design of empathy games. *British Journal of Educational Technology*, *51*(4), 1168-1187. https://doi.org/10.1111/bjet.12918_8

Yun, S., Choi, J., Park, S., Bong, G., & Yoo, H. (2017). Social skills training for children with Autism Spectrum Disorder using a robotic behavioral intervention system. *International Society for Autism Research*, *10*(7), 1306-1323.

Study 2: Player's experience Evaluation of the Kahala Computer Game [2]

[2] This study was developed in co-authorship with doctoral student Poliana Fernandes Mesquita Sanches from the Programa de Pós-graduação em Análise do Comportamento at the Universidade Estadual de Londrina, Thomas S. Higbee, executive director and founder of Autism Support Services: Education, Research, and Training (ASSERT) program, and Lyndsay D. Nix, Program Director for the ASSERT autism program.

Eiterer, P. (2025). *Avaliação da experiência dos jogadores no jogo digital Kahala*. Tese. Programa de Pós-graduação em Análise do Comportamento, Universidade Estadual de Londrina – PR.

Resumo

Os jogos precisam ser divertidos e promover engajamento por meio de reforço natural, mesmo que tenham função educativa. Avaliar jogos educativos requer uma abordagem multidisciplinar. Pesquisadores da área de Games User Research propõem a análise de aspectos relacionados à jogabilidade e ao engajamento do jogador. O jogo de computador Kahala (Eiterer et al., 2023) foi projetado com o objetivo de ensinar crianças autistas a "atender às necessidades dos outros". No entanto, o jogo ainda não havia sido avaliado. Considerando isso, o objetivo deste estudo foi avaliar a experiência do jogador do jogo digital Kahala em relação à jogabilidade e ao engajamento. Três autistas norte-americanos, com idades entre 8 e 14 anos, participaram de quatro sessões, com durações variando entre 8 e 33 minutos. Durante essas sessões, foram registrados e analisados os comentários dos participantes e os níveis de assistência necessários. Os resultados mostraram que os participantes apresentaram uma diminuição das dificuldades de jogabilidade ao longo do tempo. Indicadores positivos de engajamento foram mais frequentes do que os negativos, e os comentários dos participantes indicaram interesse e imersão no jogo. No entanto, alguns elementos precisam de refinamento, como melhoria na apresentação da história e inclusão de um tutorial prático. Apesar da necessidade de ajustes, houve engajamento dos jogadores durante o jogo e ele se mostrou adequado ao público-alvo. Para estudos futuros, sugere-se que a literatura de Games User Research seja utilizada como referência para avaliação da jogabilidade em todas as etapas.

Palavras-chave: empatia; jogos digitais; experiência do jogador; pesquisa com usuário de jogos; programação de ensino

Eiterer, P. (2025). *Player's experience evaluation of the Kahala computer game.* Doctoral Thesis. PhD in Behavior Analysis, Universidade Estadual de Londrina, Londrina – PR.

Abstract

Games need to be fun and promote engagement through natural reinforcement, even if they have an educational function. Evaluating educational games requires a multidisciplinary approach. It is necessary to evaluate their effectiveness in teaching target behaviors, as well as the player's experience. Games User researchers propose analyzing aspects related to playability and player engagement. The Kahala computer game (Eiterer et al., 2023) was designed to teach autistic children to "meet others' needs". However, the game had not yet been evaluated. Considering this, the purpose of this study is to evaluate the player's experience of the Kahala computer game regarding playability and engagement. Three American autistic children, aged 8 to 14 years, participated in four playtest sessions, with durations ranging from 8 to 33 minutes. During these sessions, participants' comments and the assistance levels were recorded and analyzed. The results showed that participants experienced a decrease in playability difficulties over time. Positive engagement indicators were more frequent than negative ones, and participants' comments indicated interest and immersion in the game. However, some elements need refinement, such as improving the presentation of the story and including a practical tutorial. Despite the need for adjustments, the game was considered engaging and suitable for the target audience. For future studies, it is suggested that the Games User Research literature be used as a reference for evaluating playability at all stages.

Keywords: empathy; computer games; player's experience; games user research; instructional programming

Evaluating educational games requires a multidisciplinary approach (Bruckman, 1999; Drachen et al., 2018; Gris et al., 2018; Perkoski & Souza, 2015). Games need to be fun and promote engagement through natural reinforcement, even if they have an educational function (Bruckman, 1999; Panosso et al., 2015; Suzuki & Souza, 2022). To evaluate player's experience, game user researchers propose analyzing playability and player engagement (Drachen et al., 2018; Korhonen, 2016). The Kahala computer game (Eiterer et al., 2023) was designed to teach autistic children to “meet others' needs”. However, the game had not yet been evaluated. Considering that, this study questions the adequacy of the Kahala computer game regarding playability and player engagement.

The Kahala's first version was a board game designed to teach eight empathy’s prerequisite behaviors (see Eiterer, 2021). However, it was considered too complex for the target audience by the Eiterer’s (2021) examining board, as it had too many stimuli and aimed to teach many behaviors simultaneously. As a result, it was modified, leading to the development of the second version (Eiterer et al., 2023). In the Kahala game's second version (Eiterer et al., 2023), the player collects items while moving around the map. Eventually, they encounter a non-player character (NPC) who presents them with a quest, directly or indirectly requesting one of the four items available on the map (Eiterer, Study 1). The game consists of four sets of quests, whose complexity varies according to the target behaviors demanded. Set 1 was designed to require the behavior “identifying others' needs”. Set 2 required the player to “share resources with others according to the specific context”. Sets 3 and 4 were both designed to require the player to “meet others' needs according to the specific context”. The definition of these target behaviors and teaching sequence were based on the behavior-analytic learning principles (Eiterer, Study 1). Similarly, the design decisions regarding the arrangement of

contingencies to select and maintain target behaviors throughout the rounds were based on behavior-analytic principles (Eiterer, Study 1).

Sanches (2024) evaluated the Kahala board game with four Brazilians who have neurotypical development, between the ages of 8 and 9 years. Results showed that 75% of participants improved their scores in empathy assessments after playing the game (Sanches, 2024). Additionally, participants exhibited progressively fewer playability difficulties during the sessions and frequently provided positive feedback, indicating both good usability and high engagement (Sanches, 2024). All four participants in her study were neurotypical Brazilian individuals, and the study exclusively evaluated the board game version.

The board game version provided faster feedback on the game's effectiveness as a teaching tool, usability, and engagement. They helped demonstrate Kahala's suitability and the feasibility of using a game to teach empathy's prerequisite behaviors (Eiterer, 2021; Sanches, 2024). However, a computer version would be easier to distribute and could be more acceptable among autistic individuals, who usually struggle with in-person social skills training and may prefer virtual interactions (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). Computer games can enhance early social skills training and facilitate the transition to face-to-face interactions later. The game used by Sanches (2024) was developed in parallel with a computer version. All game design decisions were made together to ensure maximum correspondence between the two games, differentiating them only by technology although the Kahala computer game required more complex resources and a longer development time.

In the gaming industry, player testing has become a prominent practice during both the development process and after the product's release (Drachen et al., 2018; Haider et al., 2024). The main advantage of player testing is the opportunity to receive feedback from those for

whom the game was designed (Huguenin, 2018). Evaluating player's experience to improve the system can help in designing more compelling and fun games, with immersive environments (Drachen et al., 2018; Korhonen, 2016). The Games User Research (GUR) field has been strengthened through evidence-driven game design (Drachen et al., 2018). GUR practices involve an iterative process, characterized by observing the player interacting with the game and analyzing the collected data to make improvements later (Drachen et al., 2018; Haider et al., 2024; Korhonen, 2016). GUR is a multidisciplinary field that evaluates and improves game playability and player's experience (Drachen et al., 2018; Haider et al., 2024; Korhonen, 2016).

Playability refers to the overall quality of the game and the player's experience, ensuring that players can interact effectively and be satisfied with it (Drachen et al., 2018; Korhonen, 2016). Playability evaluation involves assessing whether a game's elements are suitable for its target audience (Drachen et al., 2018; Haider et al., 2024; Korhonen, 2016). To have good playability, a game should be adequate in regards to four aspects: gameplay, gaming platform, user interface, and usability. For optimal playability, these four aspects should work harmoniously, promoting an intuitive and satisfying player's experience (Korhonen, 2016; Paavilainen et al., 2018). In the Kahala computer game (Eiterer et al., 2023), there is a good playability when the player is capable of picking up an item around the map, talking to the NPC and delivering the correct item accordingly to the quest without any prompt.

Gameplay refers to the actions the player has to perform in-game to make progress and the stimuli that lead them to do so. The rules define these actions that constitute the game mechanics (Korhonen, 2016; Paavilainen et al., 2018). The Kahala computer game (Eiterer et al., 2023) has four main mechanics: moving around the map; collecting items; dialogue with NPCs; and quest completion. As described in Study 1, to make progress in the game, players

should complete the quests by sharing the correct item based on the NPCs' requests. To complete them, they should walk around the map collecting items (i.e., food, water, clothing, and medicine), talk to the NPCs, and give them the requested item. If they share it correctly, they earn a trust point, and if they don't share an item or share an incorrect one, they lose a trust point (Eiterer, Study 1).

The gaming platform refers to the input and output devices used to play the game (Korhonen, 2016; Paavilainen et al., 2018). In digital games, player commands are given through these input and output devices (Korhonen, 2016). The keys the player presses or the movements they make with the gaming platform are reflected in actions on the screen (Korhonen, 2016; Paavilainen et al., 2018). In the Kahala computer game (Eiterer et al., 2023), the player uses laptop keyboard arrows to move around the map, and when they pass near an item, it is automatically added to their inventory. As described in Study 1, for the dialogue mechanic, the player should use keyboard arrows to make their character come in contact with the NPC. For quest completion, the player should use the left mouse button to click on the item to be shared and then also use the keyboard arrows to make their character come in contact with the NPC (Eiterer, Study 1).

User Interface (UI) refers to the elements displayed on the screen through which the player performs actions in the gameplay. It allows communication between the gaming platform and the gameplay. The player uses the input devices to interact with the screen content (i.e., interface elements), and this interaction results in in-game actions displayed in the UI (Korhonen, 2016; Paavilainen et al., 2018). Figure 1 shows Kahala's UI, composed of: (a) the Quest Board, where the player can check which quests are completed and which one are not; (b) the Trust Bar, where the points of trust are added or removed, representing the level of trust the player has acquired throughout the round; (c) the Inventory, where the collected items are

stored, showing which and how many items the player has; and (d) the dialogue box, which shows in text what the NPCs says, it appears when they start talking and disappears once they finish or whether the player hits the “close” button (Eiterer, Study 1).

Figure 1

Kahala's user interface

Usability is defined as “the extent to which a system, product, or service can be used by *specified users* to achieve *specified goals* with effectiveness, efficiency, and satisfaction in a *specified context of use*” (International Organization for Standardization [ISO], 2018, p.6). For educational games, teaching target behaviors can be considered the specific goal and should be achieved with effectiveness and efficiency, as well as promoting satisfaction (Bruckman, 1999; Panosso et al., 2015; Suzuki & Souza, 2022). To learn target behaviors, the player must be able to perform predefined actions within the game in a context previously arranged (Panosso et al., 2015; Perkoski et al., 2018). In this study, usability can be defined as how the player performed the actions required to learn the target behaviors in specific gameplay contexts.

The Kahala game (Eiterer et al., 2023) was designed with a focus on its “specified users” being autistic children 8 to 14 years old. The game's “specified goals” are to teach the three target behaviors: "identifying others' needs"; "sharing resources with others according to the specific context"; and "meeting others' needs according to the specific context". Therefore, the contingencies were arranged to create conditions that would facilitate the occurrence of target behaviors in the presence of specific stimuli and select them based on the consequences they produce in-game (Eiterer, Study 1). Additionally, the game is designed to be played under adult supervision, in “specified contexts” such as clinical therapy or at home with their parents. This design should engage users with the Kahala game, meeting educational purposes and ensuring high usability in accordance with ISO (2018) standards.

The unique aspects of usability in games have been extensively discussed in the GUR literature (see Drachen et al., 2018; Korhonen, 2016). Unlike other software, games often include deliberate challenges that may seem to contradict standard User Experience Design principles like “error prevention” (Desurvire & Wixon, 2018). While errors from poor usability can lead to disengagement, errors resulting from challenging tasks can actually improve engagement (Korhonen, 2016; Paavilainen et al., 2018). When designing an educational program, it is crucial to balance contingencies to ensure tasks are neither too easy nor too difficult (Skinner, 1968/2003). User experience designers emphasize the importance of designing systems in which user errors are prevented from the beginning (Nielsen, 1994/2024; Nielsen & Molich, 1990). In behavioral-analytic literature, this concept is addressed as “errorless learning” (Skinner, 1968/2003). Teaching is more effective when contingencies are arranged to challenge the learner while avoiding errors during the learning process (Skinner, 1968/2003).

The absence of certain information can leave a player confused, lost, and/or stuck in the map (Desurvire & Wixon, 2018). While good game design practices include providing information to prevent this type of error, providing all solutions explicitly can make a game boring (Desurvire & Wixon, 2018). New players' contact with the game should be facilitated, but the experienced players should also find challenges that keep them engaged (Desurvire & Wixon, 2018; Korhonen, 2016). Games should be designed for low "response cost" for new players while gradually increasing complexity for more experienced ones (Desurvire & Wixon, 2018). Iterative design, involving repeated playtesting and redesign cycles, is a recommended approach to achieve this balance (Perkoski & Souza, 2015; Salen & Zimmerman, 2004; Souza et al., 2019).

Playability's four aspects (i.e., gameplay, gaming platform, user interface, and usability) are usually evaluated through playtest sessions. Playtesting should not only assess whether players can use the game's controllers effectively and enjoy their experience but also respond appropriately during gameplay. Evaluating the playability of educational games helps ensure that they are fun and educationally effective (Gris et al., 2018; Perkoski & Souza, 2015; Souza et al., 2019). After defining target behaviors, the educator must not only program how to *teach* them but also how to *evaluate* the efficiency and effectiveness of the teaching program (Botomé, 1980; Cortegoso & Coser, 2011; Kienen et al., 2013). Evaluating playability in an educational game is a method for verifying its effectiveness as a teaching program (Gris et al., 2018; Panosso et al., 2015; Perkoski & Souza, 2015; Souza et al., 2019). Playability evaluation assesses how effectively the game's rules, selected devices, and visual elements support target players in achieving the game's specific goals. By observing players as they interact with the game during playability evaluation in playtest sessions, you can measure whether the correct responses increase in frequency and become more likely due to the contact with the game. The

results of playability evaluations help in identifying where players struggle, and indicate the need to refine workflows, interfaces, or processes to improve the game's efficiency as a learning program.

An educational game should also be fun and promote engagement, even if it has a teaching purpose (Bruckman, 1999; Panosso et al., 2015; Suzuki & Souza, 2022). Engagement is an outcome of good playability and refers to the likelihood of a player continuing to interact with a game due to natural reinforcement (Bruckman, 1999; Paavilainen et al., 2018; Panosso et al., 2015; Suzuki & Souza, 2022). When playability works fine, success is due to all the elements involved in the game working together, and that results in player's greater involvement (Korhonen, 2016; Paavilainen et al., 2018). However, when playability fails, this can be due to one or more poorly designed elements and "poor playability can surely lead to disasters" (Paavilainen et al., 2018, p. 259). Therefore, it is necessary to figure out which element(s) should be refined to make improvements in the game in order to improve the player's engagement (Korhonen, 2016; Paavilainen et al., 2018).

While designing an educational game, contingencies can be arranged to create a context that naturally reinforces the occurrence of target behaviors, thereby promoting gameplay progress or access to storyline information, for example (Panosso et al., 2015). This can function as a motivating operation, contributing to greater player engagement in the game, which is the teaching program (Gris et al., 2018; Panosso et al., 2015). However, it is necessary to verify whether the in-game stimuli fulfill their planned functions when the player accesses the educational game. Otherwise, the game may not meet both the purpose of being fun and of teaching the target behaviors.

The game design process shouldn't be exclusively theoretical. When the game designer plans a game feature, they can hypothesize about the effects it will have on player behavior, but they can't be sure about these effects without testing it (Salen & Zimmerman, 2004). Therefore, it is recommended that users participate in this process through iterative design (Salen & Zimmerman, 2004). In game design field, iteration is the repetition of a cycle to develop or improve a game and/or a feature (Salen & Zimmerman, 2004). Iterative design is a method that uses this repetition to consider the player's experience for decision-making during the development process. The iteration cycle consists of at least four stages: “prototyping, playtesting, evaluation, and refinement” (Salen & Zimmerman, 2004, p. 27). The game design process starts with prototyping, which refers to the development of a playable (but not finalized) version of the game or feature to be tested. After that, the playtesting begins, that version of the game/feature is made available for others to play. From playtesting results, the game designer evaluates feedback from others and makes refinements, implementing suggested changes for game improvement (Salen & Zimmerman, 2004).

The iterative design proposal, already used in the game industry, meets the needs of educational games. Through prototype playtesting, it is possible to obtain empirical evidence regarding its usability and teaching purposes (Gris et al., 2018; Perkoski & Souza, 2015; Souza et al., 2019). Analyzing the data collected during playtesting sessions enables the game designer to determine whether the game mechanics are effective, identify areas that require improvement, and understand how frequently the target behaviors occur (Perkoski et al., 2016; Salen & Zimmerman, 2004; Souza et al., 2019). Based on these results, the game designer can implement changes that lead to improvements in both teaching and player engagement (Perkoski et al., 2016; Salen & Zimmerman, 2004; Souza et al., 2019). The repetition of this

cycle guarantees that the educational game is both effective and efficient in teaching the target behaviors while promoting fun. (Perkoski et al., 2016; Souza et al., 2019).

Evaluating games requires an understanding of both playability and player engagement (Drachen et al., 2018). Playability evaluation involves assessing whether a game's elements – gameplay, gaming platform, user interface, and usability – work harmoniously to provide an intuitive, efficient, and satisfying experience (Korhonen, 2016; Paavilainen et al., 2018). Playtesting the game helps identify which features are working correctly, what are game design gaps and whether the game is engaging (Drachen et al., 2018). Although Sanches (2024) evaluated Kahala's board version, no study has evaluated the computer version. Therefore, this study's purpose is to evaluate the player's experience of the Kahala computer game regarding playability and engagement.

Method

The research study was approved by USU's Institutional Review Board (IRB) under the protocol number #14237. All participants had the proper paperwork filled out and signed by parents before the study started. Each participant also signed the Informed Assent document.

Participants[3]

The study included three North American and Caucasian autistic children enrolled in regular schools: Alicia, an 8-year-old girl; Jacob, an 11-year-old boy; and Sabrina, a 14-year-old girl. To protect participants' identities, fictitious names were used in this study. All participants had previously received clinical intervention for ASD but were not undergoing any treatment at the time of the study. They had a comprehensive verbal repertoire, and low

[3] In evaluating game playability, research participants are usually called "users" or "players". In this study, we will be using "participants" to refer to the children who playtested the game.

performance in empathetic behaviors. The participants matched Kahala's target audience, and the study sessions were scheduled during their summer break. They were recruited from ASSERT's[4] mailing list of parents who were interested in having their children participate in research but were not currently enrolled in the clinic.

Task

Playtesting occurred in four sessions (i.e., SI1, SI2, SI3, and SI4) with the Kahala game (Eiterer et al., 2023). The whole game was in EN-US language. Each session lasted from 8 to 33 min. The researcher prepared for each session by positioning the laptop to avoid screen reflection, connecting a Bluetooth mouse, opening the game, selecting the correct set according to the session, and testing if the commands were working properly before the participant arrived. This procedure was repeated 10 min before every session. At the beginning of each SI1, the researcher asked participants about their familiarity with using a computer, keyboard, and mouse.

Since the Kahala game (Eiterer et al., 2023) was designed to be used with an adult mediator, participants did not need to use the game's menu. At the start of each session, the researcher asked participants which avatar they would like to play with, chose the corresponding set, and started the game. Participants played only one set per session, but if they lost the round, they could play the same set up to three times in that session. Thus, session duration varied based on the participant's pace and their need for more opportunities with each set. In game-over situations, the researcher would reset the game and allow the participant to choose their avatar again.

[4] Autism Support Services: Education, Research, and Training (ASSERT) program is an autism training and research center at Utah State University (USU).

All four playtest sessions were filmed, and a subsequent analysis of the participants' comments was performed. The camera was positioned on a tripod diagonally to the participant's rear right, out of their line of sight. The researcher sat silently 2 to 3 meters behind the participant. The researcher only spoke when the participant directed questions or comments to her, waiting for the participant to make eye contact and vocalize their comment or question.

Data Analysis

The purpose of this study was to evaluate the player's experience with the Kahala computer game in terms of playability and engagement. The analysis in this study focused on the participants' comments and the level of assistance they needed during the gameplay. Data from these four sessions is also analyzed in Study 3 focusing on Kahala's teaching purpose. The researcher watched the videos of each session to record and categorize participant comments based on the two criteria: playability and engagement.

The analysis of comments and questions was performed on spontaneous vocalizations made by participants. Spontaneous vocalizations were defined as "comments or questions about the same content or those preceded and followed by an interval of at least 5 seconds and not preceded by the researcher's question or comment". The analysis began after the researcher clicked "OK" on the game's menu screen, when the participant started interacting with the game alone, and ended when the researcher turned off the game and dismissed the participant. All spontaneous vocalizations, including onomatopoeias, were recorded, noting the minute of occurrence and describing the context. If a vocalization could not be understood after listening to it twice, the content was recorded as "inaudible". All comments were analyzed using both playability and engagement criteria, as they are complementary.

All participants' comments were recorded in the Game Evaluation Recording Data Sheet (Appendix D). Figure 2 shows a sample of this data sheet. Comments related to poor playability were categorized according to the game element related to the issue highlighted by the participant. These categories were: (a) Usability, which was defined as difficulty performing the necessary actions to learn the target behaviors; (b) UI (user interface), which was defined as difficulty understanding the elements on the screen; (c) Gaming Platform, which was defined as difficulty using the devices to play the game; and (d) Gameplay, which was defined as difficulty performing the next step to progress in the round or making comments unrelated to the game. Good playability was defined as the harmony between usability, UI, gaming platform, and gameplay, leading to a fluid, intuitive, and pleasant experience.

Figure 2

Sample of Game Evaluation Recording Data Sheet

Appendix C
Game Evaluation Recording Data Sheet

Participant:_____ Date:_____ Session number: _____Round:_____

Quest	NPC's ID	Hit	Usability	Engagement	Levels of assistance	Obs.
1						
2						
3						
4						
5						
6						
7						
8						

All recorded comments were distributed between two categories of engagement indicators: positive and negative. Positive indicators were those comments that indicated some level of immersion and involvement with the game. The subject topics of positive indicators showed participant's satisfaction with the game (e.g., celebrating when they got an item, saying “wow” when surprised, cheering when won in-game rewards, asking to keep playing, etc.), participant's attention to the scenario (e.g., “the buildings are the same, but the characters are different”) or participant's strategic planning (e.g., checking the Quest Board, planning the next

action aloud). On the other hand, negative indicators were those that indicated dissatisfaction or boredom with the game (i.e., commenting about things unrelated to the game). Table 1 shows engagement's subcategories, four positive and three negative ones.

Table 1

Engagement's subcategories

Category	Subcategory	Code	Description
Positive	Show satisfaction	CP	Positively comment about the game, asking to play again, demonstrating approval towards the game
	Comment about the game's plot and/or mechanics	CS/CM	Describe the scenario, attribute feelings/thoughts to NPCs, comment on items distribution on the map, comment on the story
	Comment about gameplay progress	CL/CC	Celebrate in-game results and/or comment on gameplay progress
	Strategic Planning	SP	Planning actions strategically to achieve better results in the game
Negative	Unrelated comment	UC	Making observations or comments that are unrelated to the story, mechanics, characters, scenario, gameplay or any other element of the game
	Show disapproval	SD	Complain about game elements, criticize, make negative comments about the game
	Request interruption	RI	Complain about biological states (e.g., tiredness, hunger, thirst, sleepiness), directly or indirectly requesting activity interruption

The analysis also focused on the amount and type of assistance provided by the researcher during the participant's interaction with the game. The assistance could be classified into five levels: (a) Independent, when the participant did not depend on the researcher's help; (b) Supervision, when the researcher offered only a *gestural* hint (e.g., pointing to the stimulus with which the participant should interact); (c) Minimal Assistance, when the researcher gave a single hint (non-gestural) that led the participant to the correct response; (d) Moderate Assistance, when the researcher provided *more than one* hint; and (e) Total Assistance, when the researcher *performed the action* with the participant.

The use of direct measures enhances the validity of game evaluation by prioritizing observable behavior over retrospective reports. Systematic direct observation mitigates biases inherent in self-reports, such as recall error and social desirability (Cooper et al., 2020). When asked “how did you like the game?”, participants tend to answer something positive or to give feedback they believe the researcher would like to get. On the other hand, participants’ comments and the level of assistance provided during the gameplay are observable measures that allow for interobserver agreement. Thus, participants’ and researchers’ inferences about the game are avoided to improve the data reliability.

Interobserver Agreement (IOA)

Another equally qualified researcher also watched and analyzed 33% of the videos in parallel to calculate the interobserver agreement (IOA). Both researchers registered and analyzed assistance level and spontaneous comments/questions. IOA was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. Across all participants, IOA averaged 100%, 100%, and 83.3% agreement for assistance level, playability and engagement categories, respectively.

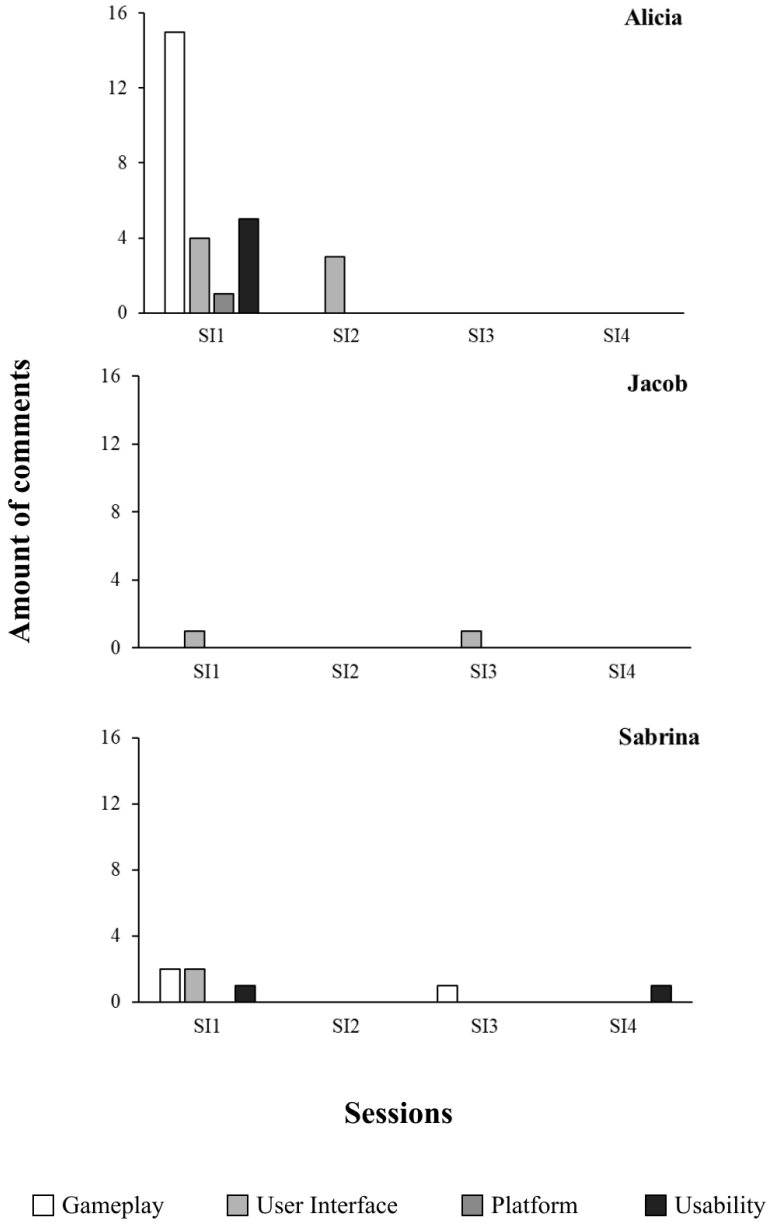
Results

There was a total of 24 comments indicative of good playability and 37 of poor playability, being 18 related to gameplay, 11 referring to the UI, one to gaming platform, and seven to usability. Figure 3 shows the number of comments categorized as poor playability, and it is displayed by session for each participant. Comments were most frequent in each participant's first session (SI1), and all participants made at least one comment or question during this session. The frequency of comments decreased in subsequent sessions, indicating that the initial difficulties were not recurring. This suggests that playability deficits were largely mitigated for all participants after their first contact with the Kahala (Eiterer et al., 2023).

Although participants made some comments indicative of poor playability after the SI1 session (e.g., “is this the library?”, “it [game over] is happening almost every time”), these were also less frequent.

Figure 3

Participants' comments analyzed under poor playability criteria



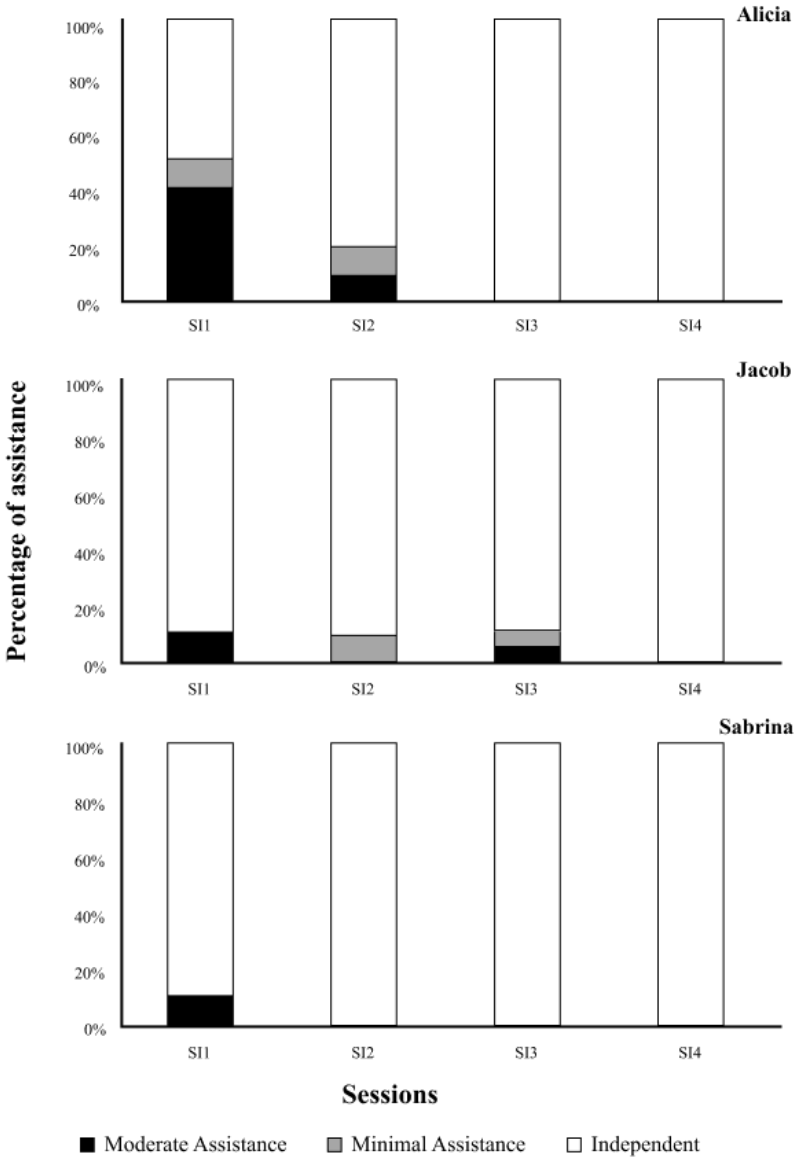
Most of Alicia's difficulties were related to gameplay (60%) due to a lack of understanding how to progress in the game. This included issues with quest completion and main quest mechanics (i.e., going to the bunker). For example, after completing an NPC's quest, Alicia showed confusion when the NPC told her a story fragment about the apocalypse that occurred in the Kahala. Even after she asked "So, what happens when it shows green?", and the researcher had already explained that saying "It means that you already completed the task". In the story fragment, the NPC said that it "caused a gigantic damage to food production". Alicia then whispered "Food production? So... I should probably give... food". The quest had already been completed, and she could move on to the next NPC. This interaction suggests a lack of understanding regarding the gameplay loop of receiving a story fragment upon quest completion. The researcher had to provide an explanation, after which Alicia continued to play without further difficulty on this specific mechanic.

Difficulty with the main quest was a shared issue among all participants, who needed help finding the library to end the game. These data suggest the need for adjusting the game's story to make it more crucial for completion and to better emphasize the main quest. Comments regarding usability were related to the quest completion mechanic of sharing items with NPCs, and most of such comments (71.43%) came from Alicia in her first session. Although Sabrina did not make any comments and/or questions about this mechanic, she dragged the item from the inventory to the NPC trying to share it that way. Even after being reminded that she should move her character to come in contact with the NPC to share it, Sabrina maintained this behavior in all attempts in all sessions. The data from Alicia and Sabrina suggest the need for improvement in this mechanic, possibly by allowing players to share items by dragging them or clicking on the NPC.

Alicia's questions in SI1 also indicated a lack of clarity regarding interface elements, such as the function of the Quest Board. For example, she asked “I gave him apple, which is food. Does he trust me?”, showing difficulty in figuring out the game status from interface’s information. This suggests a need for clearer instructions, possibly through a step-by-step tutorial or tooltip messages. Figure 4 shows the percentage of assistance levels required by each participant in each intervention session with the Kahala game.

Figure 4

Assistance levels needed in each round



There was no occurrence to be categorized as “Supervision” or “Total Assistance”. Therefore, the graph only shows the three levels required in this study's sessions. Alicia needed the most assistance, however, there was a significant increase in her independent actions between sessions SI1 (i.e., 50%) and SI2 (i.e., 80%). For Alicia and Sabrina, the need for help decreased over exposure to the game, reaching zero in the last sessions. Despite few occurrences in each session, Jacob required help in more consecutive sessions (i.e., 3 of 4). However, there was fluctuation in the assistance level and 100% of the actions were performed independently in SI4. Figure 5 illustrates the total number of engagement comments made by participants over the four intervention sessions with the Kahala game.

It is observed that Alicia and Jacob did not make any comments categorized as a “negative indicator”. Comments and questions about game difficulties indicated positive engagement, as they were related to gameplay progress (e.g., “where do I go to find the people?”, “where should I hide?”, “is this the library?”). The total number of positive comments (98.36%) greatly exceeded the negative ones, as only one negative comment was made. This single negative comment was an Unrelated Comment (UC) made by Sabrina during the first session (SI1). She asked the researcher "how are you today?" while moving her character through the game map. This comment was not accompanied by other disengagement behaviors (e.g., stand up, look away from the screen, lean back, fidget with other items, leave the game area), as the participant continued to play while asking the question. For Alicia and Sabrina, there was a considerable reduction in the number of comments from session SI1 to the subsequent sessions. This drop could be due to familiarity with the game, as it was not accompanied by other behaviors that could demonstrate disengagement.

Figure 5

Comments indicating positive engagement

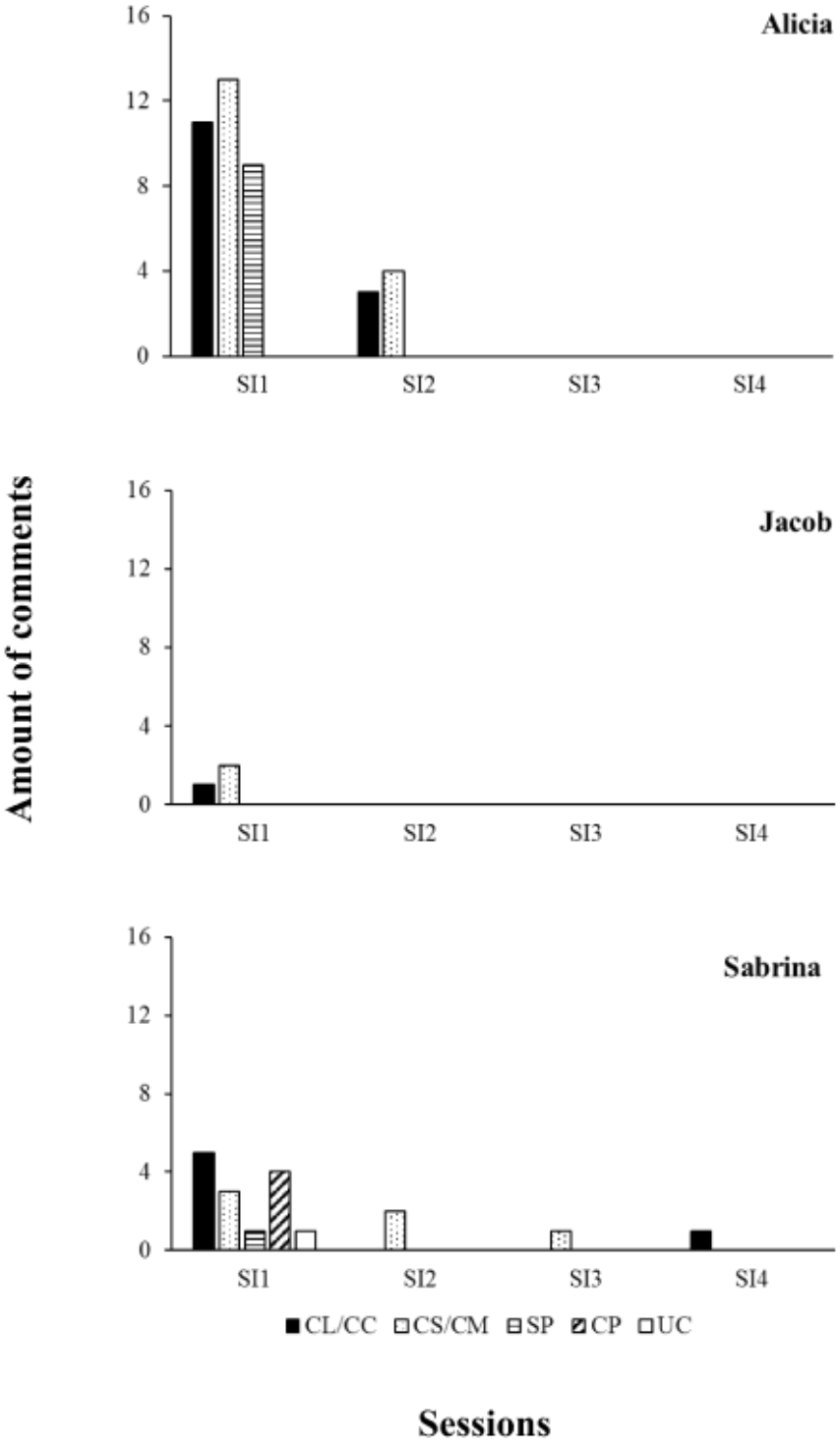
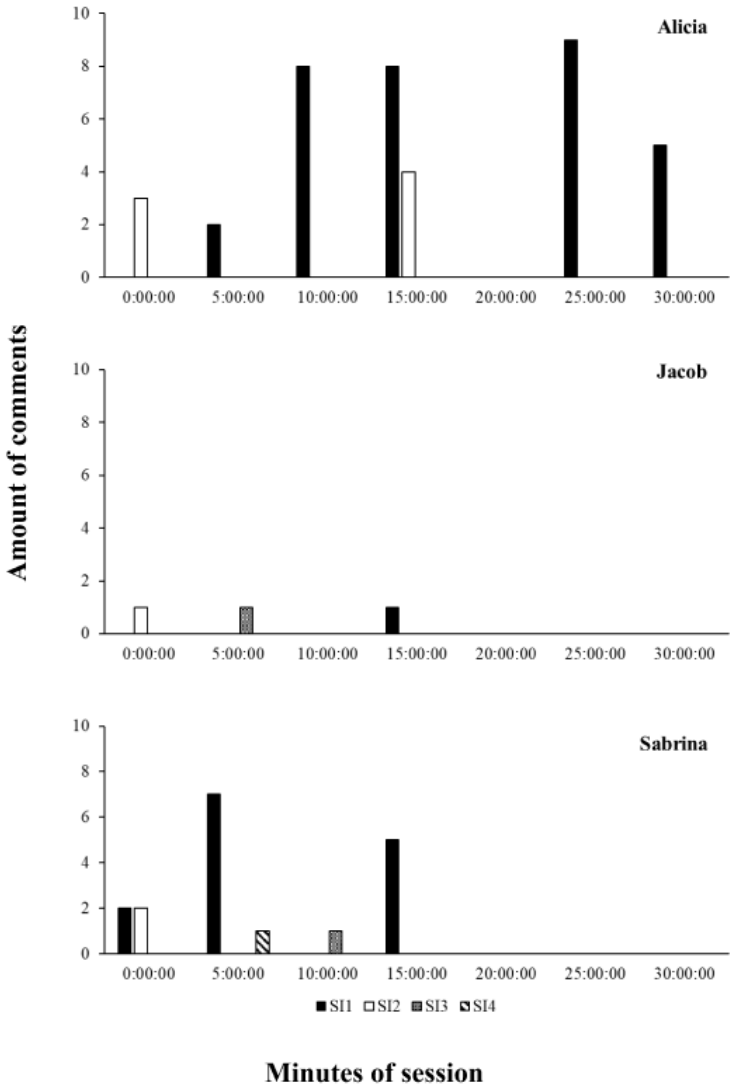


Figure 6 shows the comments distributed by interval, according to the moment they occurred in the session. Most of the comments were made in the first two sessions, SI1 and

SI2, with very few comments in SI3 and SI4. Alicia and Sabrina made the highest number of comments, particularly within the first 15 minutes of SI1 and SI2. Jacob's comments were sparse throughout all the sessions. The concentration of comments early on suggests that initial difficulties were not recurring. This suggests that playability deficits were largely mitigated for all participants after their first contact with the Kahala game (Eiterer et al., 2023). The decrease in comments' amount is particularly notable, suggesting that participants may had already learned how to play the game or had nothing further to report.

Figure 6

Comments distributed by interval



Discussion

The purpose of the current study was to evaluate the players' experience in terms of playability and engagement. The results indicated that playability difficulties decreased over time and that participants showed interest and immersion in the game, although some elements need refinement. To promote good user experience, it is recommended that the system promote a feeling of freedom and control to the user (Nielsen, 1994/2024). In games, these feelings can be fostered by letting new players learn the game's tools without consequences, for example (Desurvire & Wixon, 2018). In the Kahala game, players get information about the mechanics at the beginning of each round, narrated by the character Hector as he sets the context for the game. However, the current version of Kahala lacks a practical tutorial, and inadequate player behaviors in the first contact with the game can have punitive consequences. It is suggested that future versions include a step-by-step tutorial where players can make initial mistakes without losing points from the Trust Bar, for example.

Alicia required additional instructions regarding the game's mechanics, such as how to share an item, how to check if a quest is completed, and the difference between a quest and a story fragment. The assistance level required by her (Figure 4) suggests that she had greater difficulty understanding the gameplay than the others. These data suggest that the absence of such a tutorial may have slowed her learning curve and indicate that the game's approachability needs refinement to make it more appealing to new players.

Furthermore, for more experienced players, improvements are needed to enhance the challenges in later sets. Sets 2, 3 and 4 have few new stimuli, which can make the game monotonous as players progress. The fact that Set 4 is a duplicate of Set 3 led Jacob to question if there were different characters. To increase engagement and replayability, future versions

should have a continuous storyline with changing scenarios and a main quest in each set. Improving the replay rate is crucial for effective learning in educational games, given that repeating the teaching condition can make learning more effective (Skinner, 1968/2003; Linehan et al., 2009; Souza et al., 2019).

The evaluation context is also an important factor to consider in game research (Louvel, 2018). The differences between a research setting and a player's natural context can evoke different behaviors, leading to "false positive" or "false negative" results (Louvel, 2018). In particular, the participants' engagement may have been higher in the Kahala's evaluation due to the bias of previous relationships with authority figures (i.e., therapists, teachers, etc.), in which the participant cannot choose to avoid a task, for example. On the other hand, participants might ask more questions in a research setting to avoid judgment, which could be misinterpreted as playability issues.

To mitigate bias, it is essential to understand the variables that may affect the research (Louvel, 2018). For this study, the most suitable devices were used (i.e., laptop with 8GB RAM, large screen and connected mouse), and the setting was prepared to guarantee participants' full attention to the game (e.g., their chair was positioned facing the wall, there was no other stimuli in the room). However, in other settings, the players will not always have the appropriate devices and/or a prepared room to play. The researcher should recognize that evaluation's results may suggest changes to the game that would not be relevant if the player were using the final version at home.

The Kahala game evaluation adopted several of Louvel's (2018) recommendations, such as using a clinical room with minimal stimuli and a neutral researcher posture. The computer was positioned so that there was no reflection in the screen, and the participant

remained seated facing the wall. The camera with the tripod was positioned at the participant's rear right diagonally, out of their line of sight. The researcher sat behind the participant, remaining silent and at approximately 2 to 3 meters. After starting the game, the researcher only spoke when the participant directed questions or comments to her. To provide some assistance level, the researcher waited for the participant to make eye contact and say the comment/question out loud. This may have contributed to more reliable data on usability difficulties present in the current version of the Kahala. However, providing headphones to reduce ambient noise is recommended for future studies.

Louvel (2018) also recommends providing the same equipment and instructions to all participants, avoiding them seeing each other's screens during the playtest, and avoiding detailing what is expected from them. During the research, the same devices were used by all three participants: a Dell Inspiron 15” screen laptop, the laptop keyboard, and a Bluetooth-connected mouse. All sessions happened in the same clinical room, and all participants were positioned in the same way. This eliminated the possibility that the difficulty or ease of a particular participant could be due to the playtest environment. At the beginning of each SI1, the researcher asked the same questions and provided the same instructions, maintaining a standard approach with all participants. However, future research should ensure that instructions are read from a pre-written document to maintain consistency and avoid inducing specific actions from participants (Louvel, 2018). The Kahala evaluation occurred individually and at different times with each participant, with no contact between them during the study. The individual application of the study prevented data contamination between participants.

At the beginning of each SI1, the researcher asked participants about their familiarity with using a computer, keyboard, and mouse. All three participants reported being familiar due to computer science classes at school. Maintaining usability standards and consistency between

elements within a system and between various systems of the same category is a recommended practice in user experience planning (Louvel, 2018; Nielsen, 1994/2024). This consistency allows the user to generalize learned responses across systems, as the stimuli keep similar properties between different settings (Catania, 1998/1999; Cooper et al., 2020; Nielsen, 1994/2024). Generalization prevents errors and shortens the user's learning curve when accessing a system for the first time (Catania, 1998/1999; Cooper et al., 2020; Nielsen, 1994/2024). At the beginning of Kahala's evaluation, the researcher provided a brief explanation to all participants about using mouse and keyboard commands to execute in-game actions. The participants' familiarity with computer use may have favored their learning of game commands. Actions such as moving the character using the keyboard arrows and clicking on an item in the inventory to select it did not require any additional tips. These actions are usually performed with similar commands in other games, and this may have contributed to rapid learning.

However, they did show difficulty with the mechanics of sharing items and starting dialogues, which required additional assistance. All participants tried dragging the item at least once and needed at least one additional hint on how to start the dialogue with the NPC. In many games, the action of dragging a resource is typically employed as a command to deliver items rather than interacting with NPCs. To start dialogues, clicking on the NPC is a more common command. To make gameplay more fluid and intuitive, it is recommended that the mechanics of dialogue and quest completion be modified to resemble the more common standard in other games. In experimental condition, the researcher was present all the time to provide additional assistance when requested. However, for parents or professionals to use the game's final version in other settings, it will be necessary to modify these mechanics, implement a practical tutorial, and test additional instructions.

To evaluate the engagement promoted by the Kahala game, participants' spontaneous comments were analyzed. However, there was no constant check regarding the preference to continue playing the Kahala over doing another activity. All participants have a history of participating in therapeutic interventions in the same context as the game sessions happened. This may have contributed to maintaining their compliance throughout the sessions, even if they wanted to interrupt the game. It is recommended that future researchers plan more structured contingencies to evaluate engagement. To mitigate this bias, it is suggested that concurrent activities be available in the room and strategies be created to check and record the participant's assent several times during the game session.

The data suggested that the total number of positive comments (98.36%) greatly exceeded the negative ones, as only one negative comment was made. This corroborates previous findings (Sanches, 2024) and indicates that despite some playability flaws, the game was found to be interesting to participants. Even the UC comment wasn’t criticizing the game but asking to the researcher “how are you today?”. Considering that it was an empathy teaching context, this question could be considered more a nuance between positive and negative than a negative one. Future studies should consider analyze the engagement and distribute the comments under different criteria.

According to Stewart (2011), players can be divided into two main types: casual and hardcore. Hardcore players are characterized by seeking information beyond the game itself. They are players who seek to know about the game's creation process, releases, development team, etc. Jacob’s question about the public release of the game and Sabrina's question "where did you find this game?" demonstrate an interest that goes beyond the game's content itself, referring to its development process. According to Stewart (2011), this type of interest can be indicative of a higher engagement level, closer to that of a "hardcore" player. This positive

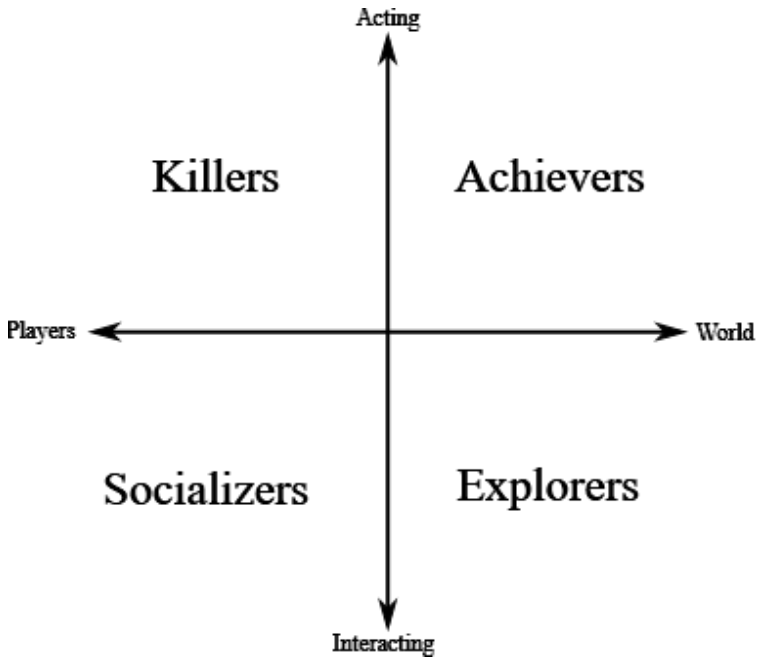
feedback suggests the game's content, technology, and language are adequate for the target audience (Desurvire & Wixon, 2018; Hamari, 2014; Stewart, 2011).

Besides the hardcore-casual continuum, the game design literature indicates several other player typologies (Hamari, 2014). Among them, the most widely cited is Bartle's (1996), which analyzes the player's profile according to the axes of acting-interacting and player-world (Bartle, 1996; Hamari, 2014). From the intersection of these two axes, each of the four quadrants represents a type of player: (a) Killer; (b) Achiever; (c) Socializer; and (d) Explorer (Bartle, 1996, see Figure 7). What differentiates player types in this typology are the elements that function as reinforcers within the game and their behavior throughout the gameplay. So, player types could be understood as a categorization based on players' preferences and repertoire. It is believed that the elements of the Kahala game can function as reinforcers for Achiever and Explorer types.

Achievers are characterized by acting in the world to complete quests and master achievements (Bartle, 1996). Alicia showed this pattern by consistently asking about task completion (e.g., "I gave him an apple. Does he trust me?" and "I completed all tasks, so people of all four sets trust me now") and highlighting the time it took to finish the game (e.g., "I knew I had to complete all tasks, so I did it quickly"). These behaviors were controlled by task completion and reinforced by signals that the NPCs began to trust her after completing their respective tasks. This corroborates the Achiever profile described by Bartle (1996), considering that the participant highlighted the game completion time as a positive indicator of her performance, even though the researcher did not mention anything related to that throughout the study.

Figure 7

Bartle's player types diagram



Explorers are controlled by elements of the game's universe, seeking to understand the storyline and paying attention to the scenario (Bartle, 1996). In the Kahala game, the story fragments were planned to function as reinforcers after completing a task. The union of all the segments tells the story that triggered the apocalypse in the city Kahala. For this player type, completing tasks would be reinforced by accessing new story segments. Sabrina demonstrated this by releasing the mouse and keyboard to listen to all story segments, suggesting the storyline contributed to her continued engagement. On the opposite, the storyline did not function as a reinforcer for Jacob, who interrupted 95% of the story segments, 61% of the thank you messages, 48% of the task narrations, and 100% of the Rules Messages throughout the study. This suggests a need to redesign the presentation of game mechanics, so they are not linked exclusively to storyline segments, as well as the need to plan for other reinforcers, more suitable for other player types. Future studies should consider the use of multimodal feedback. It could

be an effective strategy to mitigate narrative overload and excessive reliance on textual tutorials by shifting the delivery of essential game information to non-linguistic channels (e.g., visual cues, sound effects; haptic feedback). By demonstrating mechanics and story segments through the combination of these modalities, the game allows players to learn through direct experience, reducing the need to interrupt gameplay for reading.

The lack of diversification and abundance of stimuli reminding the participant about the storyline during the Kahala game may have contributed to their difficulty in remembering the main quest, which reflected in a greater demand for assistance in each participant's SI1. The data shows that the game burdens the player by not providing sufficient information to help them remember the storyline and the main quest. This contradicts the best practice of avoiding systems that depend on the user's memory (Nielsen, 1994/2024; Nielsen & Molich, 1990). Modifying this could contribute to more effective learning of target behaviors. In educational games, the storyline contextualizes the target behaviors but also promotes engagement (Souza et al., 2019). In turn, greater engagement and immersion in the game can increase the probability of emitting the target behaviors (Gris et al., 2018).

Alicia, who demonstrated greater immersion in the game's storyline, asked questions and made comments suggesting concern about the consequences of her behavior beyond the gain/loss of points (i.e., gaining the NPCs' trust). Frequent presentation of non-verbal stimuli could favor the player's behavior being under the control of its function within the game, and the emission of target behaviors becoming naturally reinforced. According to Skinner (1968/2003), in educational contexts, it is almost always necessary to manipulate natural contingencies so that the learned behavior does not remain exclusively under the control of arbitrary reinforcers. In the educational game, the natural consequences of the target behavior can be the actual game progress and unlocking new levels, for example (Panosso et al. 2015).

For a greater evaluation of future versions of Kahala, it is suggested that researchers collect information about participants' preferences and game repertoire before the experiment starts. So, these characteristics could provide more clarity about the function of game elements for each participant.

It is also suggested that a mini-map be added to help the player visualize the positions of NPCs, establishments, resources, and the bunker. This would favor a system status' overview and strategic planning (Nielsen, 1994/2024; Nielsen & Molich, 1990). From this planning, the player avoids wandering around the map without clarity of direction. In the Kahala board game's evaluation, participants asked more questions related to strategic planning than in the computer version. For example, one of the participants commented, "I'll go get more medicine, just in case someone needs it" (Sanches, 2024, p. 55) and another asked, "Can I gather several items and solve it later?" (Sanches, 2024, p. 62). The general visualization of the game map may have increased the frequency of behaviors related to strategic planning in Sanches' study (2024). An overview and strategic planning, minimize unnecessary movement, and increase the time spent on target behaviors compared to concurrent in-game behaviors. In the last sessions with the Kahala computer game (i.e., SI3 and SI4), Jacob and Sabrina collected at least one item of each type before starting the dialogue with the NPCs. Considering that this behavior occurred only in the last intervention sessions, it is possible to infer that their previous experience with the map may have enabled strategic planning in sessions SI3 and SI4.

Sabrina's UC (i.e., unrelated to the game) comment occurred while she moved her character around the map, right after leaving Hector's house where the game started. On this occasion, it was the participant's first contact with the Kahala game, and she was looking for the NPCs. This comment could be an indication of a demand for in-game stimuli that helps in maintaining the player's attention and/or increase their engagement. If there were a mini-map,

for example, the participant could have planned a well-defined route to move her character and would probably have remained more attentive to her in-game actions to follow that route. These and other stimuli that favor the player's immersion and engagement can function as motivating operations for the emission of goal behaviors throughout the gameplay and can increase the efficacy and efficiency of teaching (Gris & Souza, 2016; Panosso et al., 2015; Perkoski & Souza, 2015).

The Kahala game proves to be adequate in terms of playability and engagement, considering that: 98.36% of participant comments were positive engagement indicators; the frequency of comments/questions indicative of poor playability significantly reduced throughout the sessions (i.e., a total of 31 in SI1 to 1 in SI4 across participants); and participants were able to finish the sessions with little or no help from the researcher. However, as predicted by the iterative design, it is necessary to reformulate some features of the Kahala based on target audience feedback to suit them better. Among them, it is necessary to add non-verbal story stimuli throughout the game and adjust the dialogue and quest completion mechanics.

Considerations

This study is groundbreaking in evaluating the Kahala computer game in terms of playability and engagement. Compared to Sanches' study (2024), which used the analog version, the results of the present study corroborate the engagement data, denoting suitability of the content for the target audience. However, there is a greater demand for refinement of the playability in the computer version. To enable its use in future studies and distribution to the general public, it is essential to make adjustments to the mechanics and provide a practical tutorial at the beginning of the game. Despite requiring adjustments, the computer version still

seems useful in terms of potential distribution of this tool for parents and other professionals to use in various settings.

Iterative design evaluates the system with the target audience to identify and correct usage flaws before it becomes available to the general population (Salen & Zimmerman, 2004). In the case of the Kahala, the feedback collected in this study and by Sanches (2024) will serve as guidelines for adjustments to be made for future versions of the game. Overall, the game is playable, but it is still crucial to make these adjustments to enhance the player's experience. This can help increase engagement and replay rate (see Souza et al., 2019).

For the refinement of both versions of the Kahala and application in future studies, it is suggested that the GUR literature be used as a reference for playability evaluation at all stages. Although it is still an emerging field, studies in this area have refined a list of heuristics to be considered for promoting good usability and greater engagement (Desurvire & Wixon, 2018; Korhonen, 2016; Paavilainen et al., 2018). These heuristics act as a facilitator for organizing ideas and increase the probability that the game designer does not forget to consider any of the multiple aspects involved in a game (Desurvire & Wixon, 2018).

References

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, *1*(1), 19.

Botomé, S. P. (1980). *Objetivos Comportamentais no ensino: a contribuição da Análise Experimental do Comportamento*. [Doctoral dissertation, Universidade de São Paulo]. Repositório da Produção USP. https://repositorio.usp.br/item/000710311

Bruckman, A. (1999). *Can educational be fun?* [Apresentação de artigo]. Game Developers Conference '99, San Jose, CA, Estados Unidos.

Catania, A. C. (1999). Aprendizagem: Linguagem, comportamento e cognição. Porto Alegre: Artmed. (Original work published 1998)

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). Applied behavior Analysis [2ª ed.]. Pearsons.

Cortegoso, A. C, & Coser, D. S. (2011). *Elaboração de programas de ensino: material autoinstrutivo*. São Carlos: EdUFSCar

Desurvire, H., & Wixon, D. (2018). Heuristics uncovered for Games User Researchers and Game Designers. In A. Drachen, P. Mirza-Babaei, & L. E. Nacke (Eds.), Games user research (pp. 216-256). Oxford University Press.

Drachen, A., Mirza-Babaei, P., & Nacke, L. E. (Eds.). (2018). *Games user research*. Oxford University Press.

Eiterer, P. (2021). *Descrição e Planejamento do Ensino de Comportamentos Pré-requisito do Empatizar*. [Master's thesis, Universidade Estadual de Londrina]. https://www.uel.br/pos/pgac/wp-content/uploads/2021/03/Patricia-Eiterer-Souza-Pinto-Descricao-e-planejamento-do-ensino-de-comportamentos-prerequisito-do-empatizar.pdf

Eiterer, P., Sanches, P. F. M., & Souza, S. R. (2023). Kahala (2nd ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Eiterer, P. (Study 1). Development of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs.

Eiterer, P., & Souza, S. R. (2021). Kahala (1st ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Gillespie-Lynch, K., Kapp, S. K., Shane-Simpson, C., Smith, D. S., & Hutman, T. (2014). Intersections between the autism spectrum and the internet: Perceived benefits and preferred functions of computer-mediated communication. *Intellectual and developmental Disabilities*, *52*(6), 456-469.

Gris, G., & Souza, S. R. (2016). Jogos educativos digitais e modelo de rede de relações: desenvolvimento e avaliação do protótipo físico do jogo Korsan. Revista Perspectivas em Análise do Comportamento, 7(1), 114-132. https://doi.org/10.18761/pac.2016.003

Gris, G., Perkoski, I. R., & de Souza, S. R. (2018). Jogos educativos: Aspectos teóricos, aplicações e panorama da produção nacional por analistas do comportamento. In D. L. O. Vilas Boas, F. Cassas, H. L. Gusso, & P. C. M. Mayer (Orgs.), *Comportamento em foco 7: Ensino, comportamento verbal e análise conceitual* (pp. 50-67). Associação Brasileira de Psicologia e Medicina Comportamental (ABPMC).

Grossard, C., Grynspan, O., Serret, S., Jouen, A.-L., Bailly, K., and Cohen, D. (2017). Serious games to teach social interactions and emotions to individuals with autism spectrum disorders (ASD). *Comput. Educ.* 113, 195–211. doi: 10.1016/j.compedu.2017.05.002

Haider, A., Romanus, T., Tang, R., Gerling, K., & Abeele, V. V. (2024, May). Elevating Game User Research with a Guided Interface for Data Analysis. In Proceedings of the 19th International Conference on the Foundations of Digital Games (pp. 1-10).

Hamari, J., & Tuunanen, J. (2014). Player types: A meta-synthesis. *Transactions of the Digital Games Research Association*, *1*(2), 29-53. https://doi.org/10.26503/todigra.v1i2.13

Huguenin, J. (2018). Running user tests with limited resources and experience. In A. Drachen, P. Mirza-Babaei, & L. E. Nacke (Eds.), Games user research (pp. 256-279). Oxford University Press.

International Organization for Standardization. (2018). Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability (ISO 9241-11:1998).

Kienen, N., Kubo, O. M, & Botomé, S. P. (2013). Ensino programado e programação de condições para o desenvolvimento de comportamentos: Alguns aspectos no desenvolvimento de um campo de atuação do psicólogo. Acta Comportamentalia, 21(4), 481-494. https://www.redalyc.org/pdf/2745/274528983006.pdf

Korhonen, H. (2016). Evaluating Playability of Mobile Games with the Expert Review Method. PhD thesis, University of Tampere.

Linehan, C., Roche, B., Lawson, S., Doughty, M., & Kirman, B. (2009). A behavioural framework for designing educational computer games. Vienna Games Conference: Future and Reality of Gaming.

Louvel, G. (2018). 'Play as if you were at home': dealing with biases and test validity. In A. Drachen, P. Mirza-Babaei, & L. E. Nacke (Eds.), Games user research (pp. 392-402). Oxford University Press.

Nielsen, J. (1994, April 24). 10 Usability Heuristics for User Interface Design. Nielsen Norman Group. https://www.nngroup.com/articles/ten-usability-heuristics/ (Updated 2024, January 30)

Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 249-256). ACM Press.

Paavilainen, J., Korhonen, H., Koskinen, E., & Alha, K. (2018). Heuristic evaluation of playability. In A. Drachen, P. Mirza-Babaei, & L. E. Nacke (Eds.), Games user research (pp. 256-279). Oxford University Press.

Panosso, M. G., Souza, S. R. D., & Haydu, V. B. (2015). Características atribuídas a jogos educativos: uma interpretação Analítico-Comportamental. *Psicologia Escolar e Educacional*, *19*, 233-242.

Perkoski, I. R., Gris, G., Benevides, R. R., & Souza, S. R. (2016). Desenvolvimento de jogos educativos com base analítico-comportamental: o procedimento de design iterativo. In J. C. Luzia, G. B. Filgueiras, A. E. Gallo, J. Gamba (Orgs.). Psicologia e análise do comportamento: saúde, educação e processos básicos (pp. 48-56). Londrina: CPAC.

Perkoski, I. R., Gris, G., & Souza, S. R. (2018). Jogos Educativos: Aspectos Teóricos, Aplicações e Panorama da Produção Nacional por Analistas do Comportamento. In D L. O Vilas Boas, F. Cassas, H. L. Gusso, & P. C. M. Mayer, *Comportamento em Foco 7: ensino, comportamento verbal e análise conceitual* (vol. 7, pp. 50-67). São Paulo: Associação Brasileira de Psicologia e Medicina Comportamental (ABPMC). http://abpmc.org.br/arquivos/publicacoes/15200164548d97054097f6.pdf

Perkoski, I. R., & Souza, S. R. (2015). "O Espião": Uma perspectiva analítico comportamental do desenvolvimento de jogos educativos de tabuleiro. *Revista perspectivas em análise do comportamento*, *6*(2), 74-88. https://10.18761/pac.2015.020

Rezayi, S., Tehrani-Doost, M., & Shahmoradi, L. (2023). Features and effects of computer-based games on cognitive impairments in children with autism spectrum disorder: an evidence-based systematic literature review. *BMC psychiatry*, *23*(1), 2.

Rosales-Ruiz, J., & Baer, D. M. (1997). Behavioral Cusps: a developmental and pragmatic concept for Behavior Analysis. *Journal of Applied Behavior Analysis*, *30*(3), 533-544. doi: 10.1901/jaba.1997.30-533

Salen, K. & Zimmerman, E. (2004). *Rules of play: game design fundamentals*. Cambridge, MA: MIT Press.

Sanches, P. F. M. (2024). Avaliação do jogo Kahala para ensino de comportamentos pré-requisito do empatizar a crianças. [Master's thesis, Universidade Estadual de Londrina]. https://www.uel.br/pos/pgac/wp-content/uploads/biblioteca/Dissertacao%20Poliana%20Fernandes%20Mesquita%20Sanches.pdf

Skinner, B. F. (2003). *The technology of teaching*. Cambridge, MA: B. F. Skinner Foundation (Original work published 1968).

Souza, S. R., Perkoski, I. R., & Anjos, G. (2019). Desenvolvimento de jogos educativos para o ensino de comportamentos de prevenção contra o bullying: Procedimento de design iterativo. Jogos Comportamentais: Análises e Atuações em contextos do dia a dia (pp. 39-57). São Paulo: Imagine Publicações.

Stewart, B. (2011, September). *Personality and play styles: A unified model*. Gamasutra. https://www.gamedeveloper.com/design/personality-and-play-styles-a-unified-model

Suzuki, B. M., & de Souza, S. R. (2022). Avaliação de um jogo de tabuleiro no ensino de palavras com encontros consonantais. *Acta Comportamentalia: Revista Latina de*

Análisis de Comportamiento, *30*(1), 29-50. https://www.redalyc.org/articulo.oa?id=274570459002

Study 3: Evaluation of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs[5]

[5] This study was developed in co-authorship with doctoral student Poliana Fernandes Mesquita Sanches from the Programa de Pós-graduação em Análise do Comportamento at the Universidade Estadual de Londrina, Thomas S. Higbee, executive director and founder of Autism Support Services: Education, Research, and Training (ASSERT) program, and Lyndsay D. Nix, Program Director for the ASSERT autism program.

Eiterer, P. (2025). *Avaliação do Jogo Digital Kahala para Ensino da Classe de Comportamentos "Atender às Necessidades do Outro" a Crianças Autistas.* Tese. Programa de Pós-graduação em Análise do Comportamento, Universidade Estadual de Londrina – PR.

Resumo

A empatia é um comportamento social abrangente que, uma vez aprendido, pode funcionar como cunha comportamental para outros repertórios. Ensinar comportamentos empáticos às crianças pode contribuir para a aprendizagem de outros comportamentos sociais, bem como diminuir lacunas no repertório social de indivíduos autistas. Jogos podem ser usados para ensinar novos comportamentos e melhorar aqueles já aprendidos. Jogos podem contribuir para melhorar o engajamento de quem os usa e, consequentemente, o desenvolvimento de suas habilidades. O jogo Kahala foi desenvolvido com o objetivo de ensinar a classe "atender às necessidades do outro" às crianças. Este estudo teve como objetivo avaliar o jogo digital Kahala quanto a ensinar a crianças autistas a classe "atender às necessidades do outro de acordo com o contexto específico". Três autistas norte-americanos, com idades entre 8 e 14 anos, participaram deste estudo, jogando a versão digital do Kahala em quatro sessões de intervenção. Nas condições de pré e pós-teste, foram utilizados o QACEC, o jogo de tabuleiro Caçadores de Arco-íris e a situação avaliativa de colorir. Os resultados mostraram um aumento nas pontuações do QACEC de dois dos três participantes, que também demonstraram um melhor desempenho na Situação de Colorir e no jogo Caçadores de Arco-íris. Os dados indicam que o jogo digital Kahala é eficaz no ensino da classe "atender às necessidades do outro". No entanto, ainda são necessárias melhorias no design do jogo para aumentar o engajamento e a compreensão da história, além de ajustes nos critérios de progressão para refletir melhor o aprendizado dos jogadores.

Palavras-chave: empatia; jogos digitais; programação de ensino; programação de condições para desenvolvimento de comportamentos; crianças autistas

Eiterer, P. (2025). *Evaluation of the Kahala Computer Game to Teach Autistic Children to Meet Others' Needs.* Doctoral Thesis. PhD in Behavior Analysis, Universidade Estadual de Londrina, Londrina – PR.

Abstract

Empathy is a comprehensive social behavior that, once learned, can function as a behavioral cusp for other repertoires. Teaching empathetic behaviors to children can contribute to learning other social behaviors, as well as decrease gaps in social repertoires of autistic individuals. Games can be used to teach new behaviors and improve those already learned. Games can contribute to improving the engagement of those who use them and, consequently, their skill development. The Kahala game was developed to teach children empathetic behaviors. The purpose of this study was to evaluate the effects of Kahala computer game to teach autistic children to meet others' needs according to a specific context. Three American autistic children, aged 8 to 14 years, participated in this study by playing the Kahala computer game in four intervention sessions. In pretest and posttest conditions, the repertoire was assessed through an empathy questionnaire, a Coloring Situation and the board game Rainbow Hunters. The results showed an increase in the questionnaire scores for two of the three participants, who also performed better in the Coloring Situation and the Rainbow Hunters game. The data indicates that the Kahala computer game is effective in teaching the class "meeting others' needs". However, improvements are still needed in the game design to enhance engagement and increase understanding of the story, as well as adjustments to progression criteria to better reflect players' learning.

Keywords: empathy; empathic behavior; computer games; programming learning; programming of conditions to development of behaviors; autistic children

Empathy is a complex and comprehensive social behavior that, once learned, can function as a behavioral cusp[6] for other repertoires (Del Prette & Del Prette, 2005; Eiterer et al., 2023a; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992). The relevance of teaching empathetic behaviors to children is recorded in the literature. Teaching these behaviors can contribute to learning other social behaviors, as well as decrease gaps in social repertoires of autistic individuals (Del Prette & Del Prette, 2005). Games have been demonstrated as effective tools for teaching new behaviors and improving those already learned (e.g., Gris & Souza, 2016; Perkoski et al., 2018; Perkoski & Souza, 2015; Suzuki & Souza, 2022). Games can contribute to improving the engagement of those who use them and, consequently, their skill development (Gris & Souza, 2016; Linehan et al., 2009; Perkoski & Souza, 2015). The Kahala game was developed to teach children empathetic behaviors (Eiterer & Souza, 2021). Therefore, few studies evaluated its effectiveness. In this research, we investigate whether the Kahala game is effective in teaching empathetic behaviors to autistic children.

The Kahala (Eiterer & Souza, 2021; Eiterer et al., 2023b) is an educational game designed to teach children empathetic behaviors. Currently, the Kahala has an analog and a digital version to teach the more comprehensive behavior “meeting others' needs”, and its two less comprehensive behaviors: “identifying others' needs” and “sharing resources with others according to the specific context” (Eiterer et al., 2023b). All these behaviors were identified as

[6] A cusp is defined as “a behavior change that has consequences for the organism beyond the change itself, some of which may be considered important.” (Rosales-Ruiz & Baer, 1997, p. 534).

empathy prerequisite behaviors and are part of the decomposition diagram created by Eiterer et al. (2023a).

Empathy has been defined by Eiterer et al. (2023a) as a "comprehensive [social] operant behavior that has the function of welcoming another person without judging or denying their behaviors" (p. 9, our translation). They understand that empathy behavior is comprehensive because it includes prerequisite behaviors that should be learned in relation to others and that can be taught through operant principles (Eiterer et al., 2023a). In this study, we call "empathy" the more comprehensive behavior and "empathetic behaviors" its prerequisites. Among these prerequisite behaviors, there are two more comprehensive: (a) to evaluate the specific context and (b) to respond verbally and non-verbally according to the specific context (Eiterer et al., 2023a).

To demonstrate empathy, an individual must be able to evaluate the specific context and then respond verbally and non-verbally according to it. Evaluating the situation encompasses discriminating between the variables controlling one's own behavior as well as another's behavior, which contributes to understanding the others' behavior in various contexts (Eiterer et al., 2023a). Thus, the individual who can evaluate the specific context will also be more capable of comparing the function of their behavior to that of another's behavior (Eiterer et al., 2023a).

The behavior class "meeting others' needs" is part of the more comprehensive behavior "responding verbally and non-verbally according to relevant characteristics of the specific context" (Eiterer et al., 2023a). These were selected as target behaviors because they are prerequisite and precursor to most behaviors that constitute empathy (Eiterer et al., 2023a). Additionally, it is documented in the literature that social behaviors are complementary, so behaviors that require social interaction can function as behavioral cusp for each other (Del

Prette & Del Prette, 2005). For example, a child who is able to identify others' needs and share items will likely be more capable of initiating and maintaining friendships.

According to Del Prette and Del Prette (2005), empathetic behaviors are among the basic repertoires learned in childhood through interaction with peers and other members of the verbal community. Because these behaviors contribute to develop different repertoires, the earlier they are taught, the greater the probability that they will function as a behavioral cusp for other repertoires (Del Prette & Del Prette, 2005; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992).

It is especially important to teach autistic children empathetic behaviors because their diagnosis is also based on deficits in these behaviors. The diagnostic criteria for Autism Spectrum Disorder (ASD - DSM-V 299.0) includes persistent deficits in social communication and social interaction in multiple contexts as well as the presence of restricted and repetitive patterns of behavior, interests, or activities (American Psychiatric Association [APA], 2022). As empathy is a part of social repertoire (Del Prette & Del Prette, 2005) and autistic individuals have difficulties related to social interaction in general (APA, 2022), it is expected that autistic individuals have deficits in empathetic behaviors (Argott et al., 2017; Gena et al., 1996). Therefore, learning empathetic behaviors can decrease some gaps presented by autistic individuals in social repertoires.

Research shows that empathetic behaviors have been taught to autistic children through different resources. However, the studies often focus on recognizing and responding to others' emotions (Sanches et al., 2024). Although technological tools have shown promise in teaching these behaviors, the development of specific resources for this purpose is still in its early stages (Sanches et al., 2024). Therefore, it is relevant to thoroughly develop and evaluate these technological tools to ensure they can effectively improve the teaching of this complex social repertoire to autistic children.

According to the principles of Programming Conditions for Behavior Development, to affirm that a teaching program works as intended, learner responses should be compared before and after the learner uses the program (Botomé, 1970; Botomé, 1980; Cortegoso & Coser, 2011; Kienen et al., 2013). In this study, the Kahala computer game is the teaching program to be evaluated. It was developed following behavioral-analytical principles. However, there are not enough evaluation studies to confirm its effectiveness for teaching. Previous studies show that it is relevant to teach empathetic behaviors to autistic children and that games can be effective tools to do it (Argott et al., 2017; Gena et al., 1996; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992). Considering that the Kahala computer game was developed with the purpose of teaching empathetic behaviors and the lack of a study evaluating the effectiveness of this game, this study evaluated the effects of Kahala computer game to teach autistic children to meet others' needs according to the specific context. The effects of using the Kahala game for teaching were evaluated by recording participants' performance throughout the rounds and by comparing their performance in pretest and posttest sessions. Participants' performance in intervention sessions will serve as a guide for making future improvements and/or changes to the game.

Method

Ethical Concerns

The research study was approved by USU's Institutional Review Board (IRB) under the protocol number #14237. All participating children had the proper paperwork filled out and signed by parents before the study started. When parents showed interest in having their child participate and the child met the age range, parents read and signed the informed consent after having all their questions answered. During the first session with each child, they also signed the Informed Assent document.

Participants

Participants were recruited from ASSERT's mailing list[7,8] and were the same from study 2. Three North American autistic children that were enrolled in regular schools: Alicia, an 8-year-old girl; Jacob, an 11-year-old boy; and Sabrina, a 14-year-old girl. To protect participants' identity, fictitious names were used in this study. The inclusion criteria were an autism diagnosis, a comprehensive verbal repertoire, and low performance in empathetic behaviors. A comprehensive verbal repertoire was defined as "being able to complete schoolwork at a second-grade level". All of them had previously received clinical intervention for ASD but were not undergoing any treatment at the time of the study. The participants matched Kahala's target audience, and the study sessions were scheduled during their summer break.

Instruments and Materials

This study used the following instruments and materials: the Kahala game (Eiterer et al., 2023b), an empathy assessment questionnaire, a coloring activity, an assessing game, and personalized data sheets to each condition (Appendices C and D).

Kahala

In this study, Kahala's computer version was used (Eiterer et al., 2023b) to teach the behavioral class "meeting others' needs" to autistic children between 8 and 14 years old. The Kahala game (Eiterer et al., 2023b) was designed to teach three target behaviors: (1) identifying others' needs; (2) sharing resources with others according to the specific context; and (3) meeting others' needs according to the specific context. The first two target behaviors are prerequisites for the third one, which is more comprehensive.

---

[7] Autism Support Services: Education, Research, and Training (ASSERT) program is an autism training and research center at Utah State University (USU).

[8] ASSERT's mailing list is a database that includes the email address of parents who are interested in having their children participate in the ASSERT program or who are seeking additional resources for those with ASD. The mailing list is also for those who previously participated in the clinic.

The game's scenario is set in a post-apocalyptic city, where players must identify the needs of non-player characters (NPCs) and share resources with them. The NPCs presents them with a quest, which should function as an antecedent stimulus for one of the three target behaviors, based on their respective set. The game consists of four sets of quests, whose complexity varies according to the target behaviors demanded. Set 1 was designed to require the behavior “identifying others' needs”. Set 2 requires the player to “share resources with others according to the specific context”. Sets 3 and 4 were both designed to require the player to “meet others' needs according to the specific context”.

There are no topographical differences for the player's action across the sets. In every quest, players should give an item to the NPC. The main difference between the sets lies in the way the quests' content was designed. While the quests in Sets 1 and 2 are more concise and focus on identifying and sharing items, the quests in Sets 3 and 4 require a higher level of interpretation. Set 1 was designed to require the behavior “identifying others' needs”. Its quests consist of concise sentences designed to highlight whether a non-player character (NPC) is in need. Set 2 required the player to “share resources with others according to the specific context”. The item to be shared with each NPC is explicitly mentioned in the quest. Sets 3 and 4 were both designed to require the player to “meet others' needs according to the specific context”. Since this is the most comprehensive target behavior, its quests are presented twice to allow for more exposure to the teaching condition. These quests are longer excerpts in which the NPC contextualizes what happened to them, and the player should interpret which item would be most suitable to meet the NPC's needs according to the context described.

To progress in the game, the player must share an item with the NPC accordingly. If the player shares the correct item, they receive one point in the Trust Bar, the NPC says a thank-you message (e.g., “Thank you! I feel much better!”) and tells a fragment of the game's story. The game consists of four sets of quests, whose complexity varies according to the target

behaviors demanded. Set 1 was designed to require the behavior “identifying others' needs”. Set 2 requires the player to “share resources with others according to the specific context”. And Sets 3 and 4 were both designed to require the player to “meet others' needs according to the specific context”. In all cases, the player receives immediate feedback for their in-game actions. The game's main quest is to reach the bunker where the apocalypse survivors are hiding. The bunker is unlocked, and players need to properly complete all quests in each round to win the Kahala game. If the Trust Bar reaches zero, the player loses the game, and the round resets.

Empathy Questionnaire

The Questionnaire to Assess Affective and Cognitive Empathy in Children (QACEC – Zoll & Enz, 2010) was used because it is a standardized instrument for assessing empathy in children and adolescents. During its development, the authors gathered information from previously developed and validated empathy assessment scales (Bryant, 1982; Eisenberg, 1998; Garton & Gringert, 2005; Leibetseder, 2001). The QACEC (Annex B) consists of 29 statements, including one sample statement and 28 for testing. For each statement, the participant can answer with one of the following options: “I strongly disagree”, “I somewhat disagree”, “I don't agree or disagree”, “I somewhat agree”, or “I strongly agree”.

The researcher gave one printed copy to each participant complete individually in their first pretest session (SE1) and read the instructions aloud with them. After reading it, she asked if the participant had any questions and asked them to complete the example statement “I like school holidays”. Then, she checked if the chosen option matched their real opinion by asking “how do you like school holidays?”. If participant’s answer did not match their chosen option, the researcher explained again the meaning of each option and asked the example statement again until the participant demonstrated that they understood the task. After that, the researcher asked the participant to complete the other 28 statements and tell her once they have finished.

In this study, a rating score of 0 to 4 was assigned to each statement, according to the participant's response. That is, 0 point was scored for “strongly disagree” and 4 points for “strongly agree”. After the participant completed the questionnaire, the researcher added up all statements’ points, with a possible range between 0 and 112 points. The lower the score, the lower the empathy repertoire demonstrated by the participant. QACEC (Zoll & Enz, 2010) assessed the participants' verbal behavior regarding empathetic situations before and after the intervention. The QACEC (Zoll & Enz, 2010) was used as an inclusion criterion in the participant selection process and as a comparative measurement at the beginning of the posttest condition. Participants who scored below 100 points on the QACEC (Zoll & Enz, 2010) were considered to have a deficit in empathy prerequisite behaviors and were selected for the study. The three children with the lowest scores participated in this study.

Coloring Situation

The purpose of the coloring activity was to assess participants' behavior in a different setting by observing whether they could identify the researcher's needs and share the resources accordingly. During the activity, the participant and the researcher had a set of colored pencils and a picture that indicated which color should be used in each part. The participant was told to color their own picture with specified pencils. The colored pencils were placed inside two transparent cups, so that the participant could see the colors inside the researcher's cup. The participant had Picture A, all pencils needed to color Picture A, and three colored pencils needed for Picture B. The researcher had Picture B and some of the pencils needed to color Picture B, except the three missing colors that the participant had. The coloring situation lasted up to 20 min and was conducted at the beginning of the second pretest session (SE2), right before the assessment game.

Each participant completed the coloring activity twice, once in the pretest and another in the posttest. The situation was divided into three moments based on how the researcher

should behave. During the first moment (i.e., first three minutes), the researcher colored her own picture in silence. For the second moment (i.e., next three minutes), the researcher acted in three different non-verbal ways, being presented in the following order: looked inside her own cup, looked around, and put her hands on her head. For the third moment (i.e., last three minutes), the researcher said up to three different sentences, being presented in the following order: “I can't complete my picture”, “I wish I had all the pencils to complete my picture”, and “Three pencils are missing to complete my picture”. During the situation, the researcher did not ask directly for the colored pencils, but only used disguised mands.

The Coloring Situation was designed to be composed of three 3-minutes moments. However, it was terminated earlier when the participant shared all correct pencils before the time ended. It would also be extended up to 20 minutes if the participant chose to finish coloring the picture before moving to the next activity.

Assessment Game

The purpose of the Rainbow Hunters board game (*Caçadores de Arco-íris* – Sanches et al., 2023) was to evaluate the target behaviors in a similar situation without the reinforcer. The Rainbow Hunters game (Sanches et al., 2023) has one printed Letter size board (Figure 1), 24 quest cards (eight cards with a blue back, eight with a white back, and eight with a red back), two consequence cards, one rules card, 24 item tokens (six clothing tokens, six food tokens, six water tokens, and six medicine tokens), two pawns (one girl and one boy), and one D6 dice.

Figure 1

Rainbow Hunters' board

The cards' content is described in Appendix C. The quest cards have the same content as Kahala's (Eiterer et al., 2023b) quests but with some adaptations related to the story (e.g., the situation from the Kahala Game is “I tripped *during the blackout*! […] Could you give me some medicine?” this was adapted for the Rainbow Hunters (Sanches et al., 2023) to be “I tripped! […] Could you give me some medicine?”). The quests were distributed in three different groups according to their target behavior. Like in Kahala, there are no topographical differences for the player's action across the sets and the main difference between the sets lies in the way the quests' content was designed. Red cards consist of concise sentences and were designed to require the behavior “identifying others' needs”. In white cards, the item to be shared is explicitly mentioned and they were designed to require the behavior “sharing resources with others according to the specific context”. Blue cards have longer excerpts and were designed to require the player to “meet others' needs according to the specific context”.

The rules card describes the story, the game goal, and the rules. There are two Consequence cards (A and B). Consequence A was provided when the player reached the end

of the board path for the first time they played the game, and Consequence B, for the second time. There was no reward for the player when they completed each quest (i.e., the player delivering an item related to the quest), and there was no punishment when they didn't complete it as well. The Consequence (i.e., Consequence card A or B) was only provided when the player reached the end of the board path. The researcher read the rules card and then only observed the participant's behavior during the round.

Each participant played the Rainbow Hunters game twice, once in the pretest and another in the posttest. The Rainbow Hunters gameplay lasted up to 10 min and was played right after the coloring activity in both conditions. While the participant was playing the game, the researcher remained seated in silence across the table, observing the gameplay and available to answer any usability questions if needed.

Procedure

Participant’s performance in empathetic behaviors was assessed during the study's first two sessions, during the Pretest condition, and in the last session, during the Posttest condition. This was assessed using an empathy assessment questionnaire, a coloring activity, and Rainbow Hunters board game. All three participants completed four sessions with the Kahala game (Eiterer et al., 2023b) during the Intervention condition. Each participant completed seven sessions: two Pretest (i.e., SE1 and SE2), four Intervention (i.e., SI1, SI2, SI3 and SI4), and one Posttest (i.e., SO). The sessions were scheduled based on participants' availability. Table 1 shows the distribution of experiment sessions for each participant. Since the sessions were scheduled based on participants’ availability, there had to be an interval between some sessions. In the table, this interval is represented by the blank spaces.

Table 1

Distribution of experiment sessions for each participant

Day	Alicia	Jacob	Sabrina
1	1st Pretest Session (SE1)	1st Pretest Session (SE1)	1st Pretest Session (SE1)
2	2nd Pretest Session (SE2)		
3	1st Intervention Session (SI1)		
4	2nd Intervention Session (SI2)	2nd Pretest Session (SE2)	
5	3rd Intervention Session (SI3)		
6	4th Intervention Session (SI4)	1st Intervention Session (SI1)	
7		2nd Intervention Session (SI2)	2nd Pretest Session (SE2)
8	Posttest Session (SO)		1st Intervention Session (SI1)
9		3rd Intervention Session (SI3)	2nd Intervention Session (SI2)
10		4th Intervention Session (SI4)	3rd Intervention Session (SI3)
11		Posttest Session (SO)	4th Intervention Session (SI4)
12			Posttest Session (SO)

The Pretest and Posttest conditions were similar so that the target behaviors could be evaluated with the same instruments at the beginning (i.e., pretest) and at the end (i.e., posttest) of the experiment (Cooper et al., 2020). The Posttest condition occurred after the Intervention condition ended for each participant. It was arranged to observe whether participants would behave appropriately in a similar situation without the reinforcer (i.e., Rainbow Hunters game), and in a different setting (i.e., Coloring Situation). This is a way to check if target behaviors

are being maintained only by the consequences in the teaching condition or if they were learned and generalized (Cooper et al., 2020; Cozby, 2006).

Pretest

There were two pretest sessions. The first one lasted up to 12 min. The participant filled out the Informed Assent and the QACEC (Zoll & Enz, 2010). The questionnaire was provided individually on printed material in a soundproof room, containing a table, computer, and chairs. The researcher sat next to the participant, read the instructions aloud, and answered questions about it. The researcher waited until the participant answered the sample statement (i.e., “I like school holidays”), and then she checked with them if there was a match between their answer and their actual opinion by asking them: “Do you like school holidays?”.

The second Pretest session lasted up to 23 min. At first, the Coloring Situation was run, and then the participant played one round of the Rainbow Hunters game (Sanches et al., 2023) after that. The researcher arrived approximately 10 min early, arranged a table and two child-sized chairs in the center of the room, and set up a camera behind the participant's chair to capture both the researcher and participant. All session materials were pre-organized under the researcher's chair, and sharpened colored pencils were divided into two clear cups. After entering the room, the researcher guided the participant to sit on the chair near the camera, while she took the other chair, and said “Today we are going to do a coloring activity”. The researcher retrieved the prepared materials, read the Coloring Situation protocol instructions (Appendix E), and handed over the materials as they were mentioned. The researcher then started a timer and began coloring the picture in silence.

After completing the Coloring Situation, the researcher asked if the participant wanted to take the picture home, collected the materials, and said, "Now, you are going to play a board game". For the Rainbow Hunters game, the researcher placed the board in front of the participant, stacked the item tokens in their designated spots, and arranged the cards into three

piles on the right side of the board. The researcher asked the participant to choose a character, then the researcher placed the pawn and dice at the beginning of the board path, read the rule card, answered participant's questions, and instructed the participant to read the cards aloud during the game.

Intervention

The Intervention condition consisted of four sessions with the Kahala game (Eiterer et al., 2023b) that lasted from 8 to 33 min. These sessions were the same from Study 2. During the game, the participant's behaviors were followed by the in-game consequences as indicated in the Teaching Contingencies Table (Appendix A). To verify the effectiveness of the in-game consequences, players were provided up to three opportunities in each session to try to win that round. For example, in the first session, the researcher selected Set 1 of NPCs and the player had the opportunity to play the round with this same set of NPCs up to three times in the same session if they didn't win the game on the first or second attempts. When the Trust Bar reached zero and the participant did not complete the eight NPCs' quests in a set, the researcher restarted the round in the same set, so the participant could play all over again. After the participant shared the correct items with the eight NPCs, the session ended.

Posttest

The Posttest condition had one session that lasted about 29 min and was similar to the two Pretest sessions. At first, the participant filled out the QACEC (Zoll & Enz, 2010) again. Then the Coloring Situation was run, and the participant played a Rainbow Hunters' (Sanches et al., 2023) round.

Data Analysis

The data were collected once per participant but were analyzed under different criteria in Studies 2 and 3. The purpose of this study was to evaluate the effects of Kahala computer

game to teach autistic children to meet others' needs according to a specific context. Therefore, participants' performances in Pretest and Posttest sessions and the frequency of target behaviors during the gameplay were analyzed to verify the teaching.

All sessions were filmed, and the participants' performance was recorded afterward based on video analysis. Figure 2 shows a sample of Pretest and Posttest Recording Data Sheet (Appendix E), where the information from each activity was recorded separately.

Figure 2

Sample of Pretest and Posttest Recording Data Sheet

Coloring Situation			
Period	**Sd**	**Response**	**Obs.**
0 – 3'	The presence of researcher's pencils	+ – + – + –	
3 – 6'	Researcher looking into her own cup	+ – + – + –	
	Researcher looking around	+ – + – + –	
	Researcher putting her hands on her head	+ – + – + –	
6 – 9'	"3 pencils are missing to complete my picture"	+ – + – + –	
	"I wish I had all the pencils to complete my picture"	+ – + – + –	
	"I can't complete my picture"	+ – + – + –	

Rainbow Hunters Game (Sanches et al., 2023)				
Move	**Card Color**	**Card Content**	**Response**	**Obs.**
1			+ –	
2			+ –	
3			+ –	
4			+ –	
5			+ –	
6			+ –	

For the Coloring Situation, plus (+) and minus (-) signs were used to respectively record whether or not the participant shared the appropriate pencils in each moment in the activity (i.e., initial 3 min, intermediate 3 min, and final 3 min). While analyzing pretest and posttest videos, the researcher noted when the participant behaved appropriately and the researcher's prior behavior. It was considered appropriate if the participant shared the correct pencils with the researcher.

For the Rainbow Hunters game (Sanches et al., 2023), the color and content of the card drawn in each move were recorded. Plus and minus signs were used to indicate respectively whether or not the participant shared the correct item for each quest. It was considered appropriate if the participant shared the item as described in the teaching contingencies table (Appendix A).

Figure 3 shows a sample of the Game Evaluation Recording Data Sheet, used to record data from the intervention sessions. For each round with the Kahala game (Eiterer et al., 2023b), the following were recorded: (a) quests' order; (b) NPC identification; (c) whether the player shared the correct item, as described in the teaching contingencies table (Appendix A). Each attempt was recorded separately. For instance, if the participant failed three times to deliver the item to NPC A1 but succeeded on the fourth attempt after receiving a tip from the researcher, that would be recorded as four attempts: three errors and one correct response. It was considered appropriate if the participant shared the item as described in the teaching contingencies table (Appendix A).

Figure 3

Sample of Game Evaluation Recording Data Sheet

Quest	NPC's ID	Hit	Usability	Engagement	Levels of assistance	Obs.
1						
2						
3						
4						
5						
6						
7						
8						

To evaluate the teaching of target behaviors, the participants' performances were analyzed regarding the QACEC (Zoll & Enz, 2010) scores, the number of pencils shared and the delay to do it in the Coloring Situation, the number of correct answers in the Rainbow Hunters game (Sanches et al., 2023), and the number of attempts needed to complete Kahala's quests.

Results

QACEC scores are shown in Table 2. Alicia had an increase of 17.86% from pretest to posttest, Jacob had an increase of 5.36%, and Sabrina had no change in her score. The table shows the participant's raw score followed by the corresponding percentage provided in parentheses.

Table 2

Participants' scores in QACEC in pretest and posttest conditions

Participant	Pretest	Posttest	Difference
Alicia	71 (63.39%)	91 (81.25%)	+20 (17.86%)
Jacob	42 (37.50%)	48 (42.86%)	+6 (5.36%)
Sabrina	96 (85.71%)	96 (85.71%)	0 (0.00%)

Sometimes there may be a discrepancy between saying and doing (Catania, 1999). Since QACEC (Zoll & Enz, 2010) measures only verbal behavior, the Coloring Situation and the Rainbow Hunters game (Sanches et al., 2023) were designed to improve the assessment. The Coloring Situation evaluated the generalization to *other stimuli* and in *another setting*.

Figure 4 shows the number of pencils that participants shared with the researcher during the Coloring Situation in the pretest and posttest. Alicia shared the three pencils 2 min earlier in the posttest than in the pretest. Jacob and Sabrina each shared the pencils 1 min earlier, with Jacob sharing one more pencil in the posttest compared to the pretest.

Figure 4

Participants' performance in Coloring Situation

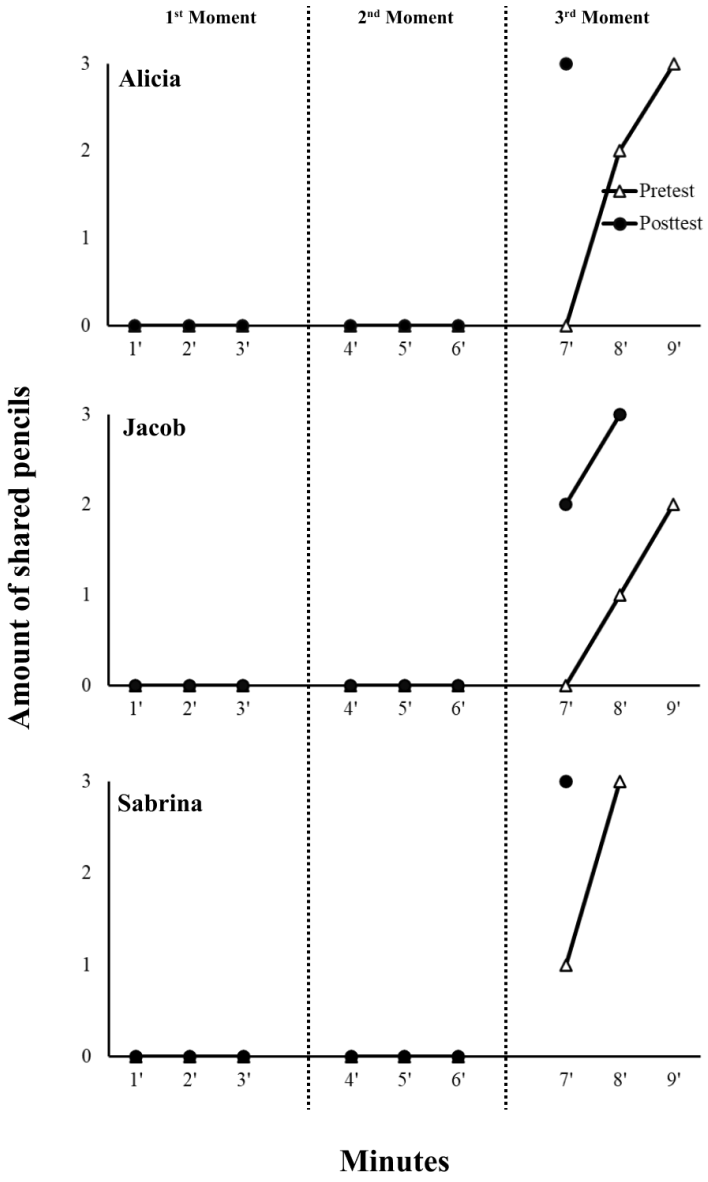
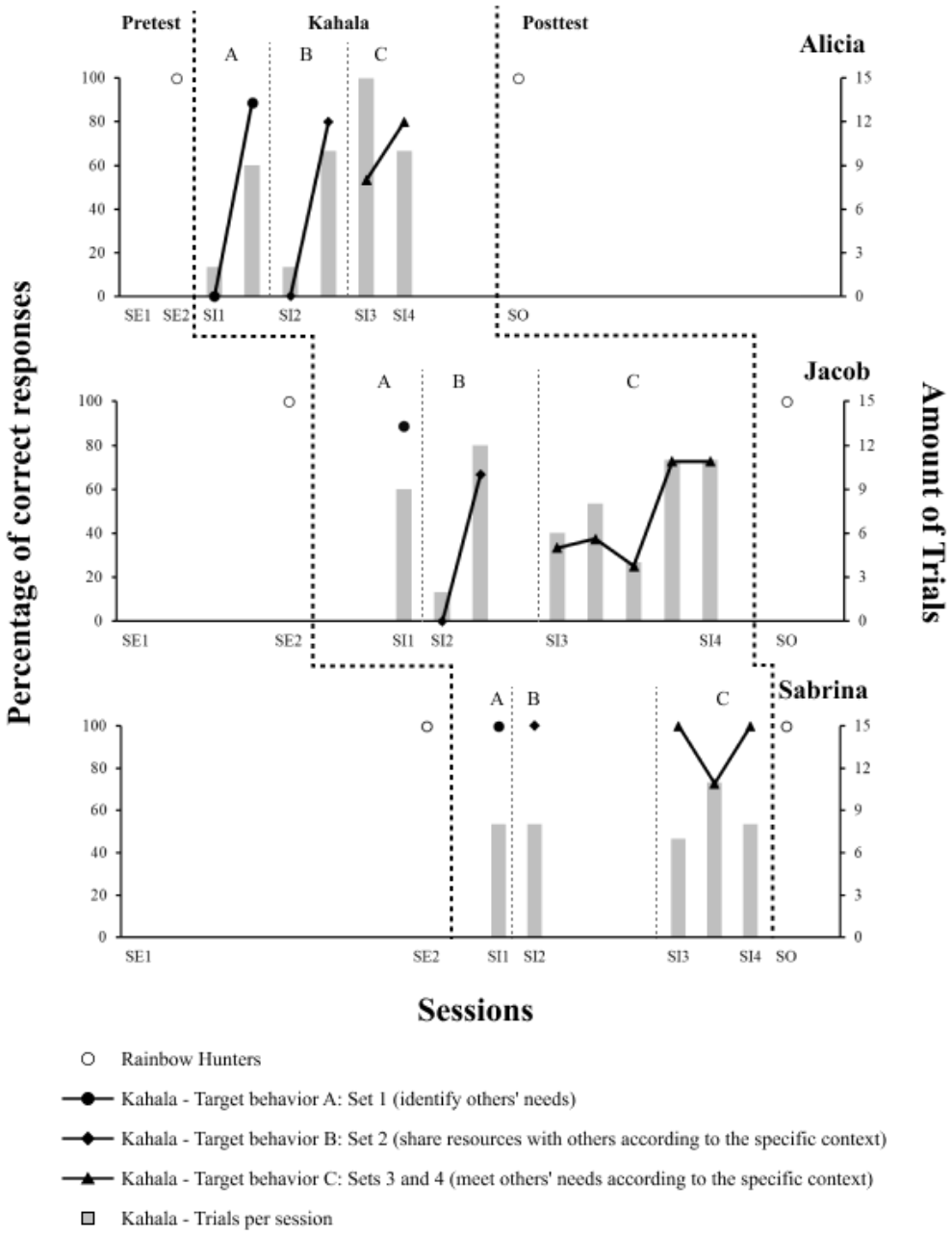


Figure 5 shows the percentage of each participant's correct answers in the Rainbow Hunters (Sanches et al., 2023) and the Kahala (Eiterer et al., 2023b) games. The Rainbow Hunters game (Sanches et al., 2023) evaluated the learning and generalization of the target behaviors to similar stimuli. The three participants completed the Rainbow Hunters' rounds after an average of five to six cards and achieved 100% accuracy in both the pretest and posttest.

Figure 5

Participants' performance in the Rainbow Hunters and the Kahala games



Each target behavior of the Kahala game (Eiterer et al., 2023b) was represented separately in Figure 5, and each line was drawn according to the number of rounds the participant played. For behaviors A and B, participants would play between one to three rounds each. For behavior C, participants would play between two to six rounds. They had to complete all the quests at least once. However, only the first attempt with each NPC was counted when calculating the percentage of correct responses.

Each set of quests has eight NPCs. To win, the player must share the correct item requested by all of them. If the player succeeds on their first trial, the round ends after eight attempts. However, some rounds ended after two attempts when the participant had two consecutive errors at the beginning of the round, while others ended after 15 attempts. For instance, Alicia succeeded six consecutive times but needed eight attempts to share the correct item with the penultimate NPC, whose quest was "I need to go to the hospital and find my friends, but I can't walk! I'm feeling weak". Therefore, the number of attempts required to complete the round also indicates the degree of difficulty faced by participants during the intervention sessions. In Figure 5, the number of attempts per round is represented by the bars on the secondary axis.

Although the participants achieved 100% accuracy in both the pretest and posttest of Rainbow Hunters (Sanches et al., 2023), all of them had difficulty in at least one of the Kahala (Eiterer et al., 2023b) sets. Alicia finished with about 80% to 88% accuracy in the final round of each target behavior. In the SI1 and SI2 sessions, she had two consecutive errors in the first round while struggling to understand game's mechanics. So, she played another round to complete the eight NPCs' quests in the respective sets, totaling two rounds in each session. This difficulty in understanding gameplay may have biased the data due to ambiguity about control variables affecting player difficulty in the initial round from sessions SI1 and SI2. She might have needed more rounds to win in these two sessions, not due to a lack of empathy, but rather because of gaps in the game's instructions regarding gameplay. In the SI3 session, Alicia finished in one round, but needed eight attempts to complete the C2 task, which was the penultimate NPC she interacted with. The participant was expected to share food with the NPC, but Alicia kept trying to share medicine. In SI4, Alicia still had difficulty with C2, but had fewer errors, needing three attempts to get the quest right and finished the round with five fewer attempts than in SI3.

Jacob had more difficulty in target behaviors B and C, needing to play two rounds for behavior B and five for behavior C. In the behavior A round (SI1), he finished with 88.89% accuracy. Regarding behavior B, he had an increase from 0% to 66.67% accuracy, requiring 12 attempts to complete the second round. Four attempts were needed to share the correct item with NPC B4 and two attempts for B2. In behavior C rounds (SI3 and SI4), there was an increase in accuracy from 33.33% to 72.73%. However, in the last two rounds, the participant needed 11 attempts to complete the quests, with most of the errors (83.33%) related to NPC C2. The participant was expected to share food with the NPC, but Jacob kept trying to share water and medicine.

Among the three participants, Sabrina had the least difficulty with target behaviors throughout all the activities performed. She completed all intervention sessions with the fewest rounds and the highest accuracy percentages, scoring 100% in the rounds for target behaviors A and B (SI1 and SI2). In session SI3, she completed seven quests on the first attempt but accidentally closed the game and had to play another round. In the second round for target behavior C, she had three errors with NPC C2 and scored 72.73%. The participant was expected to share food with the NPC, but Sabrina kept trying to share medicine. However, in the last intervention session (SI4), Sabrina needed only one round to complete all quests and scored 100%, finishing within eight attempts.

Discussion

The purpose of the current study was to evaluate the effects of Kahala computer game to teach autistic children to meet others' needs according to a specific context. After playing the Kahala game (Eiterer et al., 2023b), all participants showed some modifications in their repertoire of “meeting others' needs”. Alicia and Jacob showed an increase in QACEC (Zoll & Enz, 2010) scores of 17.86% and 5.36%, respectively. Although QACEC assesses only verbal

behavior, it is a validated instrument to measure empathy in individuals aged 8 to 14 years old (Zoll & Enz, 2010). The use of indirect measures can be helpful to assess behaviors that are not easily observable or that are not feasible to observe due to research logistics (Cooper et al., 2020; Cozby, 2006). Additionally, when taught through modeling, changes in verbal behavior can be followed by changes in non-verbal behavior (Catania et al., 1990; Catania et al., 1982; Catania et al., 1989; Cavalcante & Carrara, 2007). Therefore, Alicia's and Jacob's higher scores in the post-test suggests improvement in their empathy repertoire after playing the Kahala computer game (Eiterer et al., 2023b).

On the other hand, Sabrina maintained the QACEC (Zoll & Enz, 2010) score unchanged between the pretest and the posttest. Her score was the highest among the participants (i.e., 85.71%), leaving less room for improvement. However, other empathy prerequisite behaviors were observed during the Coloring Situation in the posttest. During this activity, Sabrina asked many questions about the researcher's interests, such as preferred movie genres, if she had any pets, and her favorite books. These questions can be interpreted as part of the empathy repertoire, aligning with the comprehensive behavior "evaluating the present situation" (Eiterer, 2021). By investigating the researcher's interests, Sabrina sought to understand the consequences that act as reinforcers for the researcher. Considering the maintenance of the QACEC (Zoll & Enz, 2010) result and the modification in her behavior during the Coloring Situation, it is hypothesized that the main deficits in this participant's empathy repertoire were in other prerequisite behaviors that the Kahala game (Eiterer et al., 2023b) was not designed to teach. It may be relevant for future studies to develop other tools to teach the remaining empathy prerequisite behaviors. Such teaching could also be done through games and/or other technologies.

The data collected by Sanches (2024) with Kahala's board version indicated that each participant's QACEC (Zoll & Enz, 2010) score corresponded to their respective performance in the Kahala game (Eiterer et al., 2023b). Three participants increased (i.e., 4%, 14%, and 2%) and one participant decreased (i.e., 7%) their QACEC score (Sanches, 2024). The participant whose score decreased was the one who showed the greatest loss of engagement in the final intervention sessions (Sanches, 2024). This reduction in engagement may have contributed to the decrease in her performance in both the Kahala (Eiterer et al., 2023b) and the QACEC (Zoll & Enz, 2010). Therefore, it is necessary to improve the planning of contingencies in the game to promote greater engagement.

In addition to the evidence from the evaluation instruments, the only mistakes made by Sabrina in the rounds with the Kahala computer game (Eiterer et al., 2023b) were related to NPC C2. The participant's errors with this NPC might have occurred due to a failure in planning the contingencies. All three participants in the present study attempted to share medicine or water with NPC C2, as did two participants in Sanches' study (2024). Before further uses of the Kahala game (Eiterer et al., 2023b), the quest from NPC C2 should be rephrased to align the instruction and the requested item better. For instance, request medicine instead of food. Similarly, the quests for NPCs C6 and C8 should be reviewed, since Jacob had difficulty in the present study as well as the participants in Sanches' study (2024).

In Sets 1 and 2, Jacob quickly read the NPC's quest and interrupted the audio when finished reading. He shared the correct item in 88.89% of attempts in session SI1 and in 57.14% of attempts in SI2. In the first three rounds of Set 3, Jacob scanned the quest text and delivered the items by trial and error. Due to this behavior pattern, Jacob needed help in more consecutive sessions than the other participants. In the third round of Set 3, the game was interrupted by a technical issue, and the researcher allowed the participant to play four rounds in the same

session. In the last two games of the study, Jacob read the quests quickly but fully read them. In these two rounds, he performed better, finishing both with an accuracy of 72.73%.

Nevertheless, the three participants in this study showed better performance in the Coloring Situation posttest compared to the pretest, which evaluated generalization between contexts and stimuli. Alicia and Sabrina shared all three pencils in both conditions, but the delivery occurred earlier in the posttest. Jacob only shared two pencils in the pretest but delivered all the pencils in the posttest and in less time than in the pretest. These data corroborate Sanches (2024) findings, where two participants shared earlier and more pencils in the posttest than in the pretest. However, in Sanches (2024) study, one of the participants shared pencils in the second moment of the Coloring Situation, whereas in this study, all participants shared the pencils within the third moment of the posttest Coloring Situation.

In the third moment of the Coloring Situation, three disguised mands were presented, each adding new information about the researcher's needs and functioning as a gradual prompt fade-in (Cooper et al., 2020). Sharing more pencils in less time within the third moment indicates that the researcher's prompts had greater control over the participants' behavior after playing the Kahala (Eiterer et al., 2023b). These data suggest a generalization of target behaviors between settings (Catania, 1998/1999; Cooper et al., 2020). The antecedent stimuli of all quests in the Kahala game (Eiterer et al., 2023b) are direct or disguised mands. Mands are verbal behaviors emitted under deprivation or aversive stimulation control, reinforced by a specific consequence, and primarily benefit the speaker (Skinner, 1957). Both in the Kahala (Eiterer et al., 2023b) and in the third moment of the Coloring Situation, the antecedent stimuli for the target response were verbal responses from another individual (i.e., NPC or researcher) demonstrating the deprivation of some item (e.g., “I'm thirsty”; “I wish I had all the pencils”)

or the presence of an aversive stimulus (e.g., “I'm getting sunburned”). The participants showed learning and generalization of meeting others' needs in response to direct or disguised mands.

If they had shared the pencils in the second moment, it could also be considered generalization between stimuli, as the researcher only exhibited non-verbal behaviors indicating discomfort. On the other hand, the first moment of the Coloring Situation, when the researcher colored the drawing silently, allowed the use of the Manipulation Test (Cozby, 2006). The lack of pencil sharing in the first moment suggests that the participants were under the control of the situation itself, rather than the pre-test condition to which they had already been exposed. This data supports the interpretation of behavior generalization between contexts, observed in the third moment of the Coloring Situation. Nonetheless, it cannot be ruled out that building a rapport with the researcher during the study may have influenced the participants' behaviors. Therefore, for future studies, it is suggested that the generalization's assessment be conducted with different individuals, including peers.

In the Rainbow Hunters game (Sanches et al., 2023), on the other hand, differential consequences were not designed for each participant's response. However, the mechanics are simpler and more intuitive, as the participants only had to roll the dice to advance along a track. The simplified mechanics were designed to avoid interruptions during testing and to ensure that participant data would not be biased. Due to the low complexity of this assessment game, the reinforcement history with track games may have been sufficient to keep participants engaged in the context of Rainbow Hunters (Sanches et al., 2023).

Visualizing the entire board at once likely made it easier to understand the goal to be achieved and to keep players focused on solving the game's main quest in both the pretest and posttest. However, the reduced track's size may have contributed to all participants achieving 100% accuracy in both Rainbow Hunters (Sanches et al., 2023) rounds. Among the 24 game

cards, participants answered 5 to 6 cards during the rounds, being exposed to approximately 20% to 25% of the designed situations. In Sanches (2024) study, two participants showed an increase in score from 80% to 100% in the Rainbow Hunters game (Sanches et al., 2023), one decreased from 100% to 83.33%, and the other kept a score of 100%. Based on this difference among the participants' data in both studies, it is hypothesized that the sample size of withdrawn cards in the Rainbow Hunters game (Sanches et al., 2023) may not have been large enough to assess the behaviors in which the participants had deficits. In the present study, the data from the other assessment activities (i.e., QACEC and Coloring Situation) made it possible to identify the improvement in the participants' repertoires. However, for future studies, it is suggested that the Rainbow Hunters game (Sanches et al., 2023) also be redesigned and evaluated through an iterative design process to function as a more accurate instrument.

Sanches (2024) was a pioneer in evaluating the Kahala (Eiterer et al., 2023b) with children and made it possible to verify, in the first instance, that it was playable. Despite the differences in technology and target audience between the two studies, the comparison between them shows some consistency in the results. However, it is still necessary to highlight that the Kahala game (Eiterer & Souza, 2021; Eiterer et al., 2023b) was designed to be used by autistic children. As empathy is a part of the social repertoire and autistic individuals have difficulties related to social interaction in general (APA, 2022), it is expected that autistic individuals have deficits in empathetic behaviors (Argott et al., 2017; Gena et al., 1996). Considering that behaviors that require social interaction can function as a behavioral cusp for each other (Del Prette & Del Prette, 2005), learning empathetic behaviors could decrease some gaps presented by autistic individuals in social repertoires. The questions asked by Sabrina during the posttest's Coloring Situation (i.e., questions about the researcher's interests) could be indicative of improvement in general social interaction by learning some social behaviors. However,

programmed test conditions are still needed for formal generalization verification between behaviors.

Validating a computer game designed to teach social behaviors could improve the development of social skills with this audience. Some autistic individuals report a preference for virtual interactions, while others may have deficits in prerequisites for social interaction (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). Interventions with autistic individuals often focus on basic social behaviors, such as eye contact and emotion recognition (Grossard et al., 2017). With these individuals, teaching these skills in person can make the intervention aversive and unfeasible (Gillespie-Lynch et al., 2014; Grossard et al., 2017; Rezayi et al., 2023). However, computer games could be an introduction to the intervention and facilitate the transition to interpersonal intervention later. Social behaviors taught through digital games could function as a behavioral cusp for the development of prerequisite behaviors related to social interaction (Del Prette & Del Prette, 2005; Gresham, 2016; Gresham & Elliott, 2008; Walker et al., 1992).

The literature demonstrates that using cooperative games in interventions with autistic individuals have the most meaningful results (Castro et al., 2017; Gresham, 2016; Salen & Zimmerman, 2004). Although the game Kahala (Eiterer et al., 2023b) is single player, its mechanics were designed in such a way that the player must cooperate with the NPCs throughout the entire game to win. The player's character's relationship with the NPCs in the Kahala (Eiterer et al., 2023b) simulates real-world interactions, where one person needs a resource that another possesses and can share without detriment to themselves. The cooperative relationship between the characters in the game may have favored the generalization of the behaviors of meeting others' needs to another context (i.e., Coloring Situation) due to the similarity between the conditions, even if simulated. In summary, it could be said that Kahala

has cooperative features and this may favored the generalization, but contingencies to improve generalization to other contexts should still be planned.

During the computer version's evaluation, participants wandered around the map, finding NPCs and resources accidentally. That is an indicator that the game lacks information about the main quest and NPCs' positions. Walk around the map could be considered a good indicative of engagement. Although, during the playtest sessions, players were wandering around, without knowing where to go and trying to figure out what to do to finish the game. Future versions of Kahala should implement features that help players figure out their tasks, but keeping the possibility to explore the map and interact with elements around it.

Considering that the Kahala (Eiterer et al., 2023b) is an educational game, it is necessary to program contingencies so that the player spends more gameplay time engaged in target behaviors rather than in concurrent behaviors that do not contribute to advancing the round (e.g., wandering around the map, testing every element in the scenario). For these concurrent behaviors, it is recommended to plan contingencies to provide a challenge-free learning experience.

Jacob required the most rounds to complete all sets. He interrupted 95% of the story fragments, 61% of the thank-you messages, 48% of the quest narrations, and 100% of the Rules Messages throughout the study. Jacob's interactions with the storyline may have influenced his performance drop in Sets 3 and 4, which required a greater understanding of the context to identify the NPCs' needs. In Sanches (2024), three participants asked not to read the story fragments after completing the quests. Among them, one showed a performance drop in Sets 3 and 4, and another one in Set 4. Considering that Sets 1 and 2 required prerequisite behaviors from the general class "meeting others' needs", the quests presented by the NPCs were simpler and were not accompanied by a long storyline for contextualization, as it is in Sets 3 and 4.

The data from these participants indicate the importance of reviewing both versions of the Kahala game (Eiterer et al., 2023b) regarding how understanding its story can affect the target behaviors' learning curve. When Bruckman (1999) discussed educational games, he emphasized the importance of contextualizing the target behaviors within the game's story so that the final product would not seem like “chocolate-dipped broccoli” (p. 75). By this metaphor, he criticized educational games that adorned the screen with attractive scenarios and characters, but whose target behaviors did not blend with the scenario's theme (Bruckman, 1999). In these cases, the player responds to a sequence of decontextualized tasks, and educators still need to plan breaks between sessions to give access to another game that is indeed fun (Bruckman, 1999). He stated that the decorations on the screen would work as a tasty coating (i.e., like chocolate) for something nutritious and unpleasant (i.e., like broccoli). The result, in this case, is a material that promotes neither the learning nor the engagement it proposes. According to him, these games convey the subliminal message that learning is boring and competes with more enjoyable activities that can only be accessed after completing the game's tasks (Bruckman, 1999).

Although repeating the teaching condition is important to promote more effective learning, it should be noted that requiring the exact same response to the same stimulus multiple times can lead to the development of rote responding and hinder the generalization of what has been learned (Kubo & Botomé, 2001; Skinner, 1968/2003). For more effective teaching, it is important to plan contingencies so that the learner develops a robust repertoire capable of varying their behavior according to the nuances of everyday situations (Skinner, 1968/2003). In an educational game, these contingencies are planned through the contextualization of in-game actions. In game design, quests can be arranged in such a way that similar stimuli select responses within the same class, that vary based on context's nuances (Souza et al., 2019).

Considering that meeting others' needs is a class of social behaviors, it is believed that contextualizing these behaviors within the game's storyline is even more necessary to enable generalization to contexts outside the game (Gresham, 2016; Souza et al., 2019). In the Kahala (Eiterer et al., 2023b), NPCs were designed to present varied situations in which the player has to respond accordingly. However, the data from Jacob in this study and the other three participants in Sanches (2024) suggest that the contextualization of these behaviors still needs to be improved so that it happens more smoothly and works adequately for all players. To enhance in-game context, story fragments could have a clearer role, requiring players to use the information gathered to solve a puzzle at the end of the round, for example.

Another way to contextualize the target behaviors would be through non-verbal stimuli that constantly remind the player of the game's plot in a subtle manner. Teaching can be more effective when verbal instructional contingencies are accompanied by non-verbal elements that increase the likelihood of the learner behaving accordingly, especially when the rules do not clearly describe the relationship between the behavior and the consequences it produces (Catania, 1998/1999). When planning the responses to be required within the Kahala (Eiterer et al., 2023b), the researchers were particularly concerned with not including verbal responses. However, for the antecedent and consequent stimuli, only verbal behaviors were planned to NPCs, which may characterize a rule-based teaching (Catania, 1998/1999). In the Kahala (Eiterer et al., 2023b), the game's aesthetics are consistent with the plot, with elements in the scenario representing destruction due to the apocalypse. But most of the plot is presented through the NPCs' dialogues. Introducing other elements that function as non-verbal stimuli to contextualize the player's actions can be beneficial in two ways: (1) increasing the player's engagement, providing greater immersion in the story's context, and (2) improving the acquisition of target behaviors by more effectively illustrating the connection between player

responses and environmental changes during gameplay, allowing users identify reinforcers for appropriate behavior. (Bruckman, 1999; Catania, 1998/1999; Souza et al., 2019).

Overall, the results suggest that the Kahala game (Eiterer et al., 2023b) may be effective in teaching its target behaviors. Data collected in the pretest and posttest conditions suggest that all participants learned and generalized, to some extent, the behaviors of the "meeting others' needs" class. By comparing the data from both conditions, it is noted that all participants became more attuned to the researcher's needs in the Coloring Situation, responding more quickly and/or sharing more pencils after playing the Kahala (Eiterer et al., 2023b). Regarding the QACEC (Zoll & Enz, 2010), Alicia and Jacob also demonstrated an increase in score, suggesting an expansion of their empathizing repertoire. However, studies with larger samples will be necessary after the game has been reformulated as suggested in this study. Larger samples could provide more robust data and reduce the impact of outliers, increasing the reliability and accuracy of the evaluation.

Considerations

Given that the Kahala (Eiterer et al., 2023b) is an educational game, it is essential that its evaluation aligns with the methodologies used for other educational games and teaching programs. This way, it can be improved and better suited to its educational purposes (Perkoski & Souza, 2015; Souza et al., 2019). The version used in this study expands the range of possibilities in social skills training, as it used a single-player computer game to teach behaviors that are usually learned in interpersonal relationships. Using a digital tool for this purpose can extend teaching beyond the clinic (Choi & Limb, 2010; Hiniker et al., 2013) and allow parents to stimulate social skills repertoire at home, even when the child is using an electronic device. Additionally, a digital tool can be a less aversive strategy to start teaching social behaviors to some autistic individuals who have greater deficits in interacting with others.

Adjustments to the procedures are recommended, including reviewing session distribution, advancement criteria, and assessment tools. Although sessions were planned to reduce participant burden, their duration of less than 30 minutes may be impractical for some families due to logistical considerations. Participants often have to travel significant distances to attend the sessions, which can be time-consuming and expensive. When considering the preparation time before and after each session, some parents think that the brief duration does not justify the effort and resources expended. Future research should consider scheduling activities for extended sessions with a set duration, like 50 minutes, to enhance participant comfort and improve the research process's efficiency.

In the current version of the Kahala (Eiterer et al., 2023b), players advance by completing all NPC quests. However, this may not always reflect true learning. Depending on the order in which the player approaches the NPCs, they might win the game by completing some quests through trial and error, since hits and errors are accounted for in the Trust Bar. Accidental errors can also unfairly deduct points and cause the game to end. To better serve the Kahala's educational purpose, it is recommended to revise the points system and advancement criteria to reward genuine expertise rather than trial and error. For instance, the progress in the game could depend on the percentage of correct responses rather than completing all quests.

References

American Psychiatric Association. (2022). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed., text rev.). Arlington, VA: American Psychiatric Association Publishing.

Argott, P. J., Townsend, D. B. & Poulson, C. L. (2017). Acquisition and Generalization of Complex Empathetic Responses Among Children with Autism. *Journal of Autism and Developmental Disorders*, 10(2), 107-117.

Botomé, S. P. (1970). *Princípios básicos para programação de ensino*. Texto adaptado de um programa reproduzido com a permissão de "Teaching Machines Incorporated – a Division of Grolier Incorporated, instituição a quem pertence o original do qual foi feita a adaptação por Botomé, utilizada exclusivamente para fins didáticos. Texto não publicado.

Botomé, S. P. (1980). *Objetivos Comportamentais no ensino: a contribuição da Análise Experimental do Comportamento*. [Doctoral dissertation, Universidade de São Paulo]. Repositório da Produção USP. https://repositorio.usp.br/item/000710311

Bruckman, A. (1999). *Can educational be fun?* [Apresentação de artigo]. Game Developers Conference '99, San Jose, CA, Estados Unidos.

Bryant, B. K. (1982). An index of empathy for children and adolescents. *Child Development*,*53*, 413-425.

Castro, T., Castro, A., Lima, D., & Bjorn, P. (2017). Model Playground for Autistic Children: Teaching Social Skills through Tangible Collaboration. *IEEE 17th International Conference on Advanced Learning Technologies*, 441-445.

Catania, A. C. (1999). *Aprendizagem: Linguagem, comportamento e cognição*. Porto Alegre: Artmed. (Original work published 1998)

Catania, A. C., Lowe, C. F., & Horne, P. (1990) Nonverbal behavior correlated with the shaped verbal behavior of children. The Analysis of Verbal Behavior, 8(1), 43-55. Recuperado

de: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2748607/pdf/anverbbe_hav00037-0044.pdf

Catania, A. C., Matthews, B. A., & Shimoff, E. (1982). Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. *Journal of the Experimental Analysis of Behavior*, *38*(3), 233-248. doi: 10.1901/ jeab.1982.38-233

Catania, A. C., Shimoff, E., & Matthews, B. A. (1989). An experimental analysis of rule-governed behavior. In: S. C. Hayes (Ed.), Rule-governed behavior: Cognition, contingencies, and instructional control (pp.119 150). Boston, MA: Springer.

Cavalcante, M. R., & Carrara, M. P. (2007). Efeitos de modelagem do comportamento verbal e de instruções sobre o comportamento de encaixar peças. *Psicologia: Teoria e Pesquisa*, *23*(2), 229-238. Recuperado de: http://www.scielo.br/pdf/ptp/v23n2/ a13v23n2.pdf

Choi, M. Y., & Limb, C. Y. (2010). *Interactive therapy system design for children with autistic spectrum disorders*. In Kansei Engineering And Emotion Research International Conference, p. 164.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior Analysis* [2ª ed.]. Pearsons.

Cortegoso, A. C, & Coser, D. S. (2011). *Elaboração de programas de ensino: material autoinstrutivo*. São Carlos: EdUFSCar

Cozby, P. C. (2006). *Methods in behavioral research* (9th ed.). McGraw-Hill.

Del Prette, Z. A. P., & Del Prette, A. (2005). *Psicologia das habilidades sociais na infância: Teoria e Prática*. Petrópolis: Vozes.

Eisenberg, N., Fabes, R. A., Shepard, S. A., Murphy, B. C., & Jones, S. (1998). Contemporaneous and longitudinal prediction of children's sympathy from dispositional regulation and emotionality. *Developmental Psychology*, 34, 910-924.

Eiterer, P. (2021). *Descrição e Planejamento do Ensino de Comportamentos Pré-requisito do Empatizar*. [Master's thesis, Universidade Estadual de Londrina]. https://www.uel.br/pos/pgac/wp-content/uploads/2021/03/Patricia-Eiterer-Souza-Pinto-Descricao-e-planejamento-do-ensino-de-comportamentos-prerequisito-do-empatizar.pdf

Eiterer, P., Kienen, N., & Souza, S. R. (2023a). Sistematização de comportamentos intermediários do empatizar: revisão e proposta de uma sequência para o ensino. *Revista Brasileira de Terapia Comportamental e Cognitiva*, 25, 1–15. https://doi.org/10.31505/rbtcc. v24i1.1715

Eiterer, P., Sanches, P. F. M., & Souza, S. R. (2023b). Kahala (2nd ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Eiterer, P., & Souza, S. R. (2021). Kahala (1st ed.) [Game]. Londrina, PR: Universidade Estadual de Londrina.

Garton, A. F., & Gringart, E. (2005). The development of a scale to measure empathy in 8 and 9 year old children. *Australian Journal of Education and Developmental Psychology*, 5, 17-25.

Gena, A., Krantz, P. J., McClannahan, L. E., & Poulson, C. L. (1996). Training and generalization of affective behavior displayed by youth with autism. *Journal of Applied Behavior Analysis*, 29, 291–304.

Gillespie-Lynch, K., Kapp, S. K., Shane-Simpson, C., Smith, D. S., & Hutman, T. (2014). Intersections between the autism spectrum and the internet: Perceived benefits and

preferred functions of computer-mediated communication. *Intellectual and developmental Disabilities*, *52*(6), 456-469.

Gresham, F. M. (2016). Social skills assessment and intervention for children and youth. *Cambridge Journal of Education*, *46* (3), 319-332. https://doi.org/10.1080/0305764X.2016.1195788

Gresham, F. M., & Elliott, S. (2008). *Social skills improvement system: Rating scales manual*. Minneapolis, MN: Pearson Assessments.

Gris, G., & Souza, S. R. (2016). Jogos educativos digitais e modelo de rede de relações: desenvolvimento e avaliação do protótipo físico do jogo Korsan. *Revista Perspectivas em Análise do Comportamento*, *7*(1), 114-132. https://doi.org/10.18761/pac.2016.003

Grossard, C., Grynspan, O., Serret, S., Jouen, A.-L., Bailly, K., and Cohen, D. (2017). Serious games to teach social interactions and emotions to individuals with autism spectrum disorders (ASD). *Comput. Educ.* 113, 195–211. doi: 10.1016/j.compedu.2017.05.002

Hiniker, A., Daniels, J. W., & Williamson, H. (2013, June). Go go games: therapeutic video games for children with autism spectrum disorders. In *Proceedings of the 12th international conference on interaction design and children* (pp. 463-466).

Kienen, N., Kubo, O. M, & Botomé, S. P. (2013). Ensino programado e programação de condições para o desenvolvimento de comportamentos: Alguns aspectos no desenvolvimento de um campo de atuação do psicólogo. Acta Comportamentalia, 21(4), 481-494. https://www.redalyc.org/pdf/2745/274528983006.pdf

Kubo, O. M., & Botomé, S. P. (2001). Ensino-aprendizagem: uma interação entre dois processos comportamentais. *Interação em Psicologia*, *5*(1), 133-171. https://doi.org/10.5380/psi.v5i1.3321

Leibetseder, M., Laireiter, A.-R., & Köller, T. (2001). E-Skala: Fragebogen zur Erfassung von Empathie – Beschreibung und psychometrische Eigenschaften. *Zeitschrift für Differentielle und Diagnostische Psychologie*, 1, 70-85.

Linehan, C., Roche, B., Lawson, S., Doughty, M., & Kirman, B. (2009). A behavioural framework for designing educational computer games. Vienna Games Conference: Future and Reality of Gaming.

Perkoski, I. R., Gris, G., & Souza, S. R. (2018). Jogos Educativos: Aspectos Teóricos, Aplicações e Panorama da Produção Nacional por Analistas do Comportamento. In D L. O Vilas Boas, F. Cassas, H. L. Gusso, & P. C. M. Mayer, *Comportamento em Foco 7: ensino, comportamento verbal e análise conceitual* (vol. 7, pp. 50-67). São Paulo: Associação Brasileira de Psicologia e Medicina Comportamental (ABPMC). http://abpmc.org.br/arquivos/publicacoes/15200164548d97054097f6.pdf

Perkoski, I. R., & Souza, S. R. (2015). "O Espião": Uma perspectiva analítico comportamental do desenvolvimento de jogos educativos de tabuleiro. *Revista perspectivas em análise do comportamento*, *6*(2), 74-88. https://10.18761/pac.2015.020

Rezayi, S., Tehrani-Doost, M., & Shahmoradi, L. (2023). Features and effects of computer-based games on cognitive impairments in children with autism spectrum disorder: an evidence-based systematic literature review. *BMC psychiatry*, *23*(1), 2.

Rosales-Ruiz, J., & Baer, D. M. (1997). Behavioral Cusps: a developmental and pragmatic concept for Behavior Analysis. *Journal of Applied Behavior Analysis*, *30*(3), 533-544. doi: 10.1901/jaba.1997.30-533

Salen, K. & Zimmerman, E. (2004). *Rules of play: game design fundamentals*. Cambridge, MA: MIT Press.

Sanches, P. F. M., Eiterer, P., & Souza, S. R. (2023). Caçadores de Arco-íris [Game]. Londrina, PR: Universidade Estadual de Londrina.

Sanches, P. F. M. (2024). *Avaliação do jogo Kahala para ensino de comportamentos pré-requisito do empatizar a crianças* [Dissertação de mestrado, Universidade Estadual de Londrina]. Repositório da Universidade Estadual de Londrina. https://www.uel.br/pos/pgac/wp-content/uploads/biblioteca/Dissertacao%20Poliana%20Fernandes%20Mesquita%20Sanches.pdf

Sanches, P. F. M., Eiterer, P., & Souza, S. R. (2024). Ensino de comportamentos pré-requisito do empatizar para crianças autistas: Uma revisão de escopo. *Revista Brasileira de Educação Especial*, *30*, e0098. https://doi.org/10.1590/1980-54702024v30e0098

Skinner, B. F. (1957). *Verbal behavior*. Appleton-Century-Crofts.

Skinner, B. F. (2003). *The technology of teaching*. Cambridge, MA: B. F. Skinner Foundation (Original work published 1968).

Souza, S. R., Perkoski, I. R., & Anjos, G. (2019). Desenvolvimento de jogos educativos para o ensino de comportamentos de prevenção contra o bullying: Procedimento de design iterativo. Jogos Comportamentais: Análises e Atuações em contextos do dia a dia (pp. 39-57). São Paulo: Imagine Publicações.

Suzuki, B. M., & de Souza, S. R. (2022). Avaliação de um jogo de tabuleiro no ensino de palavras com encontros consonantais. *Acta Comportamentalia: Revista Latina de Análisis de Comportamiento*, *30*(1), 29-50. https://www.redalyc.org/articulo.oa?id=274570459002

Walker, H. M., Irvin, L., Noell, J., & Singer, G. (1992). A construct score approach to the assessment of social competence: Rational, technological considerations, and anticipated

outcomes. *Behavior Modification*, *16*(4), 448-474. https://doi.org/10.1177/01454455920164002

Zoll, C., & Enz, S. (2010). A Questionnaire to Assess Affective and Cognitive Empathy in Children, Recovered from http://www.opusbayern.de/unibamberg/volltexte/2010/235/pdf/ZollEnzA.pdf

APPENDICES

Appendix A

Teaching Contingency Table

Table A1
Teaching Contingency Table

Target behavior: Identifying others' needs.			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
A1	In front of the NPC: "NPC – 'Ow! Ow! I think a spider bit me!'"	* Identify that the other person needs medicine; * Collect a Medicine Token around the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you, I feel much better!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
A2	In front of the NPC: "NPC – 'My son isn't wearing a shirt, because after the blackout we ran out of the house to go to the Bunker. And the sun's radiation has hurt his skin. How can you help him?'".	* Identify that the other person needs clothes; * Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Ah, that's right! A clothing will help him feel less cold."), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
A3	In front of the NPC: "NPC – 'Wow, my mouth is so dry, I don't feel very well... Could you help me?'	* Identify that the other person needs water; * Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you very much!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Identifying others' needs.			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
A4	In front of the NPC: "NPC – 'It's been so long since I ate anything... My stomach is growling and I'm feeling weak.'"	* Identify that the other person needs food; * Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("I already feel better! Thank you for the food!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
A5	In front of the NPC: "NPC – 'I hurt myself in the last earthquake! I think I twisted my ankle. It hurts a lot!'"	* Identify that the other person needs medicine; * Collect a Medicine Token from the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("I already feel a bit better, thank you very much!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
A6	In front of the NPC: "NPC – 'My clothes are all torn, and the sun's rays are burning me. Can you help me?'"	* Identify that the other person needs clothes; * Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Wow, thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Identifying others' needs.			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
A7	In front of the NPC: "NPC – 'I'm so thirsty... I feel dehydrated... If only someone could help me!'"	* Identify that the other person needs water; * Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("This water quenched the thirst I was feeling. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
A8	In front of the NPC: "NPC – 'I haven't eaten anything since yesterday...'"	* Identify that the other person needs food; * Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you, I feel much better!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
Target behavior: Sharing resources with others according to the specific context (e.g.: information, knowledge, items,)			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
B1	In front of the NPC: "NPC – 'I'm thirsty! Could you share some water with me?''	* Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Ow, thank you! This is going to help me!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Sharing resources with others according to the specific context (e.g.: information, knowledge, items,)			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
B2	In front of the NPC: "Could you give me some food? I haven't eaten for so long, I feel weak…'"	* Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Wow, this is going to make me feel better. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
B3	In front of the NPC: "NPC – 'I have burns from the sun's radiation, I don't have enough clothes to protect myself. Could you give me some clothes?'"	* Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("It was really nice of you to do that. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
B4	In front of the NPC: "NPC – 'Wow… I have a fever and I feel sick. I think I ate something contaminated. Do you have any medicine to give me?'"	* Collect a Medicine Token from the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Wow, I'm already getting better, Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Sharing resources with others according to the specific context (e.g.: information, knowledge, items,)			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
B5	In front of the NPC: "NPC – Could you give me some water? I'm so thirsty!'"	* Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("You helped quench my thirst. I already feel more hydrated, thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
B6	In front of the NPC: "NPC – 'Wow, I'm hungry! Could you share some food with me?'"	* Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("I feel better, thank you very much."), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
B7	In front of the NPC: "NPC – 'I'm feeling very hot with these clothes that I have, they are all for cold weather. Do you have any clothes to give me?'"	* Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you for the clothes!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
B8	In front of the NPC: "NPC – 'I tripped during the blackout and my knee is scraped and bleeding a lot. Could you give me some medicine?'"	* Collect a Medicine Token from the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("It was really nice of you to do that. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Meeting others' needs according to the specific context			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
C1	In front of the NPC: "NPC – 'Ouch! I tripped during the blackout and hurt my leg! I can't walk.'"	* Identify that the other person needs medicine; * Collect a Medicine Token from the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("It was really nice of you to do that. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
C2	In front of the NPC: "NPC – 'I need to go to the hospital and find my friends, but I can't walk! I'm feeling weak…'"	* Identify that the other person needs food; * Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Thank you for the help!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
C3	In front of the NPC: "NPC – 'Wow, after the blackout, a lot of people from Kahala disappeared. I'm looking for my friends, that's why I haven't gone to the bunker yet. If you could give me some food, I would be very grateful! I can't leave here, because I believe my friends are coming, and I don't want to lose them again!'"	* Identify that the other person needs food; * Collect a Food Token from the board OR Pick up a Food Token from the inventory; * Deliver a Food Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("I'm not hungry anymore, thank you very much!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Meeting others' needs according to the specific context			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
C4	In front of the NPC: "NPC – 'Can someone help me? I'm so thirsty!'"	* Identify that the other person needs water; * Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("I'm not thirsty anymore, thank you very much for the water!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
C5	In front of the NPC: "NPC – After the blackout, my house was destroyed. I couldn't go back there to get clothes… The sun is so hot during the day. Long-sleeved shirts would protect me from the sun's rays!'".	* Identify that the other person needs clothes; * Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("It was really nice of you to do that. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
C6	Diante do NPC: "NPC – 'Wow… I'm so weak and my mouth is so dry. My vision is getting blurry.'"	* Identify that the other person needs water; * Collect a Water Token from the board OR Pick up a Water Token from the inventory; * Deliver a Water Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Wow, this is going to help me a lot. Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

(to be continued)

Table A1 (continuation)
Teaching Contingency Table

Target behavior: Meeting others' needs according to the specific context			
Id.	**Teaching Antecedent Condition (Quest in the game)**	**Expected responses from learners**	**Consequences to be ensured**
C7	In front of the NPC: "NPC – 'When the blackout happened, I was at the pool with my friends. I couldn't go back home to get clothes, so I'm in a bikini! But this way I'm very exposed to the sun's radiation. I can't stay like this!'"	* Identify that the other person needs clothes; * Collect a Clothing Token from the board OR Pick up a Clothing Token from the inventory; * Deliver a Clothing Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("This is going to help me a lot! Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level
C8	In front of the NPC: "NPC – 'I got lost from my family. I've been looking for hours and can't find anyone. I think they're in this bunker. But my legs are hurting so much… I can't even walk anymore.'"	* Identify that the other person needs medicine; * Collect a Medicine Token from the board OR Pick up a Medicine Token from the inventory; * Deliver a Medicine Token to the NPC.	*** Appropriate response** Receives a Story Fragment, a Hit Consequence ("Wow, I already feel better! Thank you!"), and +1 point in the Trust Level *** Inappropriate response** Receives the Error Consequence or the Attempt Consequence, and -1 point in the Trust Level

Appendix B
Story Fragments of the Kahala Game

Table B1

Story Fragments: Description and distribution by NPC

NPC	Story Fragment
A1	With global warming, there were months of only rain and months of intense droughts. This caused a gigantic damage to food production.
A2	The food was running out and hunger began to spread throughout the world.
A3	World leaders formed a task force to deal with these issues, which became known as GFA - Global Forces Alliance.
A4	They announced a space expedition to take people to Mars, can you believe it? We were shocked! Many people went on these expeditions.
A5	The revolts intensified, leading to an interplanetary war: Earth humans versus Mars humans.
A6	They say that bombs, missiles, and rockets became a part of the daily life of the population.
A7	And believe it: this solar storm caught the attention of extraterrestrials from other galaxies! Yes, the ETs!
A8	Armies of extraterrestrials began to arrive from all parts of the universe to conquer Earth.
B1	After a long time of disappearances and unanswered questions, GFA started a new attempt to solve the lack of food for the population.
B2	Then, instead of trying to reduce global warming or increase food, the GFA began to take measures to decrease the Earth's population.
B3	The GFA even said that they were starting a project to plant soybeans on Mars.
B4	After a few years, part of the Earth's population was on Mars. The soybean plantations grew and life there became possible!
B5	This war between humans lasted three years, until the day of the Great Light.
B6	On the day of the Great Light, a missile hit the Sun, causing a huge solar storm!
B7	And so, the space war between humans ended. But only to start the Great War. Earth and Mars humans joined against the ETs.
B8	The Great War lasted years! Until the Extraterrestrials managed to invade the earth… and began to expel and hunt humans!

(to be continued)

Table B1 (Continuation)

Story Fragments: Description and distribution by NPC

NPC	Story Fragment
C1	People started to disappear! But the authorities did nothing.
C2	Then, the pursuers began to appear, they were men who showed up in the city and arrested people without reasons or justifications.
C3	We found out that the living conditions on Mars were better than on Earth! But not just anyone could go to Mars.
C4	Only very rich people went to Mars. They paid fortunes! And this started to cause a revolt among the people.
C5	This storm that caused the blackout! It caused an electrical failure all over Earth, which ended all means of communication.
C6	Earthquakes… floods… chaos! The radiation from the Sun intensified and staying exposed to sunlight for a long time began to cause serious skin wounds.
C7	There are some places, like Bunkers, that are safe. The ETs can't destroy or invade them.
C8	Spacecrafts are rescuing people who are in the Bunkers, to take them to Mars, which is now the only safe place for humans.

Appendix C
Content of the Rainbow Hunters' cards

Table C1

Description of the content of the Rainbow Hunters' cards

Card	Content
Rules	A new rainbow has appeared in the sky! Your task is to cross the sea and find treasure on the other side of the rainbow. You are carrying some items on the ship for the journey, such as water, clothing, food, and medicine. To move, roll the dice and advance your pawn the same number of spots shown on the dice. When you stop at a spot, draw a card from the corresponding color pile (blue, white, or red). You and your crew need to reach the end of the rainbow. Along the way, you'll encounter other pirates in need. Remember: you win the game by reaching the end of the rainbow!
Quests	**Blue Cards**
	Ow! Ow! I think a spider bit me!
	The sun is hurting my skin, and I don't have a shirt. How can you help me?
	Wow, my mouth is so dry, I don't feel very well... Could you help me?
	It's been so long since I ate anything... My stomach is growling, and I'm feeling weak.
	I think I twisted my ankle. It hurts a lot!
	My clothes are all torn, and I am getting sunburned. Can you help me?
	I'm so thirsty... I feel dehydrated... If only someone could help me!
	I haven't eaten anything since yesterday...
	Red Cards
	I'm thirsty! Could you share some water with me?
	Could you give me some food? I haven't eaten for so long. I feel weak…
	I am getting sunburned and don't have enough clothes to protect myself. Could you give me some clothes?
	Wow… I have a fever and I feel sick. I think I ate something that was contaminated. Do you have any medicine to give me?
	Could you give me some water? I'm so thirsty!
	Wow, I'm hungry! Could you share some food with me?
	I'm very hot in these clothes since they are all for cold weather. Do you have any clothes to give me?
	I tripped! I scraped my knee, and I'm bleeding a lot. Could you give me some medicine?

(to be continued)

Table C1 (Continuation)
Description of the content of the Rainbow Hunters' cards

Card	Content
Quests	**White Cards**
	Ouch! I tripped and hurt my leg! I can't walk.
	I'm feeling weak… I haven't eaten for so long!
	I'm so hungry! If you could give me some food, I would be very grateful!
	Can someone help me? I'm so thirsty!
	Long-sleeved shirts would protect me from the sun's rays!
	Wow… I'm so weak and my mouth is so dry. My vision is getting blurry.
	I'm very exposed to the sun. I can't stay like this!
	My legs are hurting so much… I can't even stand up anymore.
Consequence A	Well done! You have reached the other side of the rainbow. As a reward for your determination and courage, you have won the Treasure of the Seven Seas! This is not just any treasure; these coins are enchanted and grant wishes!
Consequence B	Congratulations, Pirate! You have reached the other side of the rainbow. This treasure now belongs to you: the Pirate Hat of the Seven Seas. Whoever wears this hat is respected by all who sail, for their courage and bravery.

Appendix D
Game Evaluation Recording Data Sheet

Participant: _____ Date:_____ Session number: _____ Round: _____

Quest	NPC's ID	Hit	Usability	Engagement	Levels of assistance	Obs.
1						
2						
3						
4						
5						
6						
7						
8						

Table D1

Legend for recording usability and engagement during the game round

Usability (US)	Engagement (EG)
AG - Ask about the operation of the game	SA - Show approval
RH - Request help to execute actions of the game story/plot	CS - Comment on the story/plot
RM - Need for rule modification	CM - Comment on the game mechanics
	CL – Celebrate
	CP - Comment positively about the game
	CU - Comment on things unrelated to the game
	CC - Comment on the progress/continuation of the game
	SD - Show disapproval
	RI - Request to interrupt the activity

Table D2

Legend for recording the levels of assistance during the game round

LEVELS OF ASSISTANCE (Adapted from Mancini, 2005)		
A	Independent	The participant uses the game resources appropriately without intervention from the researcher.
B	Supervision	The researcher gives a minimal hint (e.g., pointing to the stimulus which the participant should Interact with).
C	Minimal Assistance	The researcher gives a hint that leads the participant to engage in the correct response on the first attempt right after the hint.
D	Moderate Assistance	The researcher gives more than one hint and, after a while, the participant himself engages in the correct response.
E	Total Assistance	The researcher gives several hints and, after a while, the researcher performs the action together with the participant.

Appendix E

Pretest and Posttest Recording Data Sheet

Participant: ________ Date:_____________ Session number: ________

Coloring Situation			
Period	**Sd**	**Response**	**Obs.**
0 – 3'	The presence of researcher's pencils	+ – + – + –	
3 – 6'	Researcher looking into her own cup	+ – + – + –	
	Researcher looking around	+ – + – + –	
	Researcher putting her hands on her head	+ – + – + –	
6 – 9'	"3 pencils are missing to complete my picture"	+ – + – + –	
	"I wish I had all the pencils to complete my picture"	+ – + – + –	
	"I can't complete my picture"	+ – + – + –	

Rainbow Hunters Game (Sanches et al., 2023)				
Move	**Card Color**	**Card Content**	**Response**	**Obs.**
1			+ –	
2			+ –	
3			+ –	
4			+ –	
5			+ –	
6			+ –	
7			+ –	
8			+ –	
9			+ –	
10			+ –	
11			+ –	
12			+ –	
13			+ –	
14			+ –	
15			+ –	
16			+ –	
17			+ –	
18			+ –	
19			+ –	
20			+ –	
21			+ –	
22			+ –	
23			+ –	
24			+ –	

Appendix F

Coloring Situation Protocol

INSTRUCTION: "We're going to do a coloring activity. I will give you a picture and some pencils. We will have fifteen minutes to do this activity. Have fun!"

RESPONSES:

1-3min – Coloring

4min – Look inside your cup

5min – Look around

6min – Put your hands on your head

7min – "I can't complete my picture";

8min – "I wish I had all the pencils to complete my picture";

9min – "Some pencils are missing to complete my picture";

15min – Great! Now let's go to the next activity.

Obs.: If the participant shares the pencil, say "thank you" and keep coloring.

Pretest Materials

Participant's materials

Picture: Bird

Pencils:

1 Red pencil

1 Green pencil

1 Pink pencil

1 Brown pencil

1 Black pencil

1 Orange pencil

1 Gray pencil

1 Blue pencil

1 Yellow pencil

1 Purple pencil

Researcher's materials

Picture: Caterpillar

Pencils:

1 Red pencil

1 Green pencil

1 Pink pencil

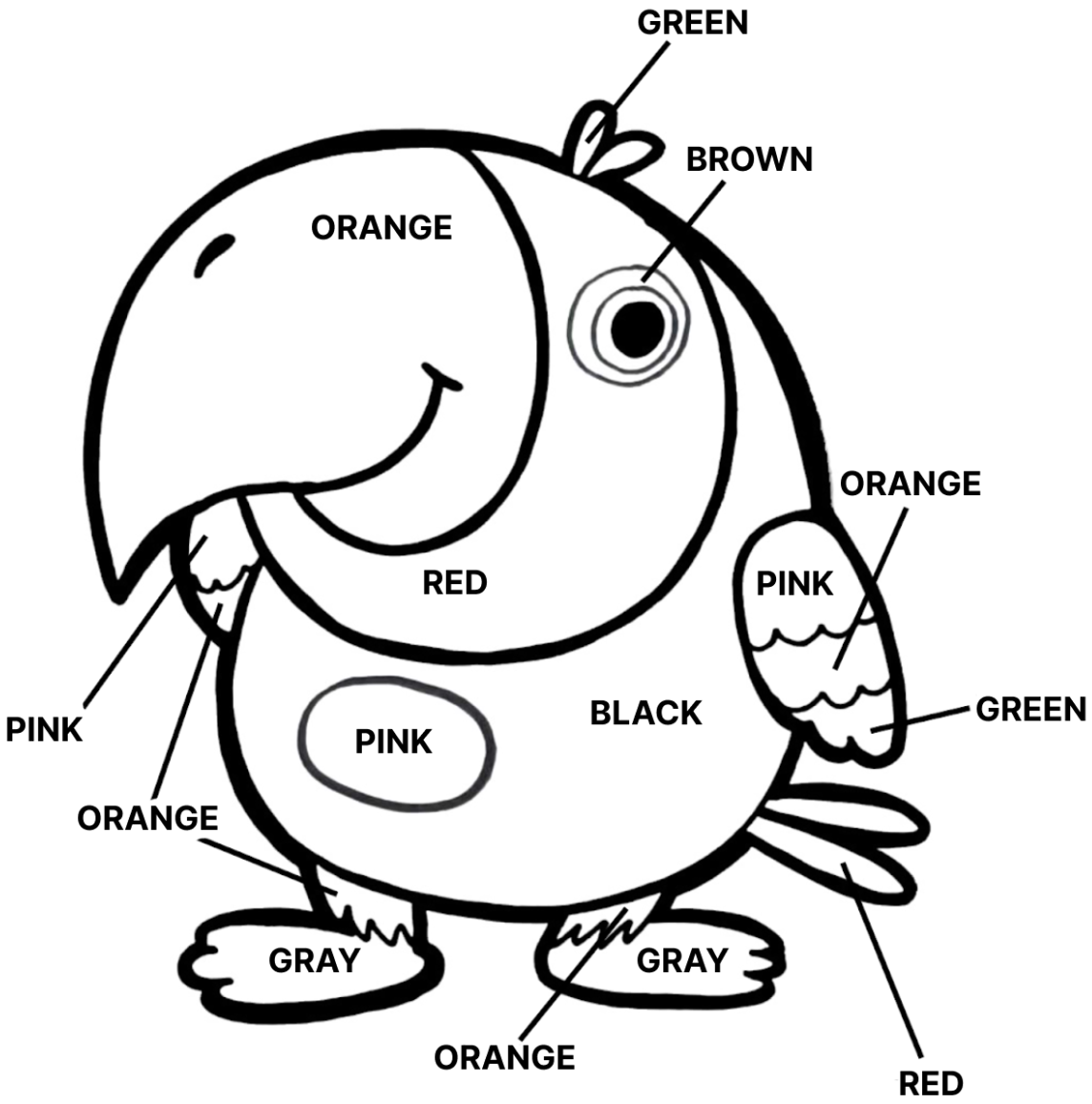
1 Brown pencil

1 Black pencil

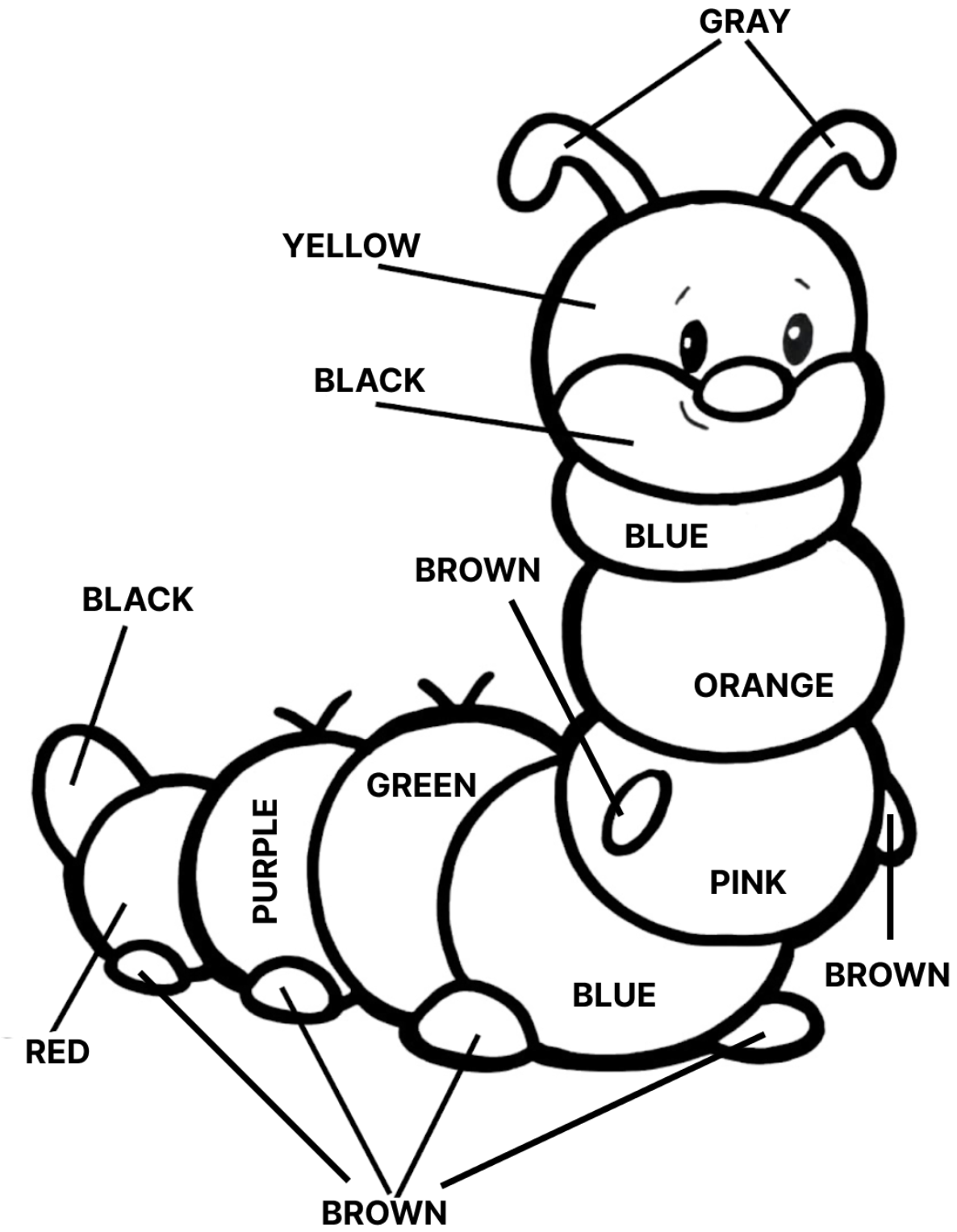
1 Orange pencil

1 Gray pencil

Participant's Picture – Pretest



Researcher's Picture – Pretest



Posttest Materials

Participant's materials

Picture: Peacock

Pencils:

1 Red pencil

1 Green pencil

1 Pink pencil

1 Brown pencil

1 Black pencil

1 Orange pencil

1 Gray pencil

1 Blue pencil

1 Yellow pencil

1 Purple pencil

Researcher's materials

Picture: Deep sea

Pencils:

1 Green pencil

1 Brown pencil

1 Black pencil

1 Orange pencil

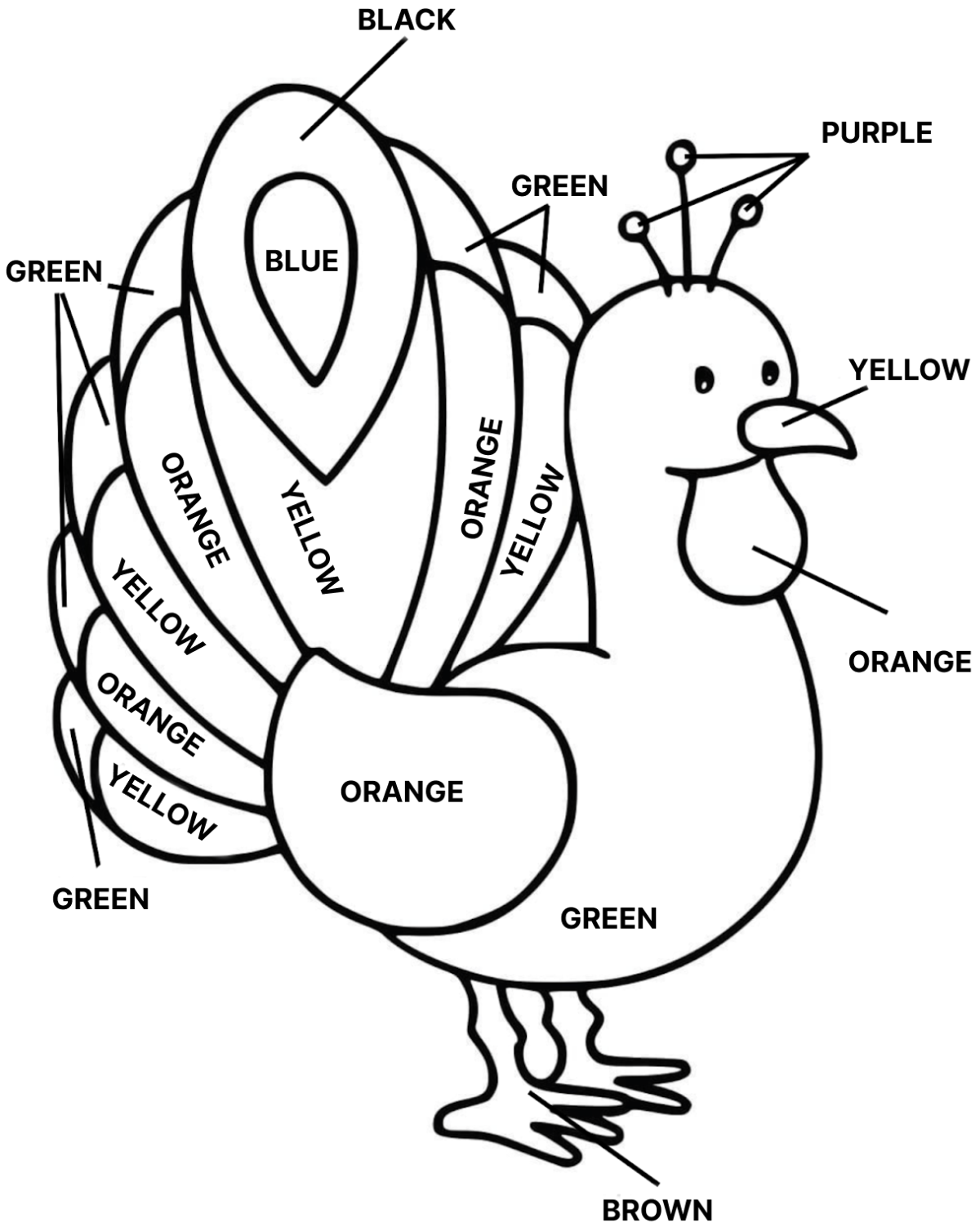
1 Blue pencil

1 Blue pencil

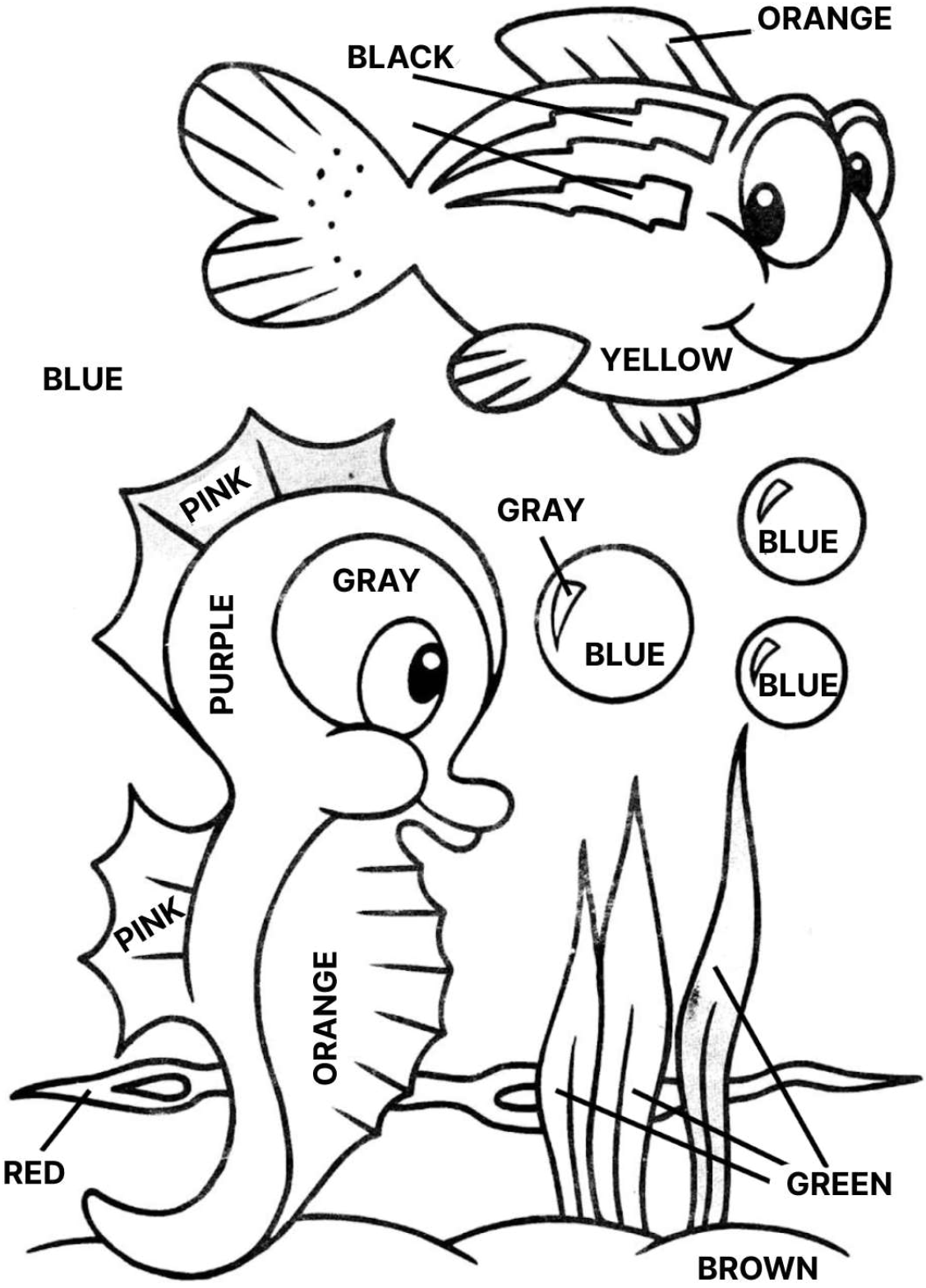
1 Yellow pencil

1 Purple pencil

Participant's Picture – Posttest



Researcher's Picture – Posttest



ANNEXES

Annex A
Intermediate Behaviors of General Class Empathize (Eiterer, Kienen, & Souza, 2023)

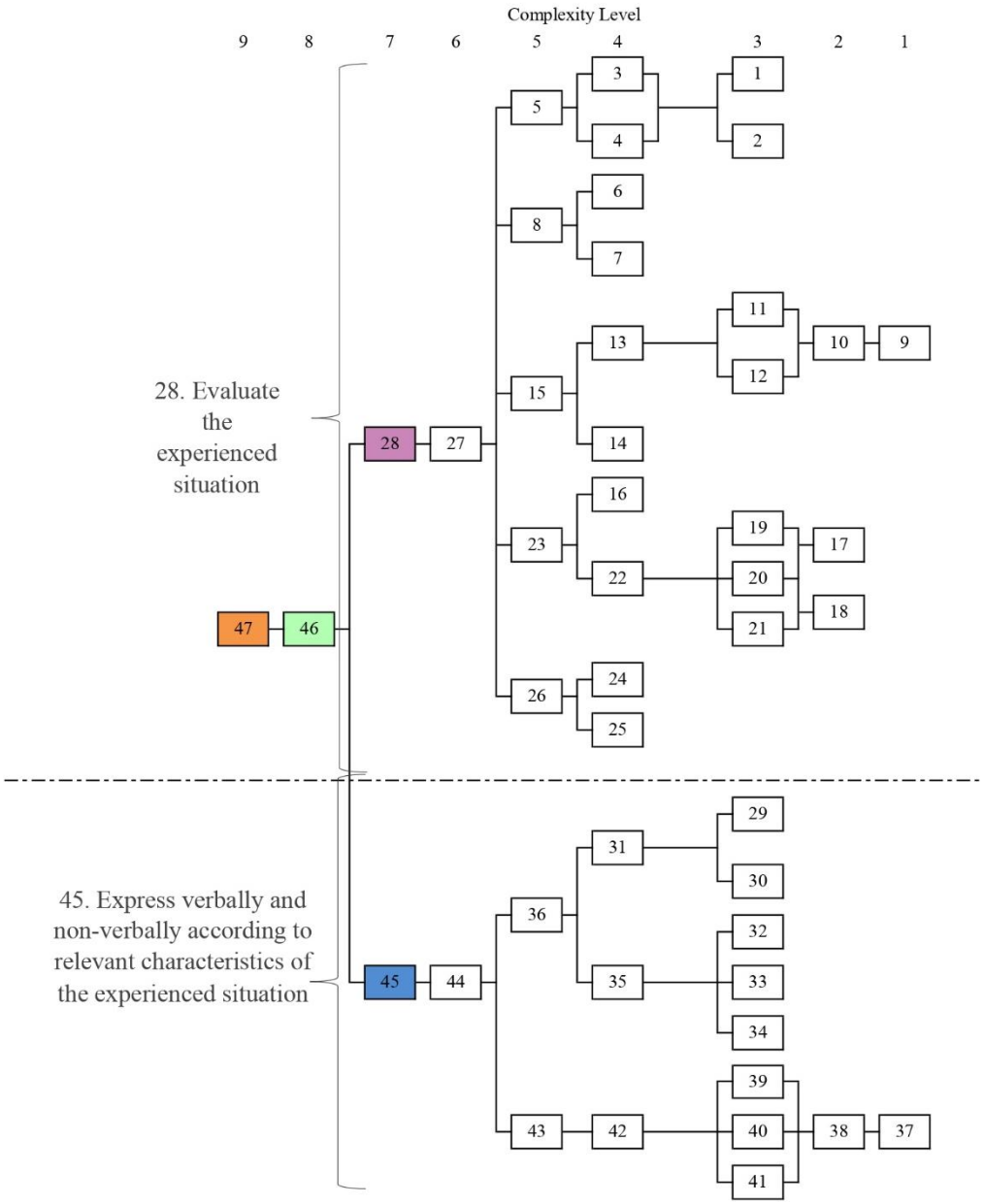


Figure A1'. Decomposition diagram of empathy prerequisite behaviors enumerated according to the sequencing table (Table A1') and with the more comprehensive behaviors highlighted in different colors, being: Empathize (orange); Validate the experiences or feelings of the other (green); Evaluate the specific context (purple); and Respond verbally and non-verbally according to the specific context (blue).

Table A1'

Sequencing of the intermediate behaviors of the general class Empathize and proposition of teaching units

Unit 1 - Identification of variables controlling others' behavior	
Reference Number	**Target Behavior**
1	Identify your own responses in the face of identical or similar situations
2	Identify responses usually demonstrated by other members of the verbal community in identical or similar situations
3	Identify situations immediately antecedent to another's response
4	Identify situations remotely antecedent to others' response
5	Relate antecedent situations with others' response
6	Identify short-term consequent situations to others' response
7	Identify long-term consequent situations to others' response
8	Relate consequent situations with others' response
Unit 2 - Identification of verbal and non-verbal types of responses	
Reference Number	**Target Behavior**
9	Characterize facial and body expressions
10	Discriminate between different types of facial and body expressions
11	Identify types of verbal responses in oneself and in the other
12	Identify non-verbal types of responses in oneself and in the other
13	Identify one's own emotions and those of others
14	Identify private responses that commonly accompany the public responses demonstrated by the other
15	Relate public emotional responses with private emotional responses
16	Identify the consequences produced by others' responses for oneself
17	Identify others' public responses in facing the context
18	Identify others' possible private responses in facing the context
Unit 3 - Relations between responses and consequences	
Reference number	**Target Behavior**
19	Identify the types of verbal responses most suitable for each situation
20	Identify the types of non-verbal responses most suitable for each situation
21	Identify the compatibility between verbal and non-verbal responses
22	Identify the consequences produced by your responses for the other
23	Relate the consequences produced by others' responses for themselves with the consequences produced by one's own responses for the other

(to be continued)

Table A1' (Continuation)

Sequencing of the intermediate behaviors of the general class Empathize and proposition of teaching units

Unit 3 - Relations between responses and consequences	
Reference number	**Target Behavior**
24	Identify the consequences produced by your responses for yourself
25	Identify the consequences produced by others' responses for himself
26	Relate the consequences produced by your responses for yourself with the consequences produced by others' responses for themselves
27	Discriminate the variables controlling one's own and another's behavior
28	Evaluate the specific context
Unit 4 - Adequacy of non-verbal response in face of a situation	
Reference Number	**Target Behavior**
29	Identify others' needs
30	Identify available resources (e.g., information, knowledge, items) that could be shared with the other according to the specific context
31	Meet the others' needs according to the specific context
32	Gesture appropriately to the specific context
33	Touch others' body in a manner appropriate to the specific context
34	Respond facially in a manner appropriate to the specific context
35	Show interest in matters concerning others'
36	Respond non-verbally in a manner appropriate to the specific context
Unit 5 - Adequacy of verbal response in a situation	
Reference Number	**Target Behavior**
37	Identify the most appropriate type of verbal response for the specific context
38	Speak to others using a tone appropriate to the specific context
39	Suggest actions to be performed by others in facing the specific context without denying or judging others' behavior
40	Comment on the specific context without denying or judging the others' behavior
41	Ask about the specific context without denying or judging others' behavior

(to be continued)

Table A1' (Continuation)

Sequencing of the intermediate behaviors of the general class Empathize and proposition of teaching units

Unit 5 - Adequacy of verbal response in a situation	
Reference Number	**Target Behavior**
42	Speak to others without denying or judging their behavior
43	Respond verbally in a manner appropriate to the specific context
Unit 6 – Validation of others' experiences and/or feelings	
Reference Number	**Target Behavior**
44	Respond verbally and/or non-verbally that you understand the experience and/or feeling experienced by others' without judging or invalidating them.
45	Respond verbally and non-verbally according to the specific context
46	Validate others' experiences and/or feelings
47	Empathizing

Annex B

Empathy Questionnaire

We would like your help by filling in the items in this questionnaire. We would like to find out about how you think and feel about different things. For each item we would like you to say how much you agree or disagree with it. Please fill in **each item** with only **one response** by ticking the box that you think is the right one for you!
You can test it with the following statement:

1 I like school holidays.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

Have fun completing the questionnaire! Lets go…..

2 I feel sorry for other kids who don't have toys and clothes.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

3 When I am angry or upset at someone, I usually try to imagine what he or she is thinking or feeling.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

4 It makes me sad to see a child who can't find anyone to play with

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

5 I can tell by looking at a person, whether they are happy.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

6 Seeing a child who is crying makes me feel like crying.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

7 I really like to watch people open presents, even when I don't get a present myself.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

8 Sometimes I cry when I watch TV.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

9 When I see someone being picked on, I feel kind of sorry for them.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

10 When I am arguing with my friends about what we are going to do, I thi carefully about what they are saying before I decide whose idea is best.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

11 I can tell what mood my parents are in by the look on their faces.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

12 I get upset when I see a child being hurt.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

13 I <u>don't</u> feel sorry for other children who are being teased or picked on.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

14 I notice straight away when something makes my best friend unhappy.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

15 Some songs make me so sad I feel like crying.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

16 I feel sorry for people who don't have the things that I have.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

17 I can often guess the ending of other people's sentences because I know what they are about to say.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

18 When I see someone suffering, I feel bad too.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

19 I often try to understand my friends better by seeing things from their point of view.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

20 When I walk by a needy person I feel like giving them something.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

21 On the phone I can tell if the other person is happy or sad by the tone of their voice.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

22 It upsets me when another child is being shouted at.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

23 I often know the ending of movies or books before they have finished.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

24 When I see another child who is hurt or upset, I feel sorry for them.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

25 When my parents get upset I feel bad.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

26 I think people can have different options about the same thing.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

27 I get upset when I see an animal being hurt.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

28 I often feel sorry for other children who are sad or in trouble.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

29 I can tell by the look on my parent's face whether it's a good time to ask them for something.

I strongly disagree	I somewhat disagree	I don't agree or disagree	I somewhat agree	I strongly agree
☐	☐	☐	☐	☐

You've done it!

Thank you very much for your help!