A Serious Game for Socioemotional Assessment Suitable for Children

Igor F. M. Kalomenconkovas[1], Simone N. Matos[1], Isabel C. Torrens[1], Helyane B. Borges[1]

[1]Depto Acadêmico de Informática – Univ. Tecnológica Federal do Paraná (UTFPR-PR)
Caixa Postal 15.064 – 91.501-970 – Ponta Grossa– PR – Brazil

`{igork}@alunos.utfpr.edu.br, {snasser,helyane}@utfpr.edu.br,`
`{isatorrens}@hotmail.com`

Abstract. *Socioemotional skills allow individuals to resolve conflicts and deal with emotions. These skills can be addressed in digital tools such as serious games.* ***Introduction:*** *Serious games have the potential to enhance players' cognitive abilities, as well as foster interpersonal and intrapersonal improvements.* ***Objective:*** *To develop a serious game for children that assesses and promotes empathy in children aged 5 to 7 years old through interactive and reflective mechanics, using a Maieutic approach inspired by the Socratic method.* ***Methodology:*** *The research followed four main stages: (1) Conceptual Design, with definition of objectives and preparation of questionnaires; (2) Communication Design, focusing on interface and gameplay; (3) Structural Design, with definition of the system architecture; and (4) Development, implementation and validation Design.* ***Results:*** *The game developed seeks to evaluate cognitive and affective responses related to empathy, in addition to engaging children through interactive scenarios and a reward system.*

Keywords: *Serious Game, Socioemotional, Maieutic Methodology, Early Childhood Education.*

1. Introduction

The concept of serious games, created by Clark C. Abt in 1970, initially referred to board and card games for educational purposes. With the advancement of research, this term mainly encompasses digital games developed as learning tools [Junqueira and Sirqueira 2023]. Unlike conventional games, aimed exclusively at entertainment, serious games incorporate essential pedagogical components, whether to introduce new knowledge or to reinforce and deepen skills already acquired [Nunes 2022].

In the educational context, these games have gained relevance as a playful and effective methodology, especially in contrast to traditional approaches that often do not engage with students' social reality, making the teaching-learning process difficult [Junqueira and Sirqueira 2023]. Considering the educational scenario, serious games are digital tools that can help in the socio-emotional assessment of students, allowing their personal and social development. Socio-emotional skills are directly linked to interpersonal issues, such as resolving conflicts and dealing with emotions. These skills allow people to deal with other people's feelings, understanding where and why these feelings exist. Developing socio-emotional skills helps to build healthy relationships, resolve conflicts constructively, and make correct decisions [Tiburski 2023].

By understanding socio-emotional values and how it can be understood from childhood**,** we recognize the importance of enabling children to interact with others,

putting themselves in another person's shoes, developing empathy, understanding why they feel happy or sad, and learning how to improve their actions based on their emotions [Almeida 2021]. Empathy can be assessed through various approaches, such as: (1) cognitive responses and (2) affective responses. Cognitive empathy is an assessment in which a person's response to their cognitive response is observed, that is, the person understands, but does not feel the other person's emotions. Affective empathy is an emotional response of the person, that is, the observer is also able to feel the same emotions that the "target" is feeling, even if they are not going through the same situation [Barroso 2022].

Empathy is a feeling that improves communication and helps develop emotional intelligence and strengthen relationship intelligence. Thus, this work presents the development of a serious game aimed at socioemotional assessment related to the ability of empathy in children. The research was structured on three fundamental pillars: (1) the theoretical basis on serious games and their pedagogical application, as well as on the assessment of socioemotional skills; (2) the development methodology; and (3) the analysis of similar games such as: PeaceMaker [Brown et al. 2006], Crystals of Kaydor [Kral et al. 2018] and StopBully [Raminhos 2018]. Although similar games share the ability of empathy, it was possible to identify limitations in each approach such as: PeaceMaker addresses complex geopolitical conflicts, far from children's reality; Crystals is limited to emotional recognition without intervention strategies and StopBully is limited to the phenomenon of bullying, but does not contemplate everyday situations of child development.

Thus, the game developed and presented in this article prioritizes dealing with everyday situations in the children's universe, promoting the importance of living in society in a healthy and friendly way, reducing problematic behaviors, in addition to improving cooperation and empathy, both in the school environment and in extracurricular contexts [Oliveira and Lucena and Duarte 2024]. The game uses scenarios from children's everyday life (such as school and games) and playful language, suitable for engaging and teaching this specific audience in a natural and effective way. In addition, research shows that stimulating empathy from an early age prevents problems such as bullying and improves social coexistence [Oliveira and Lucena and Duarte 2024].

2. Related works

A literature review on serious games and socio-emotional skills was conducted, with an emphasis on the development of empathy. The research was conducted in recognized academic databases (IEEE Xplore, ACM Digital Library, Portal Capes and Google Scholar), analyzing both methodological approaches and practical applications.

As a result of the literature review, it was possible to select three reference games for detailed study: PeaceMaker (simulation of geopolitical conflicts), Crystals of Kaydor (emotion recognition) and StopBully (combating bullying). These games were chosen for their proven impact on the assessment and development of empathic skills, serving as the basis for the proposal of this work. Table 1 presents a comparison between the games using the following criteria: objective, type of socio-emotional assessment and target audience.

Table 1. Serious games related to empathy

Game Name	Objective	Socio-Emotional Assessment	Target Audience

PeaceMaker [Scienza 2017]	Develop player empathy, involving areas of Geography, Philosophy and History.	Affective Empathy, Cognitive Empathy, Communication and SelfAssessment.	High school students aged 15 to 17.
Crystals of Kaydor [Almeida 2021]	Assess children's ability to learn emotional behaviors.	Affective Empathy and Cognitive Empathy.	Children aged 10 to 15 years old.
StopBully [Raminhos 2015]	Prevent bullying and promote empathy.	Affective Empathy, Cognitive Empathy.	Children aged 10 to 12 years old.

It is observed that literature games carry out the socio-emotional assessment of empathy, but do not address situations related to the daily lives of children aged 5 to 7 years old.

3. Metodologyy

To create a serious and effective game, literature research was carried out on some methodologies, such as the Hybrid Model by Silva et al. (2022), Maieutics (M²) by Oliveira (2015), DevJSTA by Rocha (2014), Design Thinking by Murakami et al. (2014). Of these, the Maieutics methodology was chosen, considered the most appropriate for the game's objectives due to its potential to stimulate critical reflection and meaningful learning.

The Maieutic Methodology is a way of applying interactivity to games, in addition to being a methodology focused on education and inspired by the Greek philosopher Socrates. As the methodology consists of a constant series of questions, its form of evaluation is through the interlocutor's answers. Based on the questions asked, the objective is for the interlocutor to create a general conceptualization about the topic asked, developing critical and reflective thinking [Meneses 2023].

By using Maieutic in serious games, we see the possibility of evaluating and developing socio-emotional skills in children, since by implementing this methodology, it is possible to observe the learner's reflective and critical thoughts, thus producing a selfassessment on the topic in question [Santos et al. 2018]. The methodology chosen for this game is effective in enabling players to self-assess, as it is through this methodology — along with their decision-making and the feedback received — that the development of socio-emotional skills is fostered.

When applying the methodology, the game has a dialectical character, in which the player is approached with everyday events with other characters. The Socratic methodology has a question-and-answer approach in which each phase of the game is followed by more questions, with the objective that the interlocutor reaches a correct and constructive conclusion about the event and subject of the game (and/or phase of the game), finally defining a concept about the given theme [Agati et al. 2020].

Maieutic has a difference compared to other methodologies, which is to focus on learning and how to lead to teaching efficiency, inducing reflection and creativity [Santos et al. 2018]. This methodology is divided into four distinct phases: (1) Conceptual design;

(2) Communication design; (3) Structural design; and (4) Development design [Agati et al. 2020]. However, when understanding the definitions of each phase (Table 2), it is necessary to emphasize that when developing a serious game, three distinct types of actors stand out in this context, they are: Technical Development Team (TDT); End Users Domain Expert(s) (EUD); and End User Learner(s) (EUL) [Agati et al. 2020].

Table 2. Stages of Maieutic

Stage	Description
Conceptual Design	The nature and purpose of the application were specified and defined. At this stage, the Basic Objective Questions (BOQ), Advanced Objective Questions (AOQ) and Educational Objective Questions (EOQ) were defined.
Communication project	In this phase, the questions related to the game and the respective phase, called Descriptive Communication Questions (DCQ) were determined.
Structural Design	The system architecture was defined, acting in parallel to the Communication Project that had been developed, with questions called Structure Descriptive Questions (SDQ), which aimed to define standards and styles, thus having the possibility of using Software Engineering tools, such as: Entity-Relationship Model, Data Flow Diagram, Unified Modeling Language (UML) among other tools.
Development project	After finalizing the communication and structural projects, the development project was composed of the technical team's resources, inserting schedules, development sequence, finishing with the code and software validation.

TDT was represented by the author of this work, responsible for developing the product, and guided by professionals in the areas of Software Engineering and Artificial Intelligence. EUD are the teachers from a partner institution of an extension project who are responsible for applying the tool during the teaching phase, monitoring the progress of the game. Finally, EUL, which will be the children responsible for using the developed tool [Agati et al. 2020] after its creation.

4. Results

The game development began with the Conceptual Planning stage, involving an in-depth study to define the game's genre. Given the lack of games in the field of socioemotional assessment, it was decided to create a serious game aimed at evaluating and improving children's socioemotional skills, with a focus on empathy. The target audience was chosen because childhood marks the beginning of social life, and during this phase, children are forming their understanding of the world and social relationships, making them more receptive to educational interventions.

The next step was to define the Basic Objective Questions (BOQ). For game development, 15 questions were established, of which 5 (Table 3) will be presented in this article. These selected questions help better define the game's nature and purpose.

Table 3. Basic Objective Questions (BOQ)

Number	Question	Answer
BOQ1	What is the specific age range of the children who will be the game's target audience?	5 to 7 years old
BOQ2	Which specific socioemotional skills does the game aim to assess?	Empathy
BOQ3	What scenarios and situations will the player experience?	Social problem-solving while practicing empathy
BOQ4	What types of characters will be in the game? How do they interact with the player?	Fictional characters such as schoolmates and friends. They interact through everyday situations.
BOQ5	What ethical issues need to be considered when developing the game?	A safe, inclusive and educational experience for the target audience must be included. The main issues are: Data collection and storage; Avoiding stereotypes and prejudices; Inclusion and accessibility; Constructive feedback

The questions in Table 3 helped in the development of the game, presenting: (1) the justification for selecting the target audience of children, (2) the criteria for assessing socioemotional skills, and (3) the expected personal and social impacts. This framework not only technically guides the creation of the game, but also scientifically supports the choice of empathy as a central skill, demonstrating its transformative potential in both individual development and social interactions.

After the basic questions, the introduction of Advanced Objective Questions (AOQ) helped in identifying the interaction and usability of the software, studying how the EUL (players) will interact with the virtual world. The AOQ contains a questionnaire with 8 questions (Table 4).

Table 4. Advanced Objective Questions (AOQ)

Number	Question	Answer
AOQ1	What interaction techniques are used (click, drag and drop, contextual menu, etc.)?	Drag and click
AOQ2	Are these interaction mechanisms intuitive and accessible for the EUL profile?	Yes

AOQ3	How does the EUL navigate and explore the game's virtual environment?	Using the mouse to interact with the game environment
AOQ4	What types of visual, audio, and haptic feedback are provided to the EUL during interaction?	*Visual feedback with the fictional character explaining each action*
AOQ5	Are there communication mechanisms between EUL and the system (questions, instructions, reports, etc.)?	Yes, Questions and Instructions
AOQ6	Are accessibility requirements (motor, visual, auditory, cognitive) considered in game design?	No
AOQ7	Can EUL quickly learn and familiarize themselves with the game's interaction mechanisms?	Yes
AOQ8	Are there tutorial resources, tips, and contextual help to guide you through EUD?	Yes, a fictional character will explain each phase to the user.

The questions in Table 4 (AOQ) guided the development of the game by defining the key elements of user-game interaction, including: (1) intuitive mechanisms (click, drag); (2) visual/audio feedback; (3) accessibility (motor, visual, cognitive); and (4) learning resources (tutorials, tips). These guidelines ensure an inclusive and adapted experience for children (EUL) and educators (EUD), ensuring usability and pedagogical effectiveness.

After applying for the AOQ, the Educational Objective Questions (EOQ) were asked, helping in the development of the educational aspect, verifying whether the game has an educational or training character. This questionnaire contains 7 questions (Table 5), referring to the learning of the EUL.

Table 5. Educational Objective Questions (EOQ)

Number	Question	Answer
EOQ1	Does the game have mechanisms for evaluating and monitoring EUL learning progress?	Yes
EOQ2	How does the software assess EUL learning progression? (Tests, exercises, projects)	Through testing and exercises during the game, after the player has played more than once.

EOQ3	Is the content measured and structured in a way that facilitates understanding and retention by EULs?	Yes
EOQ4	What are the main pedagogical strategies used in the game (active learning, problem solving, simulations, etc.)?	Problem solving
EOQ5	Does the game encourage reflection, critical thinking and the practical application of knowledge?	Yes
EOQ6	Is the feedback provided meaningful, constructive and aimed at improving learning?	Yes
EOQ7	Does the game promote autonomy, collaboration and a sense of progress among EULs?	Yes

The questions in Table 5 (EOQ) provided the necessary basis for structuring the educational components of the serious game, establishing: (1) mechanisms for assessing the development of the EUL; (2) effective pedagogical strategies (such as problem-based learning and simulations of real situations); and (3) stimuli for critical thinking (through reflective questioning).

Once the Conceptual Design was completed and the applicability of the Serious Game to be developed was understood, the Communication Design and the Structure Design were started in parallel. While the Conceptual Design defined the general idea, the Communication Design focused on the user interface. Through a questionnaire with 5 questions (Table 6), related to the Descriptive Communication Questions (DCQ), the system's functionalities were transformed into visual elements that guided user interaction.

Table 6. Descriptive Communication Questions (DCQ)

Number	Question	Answer
DCQ1	What will the interface provide to help meet the educational requirements of the system? - What role does the interface play in meeting the educational requirements?	The Interface ensures that players can intuitively interact with content, develop socio-emotional skills and receive meaningful feedback.
DCQ2	What actions must be taken to carry out an activity in the virtual environment?	Interaction with the environment, such as clicking and dragging.
DCQ3	Which windows/panels will make up the AV? How many will be used? How will they be arranged?	The Serious Game will feature an interface organized into a few interactive windows, ensuring an intuitive experience.
DCQ4	How will the interface help with the pedagogical aspects of the assessment?	The interface's role is to ensure understanding of the user's actions, receiving constitutive feedback.

DCQ5	What are the methods used to explain and ensure that the user understands their actions (movement, control, selection)?	These forms are aligned with the Maieutic methodology, which promotes reflection and critical thinking, and are designed to ensure that the player
		understands how their actions are interpreted by the system.

In the step of Table 6, usability and semiotics play an important role, directly influencing the formulation of questions and the construction of the interface. Since the Communication Design and Structure are designed in parallel, the Structure Design questionnaire can be defined as Structure Descriptive Questions (SDQ), which addresses questions (Table 7) regarding: Entity and Relationship, Scenarios, Limits, Formats, Structure, Content and Optimization.

Table 7. Structure Descriptive Questions (SDQ)

Number	Question	Answer
SDQ1	Based on the goals defined in Conceptual Design, which entities and their characteristics are important for the Virtual Environment?	Entities comprise the characters within the game, such as the students of a particular school. Characteristics encompass each character's personality and emotional traits.
SDQ2	Which scenarios and elements will compose the environment, and what role will each element play? How are the environments related?	The scenarios must allow player interaction, such as moving objects freely and interacting with characters. Elements of the classroom environment: chair, table, toys, board, backpacks, school supplies.
SDQ3	What is the format of the information: text, image, sound, animation, video?	Regarding text, it represents descriptions that provide clear and direct information to the player, such as instructions, dialogues, feedback, and descriptions of objects or characters. Images visually represent objects, characters, scenarios, and other elements of the virtual environment. Sound provides auditory feedback, creates atmosphere, and reinforces emotions and actions within the environment, including background music, sound effects, and character voices
SDQ4	What are the logical characteristics of the Virtual Environment? They define the procedures to be carried out within the system.	The virtual environment has a logic that defines how missions and tasks are structured, including objectives, stages, for example each mission has a clear objective, such as helping a colleague find a lost toy or resolving a conflict between characters.

SDQ5	How will the system functionality be detailed to considerably facilitate implementation?	This involves defining functional requirements. Functional requirements describe the functionality that the system must provide, such as character interactions, object manipulation, environment navigation, and player feedback.

After answering initial questions, the development of the game's graphical interface begins. In Phase 1 (Figure 1), the player interacts in a classroom setting, where the character Caio explains the rules and narrates that their classmate Gabriela had her scooter hidden by other students. The objective is for the player to drag the toy back to Gabriela to return it. Upon completing the mission, the player "gains" a new friend, with the challenge of reaching the maximum of 6 friends throughout the game.
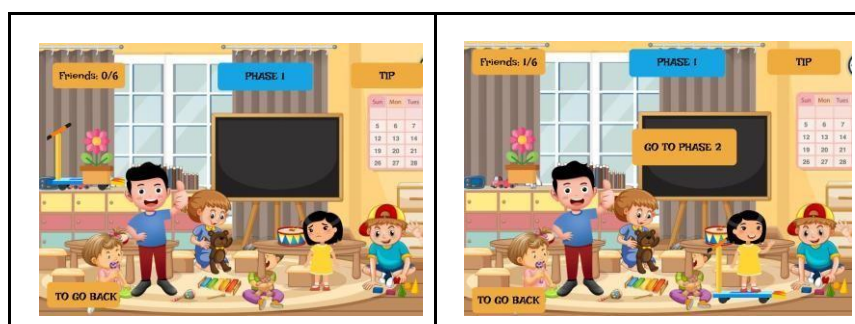

Figure 1. Phase 1 start screens and successfully completed phase

The first two phases are the only ones without question, as their purpose is to awaken in the player the importance of empathy. As illustrated in Figure 2, in Phase 2, Caio presents a situation in which Antonio, a classmate, is sad because he forgot his toy. The player, however, has two toys and can lend one of them. By dragging the object to Antonio, the user not only performs a generous gesture, but also strengthens a new friendship and brings joy to his classmate.

Figure 2. Phase 2 starts screens and phase successfully completed

Upon completing Phases 1 and 2, the user accumulates some friends, which motivates him to continue in the game, always applying empathy. In Phase 3, as shown in Figure 3, Maieutic is introduced: now, the player answers questions about empathy, but, unlike the previous stages, he can make mistakes. If this happens, he will not gain the total number of friends needed to finish the game. In this phase, Caio makes an observation to the interlocutor, describing a scenario in which his classmate Pedrinho does not have a pencil to be able to do the Art activity, thus asking the user what to do in relation to this, where he will have the possibility of: (1) Calling Pedrinho to draw and lending the pencil;

(2) Not calling Pedrinho and continuing to draw; and (3) Going to the teacher and asking to go to the bathroom.

Figure 3. Phase 3 screens and successfully completed phase

In addition to accumulating several friendships, to motivate the user, an interface is shown to the player, represented by Figure 4, with all the friends acquired so far. This screen will be displayed each time the learner gets a correct answer.

Figure 4. Screen relating to the player's friendships

Since the Communication and Structure Projects are designed in parallel, the Structure Project questionnaire is defined as Descriptive Structure Questions (DSQ) [Agati 2020]. With the completion of the projects, it is in the implementation phase and will be made available in the future to children served by an extension project.

The serious game presented in this article stands out for assessing and promoting empathy in children, using interactive scenarios that stimulate critical reflection and decision-making. This game combines cognitive and affective assessment with a proactive approach, including progressive mechanics and a reward system based on virtual friendships.

5. Conclusion

The game presented in this paper is designed to assess and develop socio-emotional skills in children, utilizing an interactive and reflective approach. Its significance is rooted in its ability to perform these assessments, while simultaneously promoting the development of empathy, a critical skill for fostering harmonious relationships and resolving conflicts, especially within the school context.

The methodology used was chosen for its potential to promote reflection and critical thinking, encouraging players to reflect on their actions and decisions through questions and answers, contributing to the development of socio-emotional skills.

The game is currently being implemented and will be applied to children in the future through an extension project. The game's playful and interactive approach is expected to facilitate learning and knowledge retention, contributing to the development of more empathetic and communicative citizens.

References

Agati, S. S. et al. (2020) "Projeto Instrucional de um Jogo Sério Educacional para a Prevenção da Obesidade na Adolescência usando a TPO", Proceedings of the Simpósio Brasileiro de Informática na Educação – SBIE 2020, Fortaleza – CE, Brasil, p. 1–10.

Almeida, P. R. P. (2021) "Criação de um jogo sério para promover a empatia em crianças no contexto de uma intervenção de aprendizagem sócio-emocional", Dissertação de Mestrado, Mestrado em Ciência em Emoções, ISCTE-IUL, Lisboa, Portugal.

Barroso, D. L. C. T. (2022) "Um estudo sobre a empatia de jogadores por personagens de jogos eletrônicos", Trabalho de Conclusão de Curso, Universidade Federal do Ceará, Instituto UFC Virtual, Curso de Sistemas e Mídias Digitais, Fortaleza, CE, Brasil.

Brown, E. et al. (2006) "PeaceMaker, ImpactGames LLC", http://peacemakergame.com/

Grimes, R. H. (2018) "Sistema Biomédico (com Jogo Sério e Dispositivo Especial) para Reabilitação Respiratória". Dissertação de Mestrado. Universidade do Estado de Santa Catarina – UDESC, Programa de Pós-Graduação em Engenharia Elétrica, Joinville, SC, Brasil.

Junqueira, A. L. C. and Sirqueira, T. F. M. (2022) Serious Games: Aplicação no ambiente educacional. Trabalho de Conclusão de Curso, Centro Universitário UniAcademia, Juiz de Fora, MG.

Kral, T. R. A. et al. (2018) "Crystals of Kaydor: A game-based intervention to improve empathy and emotional recognition", Journal of Cognitive Neuroscience, v. 30, n. 5, MIT Press, p. 801–815.

Meneses, T. S. (2020) Os sofistas: precursores da pós-verdade? O Manguezal - Revista de Filosofia, v.1, n.5, ISSN: 2674-7278.

Murakami, L. C. et al. (2014) "Design Thinking como metodologia alternativa para o desenvolvimento de jogos sérios", Proceedings of Nuevas Ideas en Informática Educativa – TISE 2014, p. 656–661.

Nunes, A. J. A. and Silva, S. E. D. (2022) Jogos Sérios em Realidade Virtual para Ensino: Um Caso de Estudo com Aulas Laboratoriais em Ciências Biológicas. Monografia (Bacharelado), Universidade Federal de Ouro Preto, Instituto de Ciências Exatas e Biológicas, Departamento de Computação.

Oliveira, H. C. (2015) "Uma metodologia participativa para o desenvolvimento de Jogos Sérios", Dissertação de Mestrado, Programa de Pós-Graduação em Computação Aplicada, Universidade do Estado de Santa Catarina (UDESC), Joinville, SC, Brasil.

Oliveira, M. J. S. et al. (2024) "Educação Socioemocional: contribuições para o processo de ensino na Educação Infantil", Revista Encontros Científicos UNIVS, v. 6, n. 2, Icó–Ceará, p. 109–110.

Raminhos, C. S. C. (2015) "StopBully – Jogo sério para prevenir o bullying e promover a empatia", Trabalho de Projeto, Mestrado em Engenharia Informática, Especialização em Engenharia de Software, Faculdade de Ciências, Universidade de Lisboa, Portugal.

Rocha, R. V. (2018) "Metodologia iterativa e modelos integradores para desenvolvimento de jogos sérios de treinamento e avaliação de desempenho humano", Dissertação de Doutorado, Programa de Pós-Graduação em Ciência da Computação, Centro de

Ciências Exatas e de Tecnologia, Universidade Federal de São Carlos, São Carlos, SP, Brasil.

Santos, A. M. et al. (2018) "O Processo de Design de um Sistema Biomédico com Jogo Sério e Dispositivo Especial para Reabilitação Respiratória", Proceedings of SBGames 2018 – Art & Design Track – Full Papers, XVII Simpósio Brasileiro de Jogos e Entretenimento Digital, Foz do Iguaçu – PR, Brazil, SBC – Sociedade Brasileira de Computação, p. 215–224.

Scienza, L. (2017). "Impacto dos jogos digitais sobre a empatia e teoria da mente de crianças: uma revisão sistemática." Monografia, Curso de Graduação em Psicologia, Universidade Federal de São Carlos, São Carlos, SP, Brasil.

Silva, L. L. et al. (2022) "Aplicação de um Modelo Híbrido na Criação do Jogo Querida Floresta para pessoas com Deficiência Intelectual", Proceedings of SBGames 2022 - Education Track - Full Papers, XXI Simpósio Brasileiro de Jogos e Entretenimento Digital, Natal - RN, Brazil, SBC - Sociedade Brasileira de Computação, p. 653-662.

Tiburski, R. (2023) "10 competências da BNCC: habilidades cognitivas e socioemocionais", https://diarioescola.com.br/10-competencias-da-bncc/, Dezembro.