**Universidade de Aveiro**
**2020**

**JAILMA DO SOCORRO UCHÔA BULHÕES CAMPOS**

# GAMIFICAÇÃO NO SUPORTE À APRENDIZAGEM DE LEITURA: MOTIVAÇÃO E ENVOLVIMENTO DE ALUNOS COM DISLEXIA DE ESCOLAS BRASILEIRAS

# GAMIFICATION AS SUPPORT TO READING LEARNING: MOTIVATION AND ENGAGEMENT OF STUDENTS WITH DYSLEXIA FROM BRAZILIAN SCHOOLS

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Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Multimédia em Educação, realizada sob a orientação científica da Doutora Ana Margarida Pisco Almeida, Professora Auxiliar do Departamento de Comunicação e Arte da Universidade de Aveiro, e coorientação do Doutor Alberto Signoretti, Professor Adjunto da Universidade Estadual do Rio Grande do Norte.

Para Heitor, âncora da minha vida.

**O júri**

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**Palavras-chave** Adolescentes brasileiros com dislexia, gamificação para envolvimento e motivação, gamificação na aprendizagem da leitura, protótipo de narrativa gamificada.

**Resumo**

Como uma Dificuldade Específica de Aprendizagem, a dislexia permanece na adolescência, bem como na vida adulta. Alunos adolescentes com dislexia ainda apresentam dificuldades com a precisão e compreensão da leitura e baixa motivação para a aprendizagem. O contexto educacional brasileiro necessita de mais debate com a escola para a criação de estratégias pedagógicas apropriadas com o objetivo de promover mais desafios e oportunidades para o desenvolvimento da capacidade de leitura desses alunos. Esta tese tem como objetivo compreender como a gamificação, entendida como um processo de integração de mecanismos de jogos em contexto de não-jogo para promover a motivação, participação, envolvimento e diversão, pode ser usada como apoio pedagógico para reforçar a aprendizagem da leitura de alunos brasileiros com dificuldades disléxicas. Trata-se de um estudo de caso qualitativo inspirado na abordagem metodológica do Design Thinking, uma metodologia iterativa e centrada nas pessoas utilizada para criar soluções e resolver problemas, que culminou numa prototipagem iterativa de uma narrativa gamificada.

Todo o trabalho de pesquisa foi desenvolvido num processo imersivo com 6 participantes – 2 alunos adolescentes com dislexia e 4 professores de 2 escolas públicas brasileiras – ao longo de quatro fases adaptadas: *fase 01 de imersão e exploração*, na qual foi conduzida uma observação-participante combinada com a) entrevistas semiestruturadas, com o intuito de mapear as necessidades e dificuldades disléxicas dos discentes, além de aprender sobre o seu universo de aluno; e b) análise documental e entrevistas abertas, a fim de investigar e compreender o contexto educacional da Sala de Recursos Multifuncionais; *fase 02 de análise e definição*, em que foi conduzida a análise e o cruzamento dos dados recolhidos na fase 01, por meio da técnica Análise de Conteúdo; *fase 03 de ideação*, na qual foi desenvolvido um processo de design e criação de um plano para a ferramenta gamificada que foi registado em notas de campo; e *fase 04 de prototipagem iterativa*, que promoveu a prototipagem e a realização de testes da narrativa gamificada, além de possibilitar a obtenção de feedback dos participantes com o objetivo de proceder à iteração e, consequentemente, redefinir a ferramenta gamificada. Neste estágio, foram produzidas duas versões da ferramenta – a primeira em papel e a segunda em programação digital. Para a recolha de dados, foram aplicados questionários, escalas e entrevistas abertas para obter feedback dos participantes. Além disso, todas as secções dos testes foram registadas em vídeo e posteriormente transcritas e analisadas. A técnica Análise de Conteúdo foi usada para codificar o material textual e fazer interpretações.

Tendo em vista os principais resultados deste estudo, ressaltam-se algumas conclusões. De início, mapear e caracterizar as dificuldades disléxicas dos discentes possibilitou uma compreensão sobre os pensamentos, sentimentos, motivações para a leitura/escrita, expectativas acerca do apoio escolar e necessidades dos adolescentes, bem como sobre as dificuldades evidenciadas e percebidas pelos participantes. Além disso, a exploração do contexto da Sala de Recursos Multifuncionais elucidou a ausência de apoio educacional para alunos com dislexia na conjuntura da Educação Especial.

Adicionalmente, o processo de ideação, design, prototipagem e realização de testes da narrativa gamificada, para além de um processo criativo, proporcionou informação sobre a contribuição de uma ferramenta gamificada para uma motivação mais intrínseca, diversão, envolvimento e aprendizagem/uso de capacidades de leitura. A avaliação dos participantes proveu perceções sobre a contribuição da experiência de uso para a motivação, envolvimento e aprendizagem, além de impressões sobre as versões analógica e digital da narrativa gamificada.

Esta tese propicia, principalmente, um protótipo digital como exemplo de ferramenta gamificada como recurso para atividades de leitura de alunos com perturbações leitoras.

**Key words** Brazilian adolescent students with dyslexia, gamification influence on engagement and motivation, gamification in reading learning, gamified storytelling prototype

**Abstract** As a lifelong Specific Learning Difficulty, dyslexia may continue in adolescence and adulthood. Adolescent students with dyslexia still experience difficulties with reading accuracy and comprehension, and a lower motivation in learning. Nonetheless, dyslexia can be manageable with appropriate educational intervention. The Brazilian educational context needs further discussion with the schools to create proper pedagogic strategies focused on giving learners more challenges and opportunities to keep developing their reading skills.

This thesis aims to understand how gamification – a process of integrating game features into a non-game context with the aim to increase motivation, participation, enjoyment, and engagement – can be used as pedagogical support to enhance reading learning by students with dyslexia. This investigation is a qualitative case study inspired in Design Thinking, a human-centered and iterative approach used to create solutions to solve problems, which led to the iterative prototyping of a gamified storytelling.

The research was developed in an immersive process involving seven participants (three adolescent students with dyslexia and four educators from two Brazilian public schools) over four adapted phases: *phase 01 – immersion and exploration*, in which a participant-observation was conducted in combination with structured interviews aiming to map the students' dyslexia needs and difficulties and learn about them, and a documentary analysis and open-ended questions in order to investigate and understand the educational context of Multifunctional Resource Rooms; *phase 02 – analysis and definition*, in which the content analysis technique was used to analyze and cross the data collected in phase 01; *phase 03 – ideation*, which was developed as a process of design and creation of the gamified plan/tool registered as field notes; and *phase 04 –iterative prototyping*, to test, obtain participants' feedback with the purpose of iterating and then redefining the gamified tool. At this stage, instruments such as scales, questionnaires, and interviews with open-ended questions were applied to get the participants' opinions on the tool. Moreover, all the testing sessions were video-recorded and subsequently transcribed and analyzed. Content analysis was the technique used to code textual material and to make interpretations.

Based on the main findings of this study, some conclusions are highlighted. First, mapping and characterizing adolescent students with dyslexia difficulties allowed a deep understanding of the learners' profiles, their thoughts, feelings, motivation to read/write, expectations about school support, needs, and evinced and self-perceived difficulties. In addition, the investigation of Multifunctional Resource Rooms elucidated the insufficient support provided to students with dyslexia in the Brazilian Special Educational context. Moreover, the process of ideation, design, prototyping, and testing of gamified storytelling beyond the creative and innovative process provided information about the contributions of a tool embedded with game mechanics to obtain a more intrinsic motivation, enjoyment, engagement, and learning/demonstration of reading skills. The participants' evaluation provided perceived information about the contributions of the gamified experience to motivation, engagement, and learning, in addition to impressions of the paper and digital versions of the tool.

This thesis mainly provides a digital prototype as an example of a gamified tool to support the reading activities of learners with reading impairment.

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## LIST OF ORIGINAL PUBLICATIONS

The following publications referred by roman numeral from I-IV describe results of this study. They are appended in the end of this thesis.

**PAPER I** Bulhões, J., & Almeida, M. (2018). Gamificação no ensino-aprendizagem da leitura de alunos com dislexia: Panorama atual. *Annals of V Congresso Internacional TIC e Educação*, p. 1930-1939. http://ticeduca2018.ie.ulisboa.pt/?page_id=1905

**PAPER II** Bulhões, J., Almeida, M., & Signoretti, A. (2019). Creating New Learning Experiences for Students with Dyslexia: A Design Thinking and Human-centered Approach. In: M. Rehm, J. Saldien, & S. Manca (eds). Project and Design Literacy as Cornerstones of Smart Education. *Smart Innovation, Systems and Technologies* (p.261-268). Springer

**PAPER III** Bulhões, J., Almeida, M., & Signoretti, A. (2020). O feedback como elemento de imersão em aprendizagem gamificada. In Araújo, M. (ed.). *Tecnologias digitais e metodologias ativas em contextos diversos (*167-187). Intercom

**PAPER IV** Bulhões, J., Almeida, M., & Signoretti, A. (2019). Exploração de Estratégias de Gamificação na Aprendizagem da Leitura: O caso de Alunos com Dislexia a frequentar Escolas no Brasil. In *Atas do XI Conferência Internacional de TIC na Educação*, p.71-84. https://www.nonio.uminho.pt/challenges/atas2019/

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AEE | Atendimento Educational Especializado |
| CERON | Centro de Educação Ronaldo Miranda |
| CRIE | Centro de Referência em Inclusão Educacional Gabriel Lima Mendes |
| DSM-5 | Diagnostic and Statistical Manual |
| DT | Design Thinking |
| IDA | International Dyslexia Association |
| IDEA | Individuals with Disabilities Education Act |
| LDB | Lei de Diretrizes e Bases |
| MDA | Mechanics, Dynamics and Aesthetics Framework |
| SDT | Self-Determination Theory |
| SLD | Specific Learning Difficulties |
| SLE | Social Learning Environment |
| SRM | Sala de Recursos Multifuncionais |

# 1 INTRODUCTION

## 1.1 Topic and Context

Developmental dyslexia is a neurobiological condition in which individuals with adequate intellectual capabilities present difficulties with literacy acquisition (International Dyslexia Association [IDA], 2002). This disorder is also classified as a Specific Learning Difficult (Lyon et al., 2003; Pierangelo & Giuliani, 2006) and characterized as lifelong (Rizzato, 2015); therefore, children diagnosed with dyslexia may continue to have difficulties through adolescence and adulthood. A person dealing with this type of disability may receive additional emotional support from the family and school, educational support focused on literacy, and also social-emotional support (Casserly, 2012; Riddick, 1996).

Difficulties with literacy activities boost demotivation and low self-esteem among learners with dyslexia; thus, the use of motivational learning strategies is recommended to increase interest in learning (Gooch et al., 2016). Active strategies, such as gamification, which is a process of applying game mechanisms to non-game contexts (Deterding et al., 2011; Zichermann & Cunningham, 2011), are seen as a potential educational approach. There are many studies of the potential of gamification in educational contexts (Kapp et al., 2014; Karimi & Nickpayam, 2017; Kim et al., 2018; Muntean, 2011; Nand et al., 2019; Rabah et al., 2018; Schmitz et al., 2012; Simões et al., 2015).

Gamification can be helpful to this specific learning population – Brazilian learners with dyslexia –, given the neglect and lack of special/individual assistance or targeted learning support in public schools. Therefore, this thesis reports the research process and findings of a study involving the design, prototyping, and testing of a tool embedded with game elements, such as challenges, rewards (badges and points), feedback, a fantastic story, levels/progress, and time pressure, to support reading learning by students affected by developmental dyslexia. The emphasis is placed on the process, which consists in four phases: (i) immersion in the Special Assistance context of two public schools in the city of Belém-Pará, Brazil, and investigation of the legal documents and dyslexia characteristics of two adolescent students; (ii) analysis of data obtained in phase 01 in order to provide information for the tool design; (iii) ideation of a gamified tool; and (iv) iterative prototyping (creation, testing, and evaluation of a paper and a digital version of the tool).

This research does not involve only the use of badges or points (the core of gamification, as postulated by Zichermann & Cunningham, 2011). It is instead focused on providing a learning tool that could promote teacher-student interactions with the aim to make reading activities more engaging and motivating. Moreover, even though the effects of gamification

on learning have not been studied in depth in students with dyslexia (Saputra, 2015), it was a goal of this study to explore the cognitive use of skills and knowledge by involving the process of reading decoding and text comprehension.

Motivation, engagement, and learning are key concepts in this work. Motivation is very important in gamification and education because it is understood as an enthusiasm to do things, so it influences individual behaviors. However, it is not a unitary concept (Zisimopoulos & Galanaki, 2009), and it is divided into extrinsic and intrinsic motivation. The first type motivates an individual because of external rewards, and the second is an innate interest to do something. This work attempts to inspire this authentic intrinsic motivation by using gamification.

Engagement and motivation are related concepts, but they are not the same (Alexiou & Schippers, 2018). Engagement represents the interest and participation of students(Saputra, 2015), and this thesis also focuses on indicators of dimensions of engagement flow that indicate the learners' involvement in the gamified activity.

Cognitive learning is an important goal of this study as well. It is expected that students with dyslexia could activate, recall or modify reading skills and knowledge when experiencing the gamified storytelling through a great increase in engagement.

This thesis is more about providing the necessary stimuli for learners to feel involved and motivated to learn, with fails and teacher guiding, progress and achievements, effective and situational feedback, and recall of cultural information on Amazon legends. The value of using gamification for pupils with dyslexia lies on an opportunity to boost encouragement and motivation by obtaining a tool designed and developed for these neglected learners as part of an inclusive education in Brazil.

## 1.2 Problem Statement

A few studies reporting the contributions of gamification to learning by students with dyslexia have been identified in literature (Dymora & Niemiec, 2019; Gooch et al., 2016; Saputra, 2015). In Brazil, there are no reports of research on how the use of game mechanics can boost the psychological outcomes, such as enjoyment, motivation, and engagement, as well the cognitive outcomes of learners with specific learning difficulties, namely reading impairment.

International and Brazilian investigators have indicated the need to promote diverse pedagogical strategies/resources to foster learning in students with dyslexia difficulties at school (Alsobhi et al., 2015; Correia, 2011; Demonet et al., 2004; Ianhez & Nico, 2002; Silva, 2004; Shaywitz et al., 2008; Teles, 2004). Additionally, considering the lack of legal pedagogical assistance and the creation of specific support in literacy in an inclusive manner at school, it becomes important to develop designed learning strategies for these types of learners.

Therefore, this study proposed to identify how the use of gamification mechanisms can support reading learning among Brazilian students with dyslexia. With the purpose to obtain

answers to this central question, five sub-questions were posed: (i) What are the students' needs and difficulties in the schooling context?; (ii) How do game elements influence students' engagement and motivation?; (iii) How do game elements/strategies influence students' learning?; and (iv) How will teachers and students evaluate the contributions of gamification to support reading learning?

### 1.3 Research Aims and Approach

The primary aim of this research is to understand the influence of gamified storytelling in facilitating the motivation, engagement, and reading learning outcomes of Brazilian students with dyslexia. More specifically, it is intended to map and characterize the students' thoughts, feelings, motivations, needs, and difficulties, explore special educational contexts in supporting students with dyslexia, and ideate, prototype, and test a gamified tool. In addition, it aims to evaluate indicators of motivation, engagement, and reading learning among students with dyslexia and obtain teachers' and learners' perspectives on the gamified reading experience.

Two participants with dyslexia and their teachers were selected from two public schools in the city of Belém-Pará, Brazil, considering the uncommon identification of learners with this Specific Learning Difficult in public institutions in this region. The choice of these individuals occurred after a process of: 1) identification of schools providing special educational assistance in Multifunctional Resources Rooms (Sala de Recursos Multifuncionais - SRM), where teachers assist students with dyslexia 'off the record' and despite the legal guidelines, by the Centro de Referência em Inclusão Educacional Gabriel Mendes (Crie); 2) presentation of the project to teachers, parents, and students; and 3) acceptance and subscription of the intervention by the participants. Following this process, two cases were defined, each comprising one student and two teachers, for a total of six participants.

The significance of this investigation lies in its contributions to the pluralization of reading tools, especially those using digital technologies, by combining multisensory stimuli at work with reading difficulties/impairment.

Firstly, gamification is an active strategy that can make the learning experience more emotionally engaging for learners (Schmitiz et al., 2012; Shneiderman, 2004). The creation of contextualized reading activities to challenge learners to solve problem situations, the use of technological tools to accomplish missions and learn, as well as to interact with scenarios, characters, and events in an interactive process with the text, may contribute to improved engagement.

Secondly, game-based design can involve the users with the aim to motivate them (Zichermann & Cunningham, 2011) to reach goals (Simões et al., 2015). As motivation is an important construct for students with dyslexia (Gooch et al., 2016), a setting of well-designed game elements is seen as a way to stimulate intrinsic motivation (Alexiou & Shippers, 2018). Therefore, a gamified tool can contribute to the motivation of learners with

dyslexia, immersing them in a reading experience made of challenges and learning through failures in order to progress towards mastery of a subject.

Thirdly, users can learn through intrinsic motivation and engagement (Alexiou & Shippers, 2018). Learning is a progressive activity in which skills and knowledge are constructed; therefore, when motivation and engagement increase, large gains in authentic learning would probably be stimulated (Simões et al., 2015).

Finally, even though there is a small number of studies discussing gamification and dyslexia, the literature includes promising results about the application of gamification as a strategy that can help motivate students with dyslexia (Gooch et al., 2016) and improve engagement in reading learning (Saputra, 2015). In turn, this research may foster important contributions to this field of implementation of active methodologies in Special Education.

### 1.4 Overview of the Study

This study is structured as follows:

Chapter 2, *Theoretical background*, presents the theoretical fundaments of the reading process as a cognitive process and as a social act, as well as of dyslexia, a specific learning difficulty associated with reading skills. The reading process, gamification and its types, game mechanics, gamification for motivation and engagement and, finally, the contributions of gamification to learning by students with dyslexia are also covered, according to the related studies. This chapter provides an overview of the main theoretical concepts that form the foundation of this research.

In Chapter 3, *Methodological Path*, the research design and procedures used in this study will be described. It covers the paradigm, nature, method of the study, characterization of participants and context, model of analysis, and the research design, in addition to the phases of the study and techniques and tools. In summary, it provides an overview of the research methodology in order to contribute to a better understanding of its developmental process.

The following chapter, Chapter 4, *Game designed mechanics for storytelling prototype: results and discussion*, shows and discusses a process based on the Design Thinking approach of creation of gamified storytelling to support reading learning among Brazilian students with dyslexia. It focuses on the presentation of methods and results for each of the four phases performed, and also on the discussion of issues surrounding the topics, such as empathizing with and understanding the needs of students with dyslexia, their difficulties and the schooling context, the effects of game-based strategies in learning, motivation, and engagement, and the participants' perspectives on the gamified reading experience.

The closing chapter, Chapter 5, *Conclusions*, summarizes the main aspects, implications, and limitations of the study, as well as contributions for future work, while the appendixes present the complete research tools, terms of informed consent, field diary, ideation planning, and the gamified storytelling tool.

# 2 THEORETICAL BACKGROUND

## 2.1 The Reading Activity

There are various studies addressing reading from different perspectives. In the cognitivism field, which was dominant in the end of the 1970s and beginning of the 1980s, cognitive theories about reading as a mental process emerged. Later on, reading comprehension as a social and collective event appeared in literacy studies (Kleiman, 2010). Hence, reading as a cognitive activity par excellence (Kleiman, 2002), and also as a social act, is described in this section and provides a better understanding of this skill in the learning process.

### *2.1.1 Reading Definitions*

In the cognitive line, reading is seen as a linguistic skill of high complexity (Ellis, 2001), a cognitive process that involves the recognition of words to derive meaning (Sangia, 2014). In the words of Kim and Goetz (1995), reading is "a cognitive process in which the reader, through interaction with the text, constructs meaning […]" (p. 205), meaning that, when reading, an individual is always seeking to comprehend the text. Thus, comprehension is the intrinsic goal in the reading process (Goodman, 1976 as cited in Klein, 2013). By contrast, although comprehension may be the end purpose of the process, Grégoire and Piérart (1997) consider that fluency in word recognition is a required condition for reading. Therefore, a competent reader recognizes words and infers their meaning accurately, what we call fluency in reading.

Klein (2013) postulated that the cognitive nature of reading is revealed by the understanding of meaning as not intrinsic to the text, but as a creation of the writer's mind represented in the text, and also as a (re)creation in the readers' minds while reading. In this regard, this concept redirects the focus from the text to the readers.

In the opinion of Leffa (1996), there are two restricted definitions of reading. The first one refers to reading as *extracting the meaning of a written text*, i.e. the use of the verb *extract* in this definition ascribes the meaning to the text, so that readers may have to dig into the text until they find its meaning. The visual aspect is essential because the meaning goes from the text to the readers through their eyes. Thus, reading is an ascending process, and comprehension increases as readers move forward with reading. However, according to this author, this definition has some limitations since

readers do not extract content from the text. The second definition considers reading as *attributing meaning to the text*. The use of the verb *attribute* means that the same text can result in different understandings for different readers since each individual has a unique previous knowledge. Thus, reading is a descending process and, consequently, comprehension develops throughout the reading activity. This definition also presents limitations because of the paradox of the amount of information offered by the written surface of a text that is needed for readers to comprehends its content. For that matter, this author conceived a third definition, in which the reading activity is a process of interaction between the readers and the text. Hence, when referring to reading, its complexity involves the role of the text and readers, as well as the process of interaction between these two.

In the socio-discursive perspective, reading is understood as a highly complex interactive activity of production of meaning (Koch & Elias, 2011). In other words, reading is based on the linguistic elements of a text; however, it demands mobilization of a vast set of knowledges related to the communicative event. Therefore, reading is a social event in which the readers' experiences and knowledges, other than linguistics, are operating in an effective manner.

In the socio-interactional perspective, researchers conceive the existence of an interaction between writer and readers, called the social and active subjects, who create meaning when they read a written text or images (Koch & Elias, 2011). Thus, every reading activity is unique because it involves meaning construction according to the perspectives and experiences of each reader. Leffa (1999) stated that reading is no longer an individual skill but social performance, in which meanings are not expressed in the text or inside the readers' minds, but belong to the domain of social interaction conventions where reading occurs. In the opinion of Soares (2000):

> Leitura não é esse ato solitário; é interação verbal entre indivíduos, e indivíduos socialmente determinados: o leitor, seu universo, seu lugar na estrutura social, suas relações com o mundo e com os outros; o autor, seu universo, seu lugar na estrutura social, suas relações com o mundo e os outros.[1] (p. 18)

Reading is a dynamic and social activity that results from the interaction between readers and writer, by means of a text, in a certain social and historical timing. This interaction is what constitutes reading as language practice. In summary, reading is a process of creating meanings, and not a product formed by the meanings themselves (Nunes, 2000).

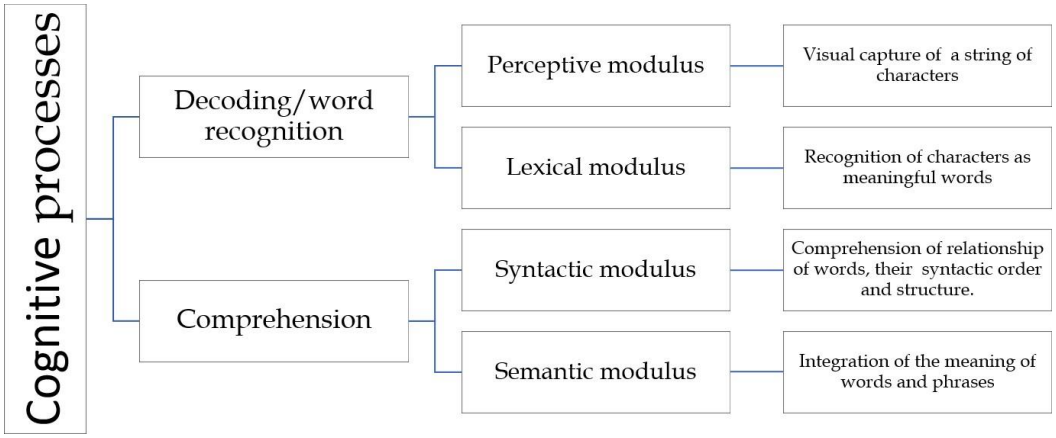
[1] Reading is not a solitary act. It is verbal interaction between socially determined individuals: the readers, their universe, their place in the social structure, their relations with the world and with others; and the authors, their universe, their place in the social structure, their relations with the world and others. (free translation)

These different perspectives on reading should not be seen as opposing but complementing, because they both have distinctive goals according to their fields. The cognitive perspective is interested in the mental processes involved in reading; to the socio-discursive perspective, the production of meaning in the use of language in communicative events is what matters. In the opinion of Kleiman (2010), since reading is a cognitive activity, the mental process involved in this activity may be continuously studied in order to understand the set of strategies and mental resources applied by readers in the act of decoding and comprehending a text. Complementarily, there are other relevant aspects when we refer to reading as a social act, which allow for a better understanding of how readers assume an active role in the reading process by establishing connections between their previous knowledge/experiences and the new knowledge stemming from reading.

### *2.1.2 The Cognitive Processes in Reading*

According to Kim (1995), it is broadly agreed that word recognition and comprehension are the most relevant components of reading. In the literature, it is common to find a subdivision of these processes into moduli, as shown in Figure 1:

**Figure 1** - Cognitive processes in reading




Source: Adapted from Rodrigues (2012)

Figure 1 illustrates the four moduli that include the processes effectuated during reading, as stated by Garcia (1998). These processes will be described and discussed in the following subsections.

#### 2.1.2.1 Word Recognition Skills

As mentioned, the first process in reading is decoding or word recognition, in which the perceptive and lexical moduli are identified. In order to define and describe

*word recognition* as part of the reading process, it is also important to understand *how an individual reads*.

In an investigation about the biological processing of reading, Dehaene (2012) stated that this activity starts in the eye. According to him, the center of our retina, named fovea, captures the letters with its full set of *cones* or high-resolution photoreceptor cells. This is the physiological process of capturing and identifying "pots" in the paper.

As the fovea is narrow (the human eyes are able to cover solely 15º of the visual field), our eyes are incessantly moving while reading. The eye movements during reading are, therefore, a sequence of breaks and jumps, i.e. the eyes do not slide in uniform motion over the text, but advance jumping from one point to another (Leffa, 1996). When reading, the eye movements cover two distinct moments: (i) saccades, when the eyes make minor movements (three or four times per second) in order to 'carry' letters to the fovea; and (ii) fixation, when the cones fixate in some spot of a written line. In the opinion of this author, our eyes impose some limitations to reading since the optical nerve obligates an individual to look at the line in saccades, jumping the glance every two or three seconds. Hence, "a leitura não é senão uma sucessão de tomadas do texto, que é apreendida quase palavra por palavra"[2] (Dehaene, 2012, p. 31). As a consequence, our eyes jump grammatical words such as prepositions, conjunctions or articles most of the time and fixate in content words, e.g. verbs, adverbs, and nouns.

In this process of word capture, Dehaene (2012) believes that the brain does not read words in their totality, instead they are "desmembradas em milhares de fragmentos pelos neurônios da retina"[3] (p. 25). Consequently, "a cadeia de letras deve ser reconstituída antes de ser reconhecida [....]"[4] (p. 25) and "a informação visual deve ser extraída, destilada, depois recodificada num formato que restitua a sonoridade e o sentido das palavras [...]"[5] (p. 26). Thus, the brain regroups the words and then moves forward to the level of meaning. This can be accessed in two parallels routes of reading: (i) the phonological route, which converts letter strings to sounds (phonemes); and (ii) the lexical route, which accesses a "mental dictionary" where the words are stored. These two routes work in parallel, one supporting the other, but in case of new words only the phonological route is activated and readers can decode the sound into comprehensible acoustic images and find its meaning. Batista and Venturini (2015) stated that fluent reading results from close coordination between the two routes, since "a identificação através das letras e das palavras é um processo

[2] "Reading is nothing but a succession of takes on the text, which is apprehended almost word for word" (free translation).
[3] "Broke up into thousands of fragments by retinal neurons" (free translation)
[4] "The string of letters may be reconstituted before it is recognized" (free translation)
[5] "Visual information must be extracted, distilled, and then recoded in a format that restores the sound and the meaning of the words" (free translation)

ativo de descodificação no qual o cérebro acrescenta a informação ao sinal visual"[6] (p. 101).

As seen, in order to accomplish word recognition, the perceptive dimension (perceptive modulus) of visual identification is perceived to be very important to the process of decoding because it allows readers to recognize and analyze the linguistic signs. However, the lexical dimension (lexical modulus) also performs relevant work since it helps recover the lexicon and recognize the meaning of the words (Cruz, 2007).

Regarding this reading process, word recognition can be defined as "the ability to transform printed letter strings into a phonetic code" (Voeten & Oud, 2001, p. 62). This act of seeing a word and recognizing its pronunciation is part of word recognition, so this component represents the action of readers to "consciously and deliberately apply their knowledge of the mapping system to produce a plausible pronunciation of a word they do not instantly recognize" (Back & Juel, 2002, p. 9). Consequently, after a word is decoded with accuracy it is recognized by the reader without effort, thus leading to expeditious word recognition.

Gough and Tunmer (1986, p. 7) also emphasized the function of the decoding skill: "decoding surely connotes, if not denotes, the use of letter-sound correspondence rules". In these terms, although word recognition "is fundamentally dependent upon knowledge of letter-sound correspondence rules" (Gough & Tunmer, 1986, p. 7), there are also other underlying elements for recognizing a word, such as phonological awareness and sight word recognition, as an irregular word.

In order to proceed effectively to a higher level of reading, readers may be fluent in decoding/word recognition. In this respect, Cotter (2012) claimed that fluency is multidimensional because it refers to accuracy (the ability to read words precisely), automaticity (the ability to read rapidly and effortlessly), and prosody (the ability to read with proper expression and phrasing). In addition, fluency "is a critical literacy component that is necessary for successful reading" (Cotter, 2012, p. 9). Hence, to be successful in reading a person may be fluent, which embraces the ability of recognizing words. Pikulski and Chard (2005, p. 510) synthetized that fluency refers to "efficient and effective word recognition skills", and also manifests itself in "accurate, rapid, expressive oral reading and is applied during, and makes possible, silent reading comprehension" (p. 510).

What is claimed in these definitions is the foundation of fluency in oral language skills – *accuracy, prosody, phonemic awareness, efficient decoding, etc.* However, Pikulski and Chard claimed that a definition of fluency may embrace more than an oral phenomenon and be correlated with comprehension. Therefore, by characterizing the role of fluency as a multifaceted process including *word identification or decoding* and *comprehension or the construction of the meaning,*

[6] "Letters and words identification is an active decoding process in which the brain adds information to the visual signal" (free translation)

they argue that non-fluent readers are not able to understand a text since they have to make laborious efforts to decode the words. The authors thus emphasize that readers cannot focus on both processes of decoding and comprehension at the same time, considering that the "[…] automaticity of decoding – a critical component of fluency – is essential for high levels of reading achievements" (Pikulski & Chard, 2005, p. 511). In summary, reading fluency has a high level of importance, hence this skill may be built upon during reading development in order to engage individuals in a successful reading practice.

#### 2.1.2.2 Reading Comprehension

The main purpose in reading is to comprehend the meaning of the text. In simple words, comprehension can be defined as the act of understanding a written text. Although comprehension can be simply stated, it is not a product but is instead a very active and interactive process occurring during a reading activity (Leffa,1996). This ability was defined by Hoover and Gough (1990) as an ability to take lexical information and interpret sentences and discourse. Likewise, Cruz (2007) considered comprehension as a cognitive process regulated by readers, in which the existent elements stored in their memories are integrated into the new information presented in the text in order to construct meaning.

Concerning the act of comprehension, Kroner (2012) claimed, and authors as McKeown and Beck (1990) and Adams and Collings (1977) clarified, that individuals obtain the implicit and explicit meaning of a text when they read. The explicit meaning is derived when the understanding of readers is superficial, i.e. it is exactly what was written by the author. If readers understand beyond what is explicit in the text, then they have developed an implicit understanding. When readers understand both the implicit and explicit meaning, and also combine it with their prior knowledge, then successful comprehension of the text occurs.

Therefore, reading comprehension seems to be an incredibly complex process that may be learned and reinforced during schooling. So, how is this process conducted? In the literature, there are explanations for comprehension as the dynamic process of creating inferences, world representations, and ideas using the *bottom-up*, *top-down*, and *interactive processes of reading*, as defined below:

- *Bottom-up process*: Reading is seen as an ascending process, flowing from the text to readers (Leffa, 1999), and occurs from the smallest units (such as graphemes) to extensive and global units (such as sentences and paragraphs). In this reading model, reading means to extract meaning; therefore, "um mesmo texto produz sempre os mesmos significados, pelo menos em leitores de um mesmo nível de competência" (Leffa, 1999, p. 6). Klein (2012)

claimed that novice readers usually resort to this reading process because of their non-fluency;

- *Top-down process*: In this view, reading is more dynamic, and readers use their background knowledge to comprehend a text (Klein, 2012). It a descending process, i.e. it starts with previous knowledge and proceeds to decoding. In the opinion of Klein, readers who use this cognitive process are fluent in reading, but they can do excessive guessing since they rarely use the bottom-up process.
- *Interactive process*: In this approach, reading combines background knowledge (reader) and linguistic features and meaning (text). According to Solé (1998), the meaning of a text is constructed when readers simultaneously use background information to comprehend a text and linguistic knowledge when they encounter unfamiliar words, for instance. Kleiman (2002) claimed that experienced readers usually use the *bottom-up* and *top-down process* in an adequate manner throughout the reading process.

It is relevant that these three approaches provide a general understanding about reading and the process of comprehension, and the use of each one of them depends on conditions such as readers' fluency, text complexity, reading goals, level of background about the subject, individual reading styles, and so on (Klein, 2012).

In essence, besides the level of word recognition, there is this important level of comprehension. As pointed above, the syntactic and semantic moduli are nested in the level of comprehension (Cruz, 2007). The syntactic modulus, which includes strategies for grammar or syntactic recognition of word order, its functional role and meaning, the use of punctuation and others (Guidetti & Martinelli, 2007), also implies the construction of propositions, extraction of the global meaning of the text, and correlation between the ideas in the text (Cruz, 2007). The semantic modulus encloses the integration of words in a meaningful whole (Guidetti & Martinelli, 2007) and the articulation of new and previous knowledge (Cruz, 2007).

The semantic modulus presents the comprehension of words, sentences, paragraphs, and the whole text as the main goal (Guidetti & Martinelli, 2007); however, this dimension is not enough for an effective comprehension. The interrelationship between the other moduli – decoding/word recognition fluency and the syntactic knowledge – is also necessary, as well as the prior knowledge of readers. Thus, as pointed by Vega (2006 as cited in Rodrigues, 2012), the semantic modulus is formed by two components: the extraction of meaning and the integration of this meaning with the information stored in readers' memories.

This prior knowledge, as mentioned, is an essential part of comprehension. Thus, in the words of Kleiman (2010), "a compreensão do texto é um processo que se caracteriza pela utilização de *conhecimento prévio:* o leitor utiliza na leitura o que

ele já sabe, o conhecimento adquirido ao longo de sua vida"[7] (p. 13). In otherwords, a more effective comprehension is developed when the readers' background knowledge about the subject of the text is greater.

According to Kleiman (2002), readers activate various levels of prior knowledge stored in their memories during reading, such as linguistic, socio-cultural, and encyclopedic knowledge. This is also called strategical textual processing, which means that readers simultaneously perform a number of oriented, effective, efficient, flexible, and extremely fast interpretive steps (Koch & Elias, 2011):

(i) The linguistic knowledge refers to proficiency on the linguistic surface of a text, i.e. it includes the recognition of phonemes, letters, syllables, words, and sentences in order to decode a text (first procedure of accessing the written world). Since the construction of meaning is based on the interrelationship between discursive and linguistic factors (Rojo, 2002), decoding does not exhaust all the procedures involved in this activity.

(ii) The socio-cultural knowledge embraces ways of interacting by means of language, e.g. recognizing the author's goals when reading a text, appropriate use of language, and so on;

(iii) The encyclopedic knowledge is related to worldly wisdom stored in memory.

These types of knowledge form the background knowledge of readers, without which there is no comprehension of a text. Thus, reading is the *activity of searching* for relevant memories from past experience and knowledge to comprehend what is presented at the surface of a written text.

Furthermore, Kleiman (2010) suggested that reading comprehension also presumes the use of other relevant metacognitive activities, such as the establishment of objectives and formulation of hypothesis, which imply conscious control and reflection about the readers' knowledge. This author also claimed that, beyond this contextual constituent, there is also what she named the "contextual" component, which refers to the readers' interpretation of the formal elements that contribute to the creation of cohesive relationships over a text.

In summary, as discussed above, reading successfully is a complex activity that encompasses the mental processes of decoding/word recognition (the ability to recognize and discriminate the letter-sound relationships, as well as to identify written

[7] "Text comprehension is a process characterized by the use of the prior knowledge: the reader uses in reading the knowledge acquired through his/her life." (Free translation)

words with fluency) and language comprehension (the ability to construct a mental representation of the meaning of a text by correlating different kinds of background knowledges). When readers follow these processes, it is assumed that they are experienced or fluent readers. In other words, fluency is not solely about decoding skills, but also directly related to comprehension skills.

### *2.1.3 Skilled Reading and Reading Disability*

As discussed above, reading is a complex process that can be broken down into levels of related grapheme-phoneme correspondences and word recognition (Dehaene, 2012) with semantic perception and comprehension and interpretation (Leffa, 1999). These skills refer to the ability to understand what is printed in a text, construct meaning, and combine one's comprehension with prior knowledges. Hence, it is possible to say that a proficient reader has developed all these skills.

Hoover and Gough (1990) endorsed this assumption by supporting a theory named simple view of reading, by which they expressed this relationship: R=D x L, where R (reading) is a product of an individual's decoding skills (D) and linguistic comprehension (L). These two components are not summed but act together, since "without a minimum of decoding and some language comprehension ability, reading comprehension is impossible […]" (Protopapas et al., 2012). In order for someone to read successfully, the authors assume that these two components cannot be non-zero.

In this vein, it can be concluded that skillful reading encompasses fluency and automacity in recognizing most of the words effortlessly and rapidly (Dehaene, 2012), so that readers can focus on the meaning (Cotter, 2012) beyond recognizing the semantic values of words (Cruz, 2007) and use of background knowledges (Kleiman, 2002). However, it is important to highlight that becoming a skillful reader is a process of literacy. Fluency may be developed along the schooling process, which means that readers gradually build decoding skills in order to construct meaning by making inferences, setting hypotheses, responding critically, and so on (Pikulski & Chart, 2005). This means that reading is a skill that may be acquired.

On the other hand, non-skilled readers, that is to say, people with low literacy levels and more typically with poor decoding abilities, and consequently not fluent in applying morpheme-phoneme correspondences and in recognizing words, are not able to dedicate attention to text comprehension (Pikulski & Chart, 2005). Nonetheless, Jackson and Doellinger (2002), in their study about poor decoders, identified a small group of readers that, despite their non-fluency in decoding, present average comprehension skills. The authors named them *resilient readers*. To the researchers, this type of readers may develop comprehension skills to compensate for their poor decoding abilities.

In view of that, it is imperative to highlight that this kind of literacy difficulties does not imply a disability. A person with reading problems who receives

appropriate pedagogical support will be able to develop reading skills. However, some learners are diagnosed with a learning disability, such as reading impairment, and hence may need to be continuously supported throughout the schooling process. This reading disability can be related to word recognition errors, deficits in understanding a written text, or both (Gough & Tunmer, 1986).

According to Schawitz (2003), reading disabilities are very common in childhood, occurring in at least 20% of the population and often continuing throughout adolescence and adulthood (Rizzato, 2015). Therefore, one must bear in mind that disabilities/difficulties in literacy may be understood at a deeper level in this study. Learning disabilities/difficulties and its types in the academic domain (i.e. reading impairment, popularly known as dyslexia) will be discussed in more detail in the next section.

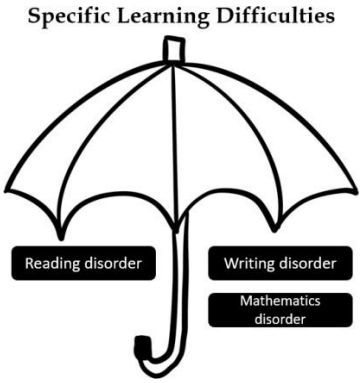
## 2.2 Specific Learning Difficulties

### *2.2.1 Conceptualization*

According to the specific psychological and medical fields, Specific Learning Difficulties (SLDs) are labelled as specific learning disorders or disabilities. The Diagnostic and Statistical Manual of Mental Disorders - DSM-5 (APA, 2014) uses the term “disorder”, whereas the Individuals with Disabilities Education Act of 2004 (IDEA) uses “disability” instead. Both terms (“disorder” and “disability) are adequate in the medical and psychological contexts because researchers aim to study these SLDs. In the educational field, we consider that the use of the term “difficulty”, used by authors such as Correia (2011), Correia and Martins (1999), and Cruz (2011), better reflects learning impairments. Therefore, in this work, we use the SLD label to refer to a set of disabilities.

SLD is in fact an umbrella concept (APA, 2014; British Dyslexia Association [BDA], 2018) covering a number of learning disabilities, as shown in Figure 2.

**Figure 2**: Specific Learning Disorders/Difficulties




Source: Adapted from DSM-5 (APA, 2014)

These disabilities are combined because learning deficits in reading, writing, and math commonly occur together.

One of the most influential definitions of SLDs (Correia & Martins, 1999) is stated in the IDEA (2004):

> (i) General. The term means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.
>
> (ii) Disorders not included. The term does not include learning problems that are primarily the result of visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage.

IDEA's definition gives the concept of what an SLD is in general, describing the academic difficulties associated with the cognitive processes of "understanding" and "using" verbal language. It also includes a list of included and non-included disorders. Thus, it summarizes the excluded elements in order to distinguish SLDs from others neurological disorders.

Kavale (2009) stated that IDEA's definition, although having attained an important and consensual status, presents failures of "stipulative definition". Therefore, this definition does not provide an explanation for the included disorders and also for what is considered "general" in SLDs. According to this author, many efforts to improve the definition of SLDs have been attempted but ignored. Therefore, it was still necessary back in 2009 to create an operational definition to describe what an SLD really is. Scanlon (2013, p. 29) described the challenges in defining SLDs:

> a precise definition of LD [learning disability] must fully define LD in relation to the multiplicity of ways it might be used. Certainly, the definition should be relevant for identifying LD and for labeling and providing services to individuals, but also for determining who is included in research samples, theorizing on the nature of LD, and determining the scopes of laws and policy, for example […]

Seen in these terms, an useful definition for the purpose of assisting the clinical and educational field is still necessary. A new definition could direct to a clear understanding of what a SLD is as an entity and how to recognize a SLD for what really is.

As in the medical and psychological fields, it also important, as mentioned by Correia (2008), in the educational field to clarify the difference between Learning Difficulties, which include any learning problem at school or impairment of intellect, and SLDs, which are intrinsic to an individual and have neurodevelopmental causes. Thus, it is important to highlight that SLDs are not a mental, intellectual, auditory, visual or other physical disorder (Correia & Martins, 1999) and are not due to problems with literacy and teaching (Correia, 2011). According to Correia (2008, p. 165):

> As dificuldades de aprendizagem específicas dizem respeito à forma como um indivíduo processa a informação – a recebe, a integra, a retém e a exprime –, tendo em conta as suas capacidades e o conjunto das suas realizações. As dificuldades de aprendizagem específicas podem, assim, manifestar-se nas áreas da fala, da leitura, da escrita, da matemática e/ou da resolução de problemas, envolvendo défices que implicam problemas de memória, perceptivos, motores, de linguagem, de pensamento e/ou metacognitivos. Estas dificuldades, que não resultam de privações sensoriais, deficiência mental, problemas motores, défice de atenção, perturbações emocionais ou sociais, embora exista a possibilidade de estes ocorrerem em concomitância com elas, podem, ainda, alterar o modo como o indivíduo interage com o meio envolvente[8].

This definition, as cited, includes all the main characteristics of definitions used around the world. Thereby, it describes the skills involved and the possibility of association with other disabilities.

[8]"Specific learning difficulties relate to the way individuals process information, i.e. receives, integrates, retains and expresses information, taking into account their abilities and all their achievements. Specific learning difficulties can manifest in the areas of speech, reading, writing, mathematics and/or problem solving, involving deficits with memory, perceptual, motor, language, thought and/or metacognitive problems. These difficulties, which do not result from sensory deprivation, mental deficiency, motor problems, attention deficit, emotional or social disturbances, although they may occur concomitantly with them, may also alter the way the individual interacts with the surroundings." (free translation).

The DSM-5 (APA, 2014) presents the most recent and best empirically grounded definition (Kormos, 2017). According to Tanock (2014):

> DSM-5 considers SLD to be a type of Neurodevelopmental Disorder that impedes the ability to learn or use specific academic skills (e.g., reading, writing, or arithmetic), which are the foundation for other academic learning. The learning difficulties are 'unexpected' in that other aspects of development seem to be fine. Early signs of learning difficulties may appear in the preschool years (e.g., difficulty learning names of letters or counting objects), but they can only be diagnosed reliably after starting formal education. SLD is understood to be a cross-cultural and chronic condition that typically persists into adulthood, albeit with cultural differences and developmental changes in the way the learning difficulties manifest.

This definition groups SLD subtypes, i.e. dyslexia, dyscalculia, and dysgraphia, under an umbrella (as seen in Figure 2). This is a very important shift because it demands a "comprehensive assessment of academic skills" from clinicians and researchers besides helping to reduce the "challenges associated with defining the subtype of SLD", according to Tanock (2014), because of combined learning deficits in different skills domains.

Facing these definitions, and in accordance to what Correia and Martins (2009) and Scanlon (2013) stated about an absence of consensual definition amid most clinicians and researchers, we identify two main contributions to our work: 1. Comprehension that SLDs are co-occurring disorders, which justifies finding students with combined problems in reading, writing, and math; and 2. SLDs can vary with the different difficulties from student to student at different ages, thus learners may personally present particular difficulties and needs when involved in schooling activities.

### *2.2.2 Characterization*

According to the given definitions, we highlight SLD's main characterization:

(i) It involves academic disorders in reading, writing, and calculation;

(ii) It is a *neurodevelopmental dysfunction (*APA, 2014; Larusso et al., 2014), which means it originates during the developmental period (in the

proposed revisions, manifestation during "formal schooling") (Scanlon, 2013);

(iii) It is related *to learning or use of specific academic skills*, and the various subtypes, i.e. dyscalculia, dyslexia, and dysgraphia, are included as co-occurring elements;

(iv) The disability is *unexpected*, i.e. there is academic discrepancy in learners' achievements and their cognitive and intellectual capacities;

(v) It is chronic (APA, 2014; Correia, 2008), i.e. it can exist throughout life, differentially affecting individuals in its manifestations and significance across age groups and contexts;

(vi) Its phenotypic expression is modulated by age and environment (Larusso, et al., 2014), with manifestations changings across contexts and age groups (Scanlon, 2013).

SLD does not show physical signs. A person with a SLD has intellectual ability to participate in academic activities; therefore, teachers may be "able to identify children with persistent difficulties in learning and report the problems to the families […]" (Larusso et al., 2014, p. 78).

A learner with SLD may exhibit characteristics such as cognitive, academic, social, emotional, and behavioral difficulties (Pierangelo & Giuliani, 2008). We note that these difficulties may be *persistent.* Therefore, it is important to document students' persistent failures when they receive appropriate intervention.

### *2.2.3 Possible Causes*

The causes of SLDs are diverse and complex (Pierangelo & Giuliani, 2006). Scientific studies show that the majority of learning disabilities have various causes and, in most cases, these causes are not clarified (Fonseca, 1999).

The literature pinpoints some causes: (i) SLDs may be caused by *hereditary factors* (Hallahan & Kauffman as cited in Pierangelo & Giuliani, 2008; Winkler, 2006); (ii) *prenatal factors* such as use of tobacco, alcohol, and drugs during pregnancy may cause developmental, cognitive or emotional damage in children (Correia & Martins, 1999; Williams, 2015) and; (iii) *postnatal factors* associated with tumors, cranial trauma, poor nutrition, toxic substances, and physical abuse may also be involved (Correia & Martins, 1999; Pierangelo & Giuliani, 2008).

In summary, as stated by Correia & Martins (1999), we may not consider that all cases of SLDs are caused by a myriad of causes, and it is relevant to highlight that most cases of SLDs are considered a mystery (Hallahan & Kauffman, 2006 as cited in Pierangelo & Giuliani, 2008).

### *2.2.4 Types*

There are various types of SLDs, including learning disabilities in communication and behavior disorders (Pierangelo & Giuliani, 2008), but in this section we will focus solely on three major academic domains, labeled as reading, writing, and mathematics, according to the DSM-5 (APA, 2014):

a. Mathematics disorder is also referred as **dyscalculia,** a learning difficulty with mathematics. According to Pierangelo & Giuliani (2008, p. 42), "These disabilities affect a person's ability to understand and/or manipulate numbers, perform mathematical operations, and/or conceptualize numbers themselves as an abstract concept of comparative quantities". Therefore, this lifelong difficulty impacts math-related activities, hindering many aspects of mathematics such as understanding quantities, problems, and solutions requiring numerical reasoning among children/teenagers;
b. The reading disability also named **dyslexia** (Lyon et al., 2003; Pierangelo & Giuliani, 2006;) refers to a disorder primarily affecting word reading accuracy and reading fluency (APA, 2014), and secondarily reading comprehension (Rodrigues & Ciasca, 2016);
c. Writing disability, sometimes named **dysgraphia,** involves issues with written organization and formulation, functional problems with the act of writing (such as irregular writing, motricity difficulties, etc.), and spelling disability, named **dysorthographia** (Pierangelo & Giuliani, 2008). Some authors use the term *dysgraphia* to refer to all problems involving written expression (Deuel, 2015).

Essentially, it is important to highlight that these three basic categories of learning difficulties inhibit students' progress; thereby, it is important to recognize and understand them in the education context in order to create specific teaching interventions to help these learners.

## 2.3 Reading Difficulty: Dyslexia

### *2.3.1 Definition*

DSM-5's novelty consists in using the term SLD, as shown in section 2.2, and preferring the code "with impairment in reading" to refer to dyslexia. It states that "Dyslexia is an alternative term used to refer to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding, and poor spelling abilities" (APA, 2014, p. 67). Thus, according with DSM-5, dyslexia is an acceptable and equivalent label for the same condition.

As a term widely used in the international literature, dyslexia is defined by the International Dyslexia Association (as cited in Lyon et al., 2003) as:

> […] a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.

This definition is broadly accepted in the scientific community (Teles, 2004) and also includes some key terms that define dyslexia as a variant of SLDs.

Firstly, the definition emphasizes the *biological foundations* of dyslexia. Vellutino et al. (2004) stated that genetic and brain structure and function studies confirm dyslexia as a disorder with neurobiological (Associação Brasileira de Dislexia [ABD], 2016; Lyon et al., 2003; Rello & Baeza-Yates, 2013) and genetic traces (Nijakowska, 2018; Vellutino et al., 2004), which means that developmental dyslexia has a genetic influence.

Secondly, it also includes a characterization of the disability *with accurate and/or fluent word recognition and poor spelling and decoding abilitie*s, and that these difficulties result from *a deficit in the phonological component that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction.* In other words, this phonological deficit inhibits discrimination and processing of language sounds, awareness about how words are formed by syllables and syllables by phonemes, and that phonemes are represented by letters in written language (Teles, 2004).

Dyslexia is defined as *unexpected in relation to other cognitive abilities*. Authors as Riddick (1996) argued that it is possible to have a number of ambiguities about "an unexpected difficulty" because there are no explanations about the kind or frequency of difficulties and the particularities of the difficulties according to the child. Petreto and Masala (2017) posited the idea of *an unexpected difficulty* referring to a double interpretation associated with the *principle of discrepancy* (Bateman, 1965) between ability and achievement, and also amid "the level of achievement in specific instrumental school abilities and the level of schooling ('low achievement criterion')" (Petreto & Masala, 2017, p. 1). Moreover, regarding *the provision of effective classroom instruction,* people who have difficulties in reading solely due to illiteracy or poor instruction are not considered to be dyslexic (Dieckman, 2017).

Lastly, *secondary consequences may include problems in reading comprehension and reduced reading experience that can hinder vocabulary growth and background knowledge.* This part of the definition states that a poor reading ability promoted by difficulties in decoding and fluent word recognition can result in insufficient reading experience and have an impact on the ability to comprehend texts. "Therefore, comprehension is a derivative and indirect casualty of not being able to identify words accurately" (Dieckman, 2017, section Analysis of current definition, par. 7.).

Although researchers agree on dyslexia's neurobiological origin, as mentioned in its definition, the frequency of this reading difficulty differs between languages (Rello et al., 2016) due to different orthographies (Teles, 2004). Thus, as Portuguese, for instance, is a language with regular orthography (Barbosa et al., 2015), or reasonably transparent[9] (Capovilla et al., 2007), the reading and written difficulties of Brazilian or Portuguese students with dyslexia can differ from those of learners who speak languages with opaque orthography such as English.

Regarding the characterization of dyslexia, it is still relevant to mention that many individuals may present other co-occurring cognitive disorders (Rodrigues & Ciasca, 2016), so the reference to specificity helps us, as teachers, understand what characterizes developmental dyslexia. In addition, this reading difficulty is *persistent*, although its consequences and manifestations may vary over life (Teles, 2004); therefore, it requires specialized intervention at school in order to define and implement more adequate teaching strategies. Thereby, the following section will focus on the relevance of appropriate didactic intervention.

### *2.3.2 Etiology*

There are some theories about the fundamental causes of dyslexia (Ramus et al., 2003; Teles, 2004): (i) the phonological theory; (ii) the magnocellular (auditory and visual) theory; and (iii) the cerebellar theory. The phonological theory is the most prevalent amid researchers.

According to Ramus et al. (2003), the phonological theory suggests that "dyslexics have a specific impairment in the representation, storage and/or retrieval of speech sounds" (p. 842), which means that this model defines dyslexia in terms of difficulties associated with the phonemes – the smallest units of speech. This deficit reduces an individual's ability to make correspondences between letters and speech components. Thus, if a person with dyslexia is not aware of the representation,

[9]According to Capovilla and Capovilla (2002), there is variation in the type of speech mapping, so there are transparent and opaque orthographies. Veloso (2005) postulated that opacity and transparency appear in a continuum in which the Portuguese language is closer to the languages with phonemically transparent writing, which means that there is regularity in the relationship between phonemes and morphemes.

storing, and retrieving of sounds, the learning of the alphabet system is affected (Shaywitz, 2003).

Teles postulated that reading integrates two distinct and inseparable processes: decoding and comprehension (see section 2.1 for more details) of a written message. The phonological deficit impairs solely the process of decoding, which means that an individual with dyslexia is not able to identify and interpret the letters/words.

The main weakness of this theory, as claimed by Ramus et al. (2003, p. 843), is "the inability to explain the occurrence of sensory and motor disorders in dyslexic individuals"; therefore, its supporters consider these disorders as co-occurring with reading impairment, but not part of the causes of dyslexia.

The magnocellular theory suggests that dyslexia is caused by visual impairment at the magnocellular pathway (Teles, 2004). In the opinion of Santos and Ferreira (2012), the magnocellular theory is based on a visual deficit that causes difficulties in the processing of letters and words in a text through unstable binocular fixations, problems in vergence, or visual crowding. For Ramus et al. (2004), the magnocellular dysfunction is not restricted to the visual pathways but extends to the visual, auditory, and tactile modalities. Nevertheless, this theory is not consensual because it is not able to explain all the disorders observed in individuals with dyslexia.

Lastly, the cerebellar theory refers that dyslexia is characterized by an automatization deficit linked to impaired functions of the cerebellum. As stated by Santos and Ferreira (2012), the cerebellum has an important role in the process of automatization of various motor activities such as driving, reading, and writing. Therefore, people with dyslexia present difficulties in automating word decoding or fluent reading (Teles, 2004). This theory is supported by scientific studies in which people with dyslexia showed poor performance in various motor tasks and also in time estimation (Fawcett & Nicolson, 1996 as cited in Santos & Ferreira, 2012).

As with the other theories, the magnocellular model has limitations. Studies such as those by Desmond and Fiez (1998 as cited in Santos and Ferreira, 2012) question if the cerebellum solely contributes to the cognitive functions or whether it also adds dysfunction to other parts of the brain. Moreover, another problem related to this theory is that "the causal link postulated between articulation and phonology relies on an outdated view of the motor theory of speech, according to which the development of phonological representations relies on speech articulation" (Ramus et al., 2003, p. 843).

### *2.3.3 Subtypes*

According to its emergence, dyslexia is categorized as:

(i) *Acquired dyslexia:* Some "disorders of reading are frequently encountered in patients with acquired cerebral lesions" (Coslett, 2000, p. 419), thus acquired dyslexia is experienced by individuals who were previously "competent readers" (Castles & Coltheart, 1993) and have lost reading and writing abilities due to brain injuries;

(ii) *Developmental dyslexia:* This other type of dyslexia "refers to a developmental disorder of suspected congenital or hereditary origin, in contrast to acquired dyslexia, which is a disorder resulting from brain injury after the onset of reading" (Sprenger-Charolles et al., 2000, p. 71). Yet, it is "observed in children who fail to achieve normal reading skills" (Manis et al.,1995, p. 158), i.e. these disorders are found in individuals who never attained the ability to read.

Table 1 presents the subtypes of acquired and developmental dyslexia:

**Table 1** - Subtypes of Dyslexia

| | |
|---|---|
| Acquired dyslexia (difficulty in using the lexical or sublexical procedures, or both, due to brain injury) | - **Phonological or dysphonetic dyslexia**: It is a deficit in the sublexical procedure associated with a difficulty in reading non-words or unfamiliar words (Peterson et al., 2013; Friedman & Coltheart, 2018). As stated by Muszkat and Rizzutti (2012), the main characteristics of this kind of dyslexia are: global reading, phonological weakness, difficulties reading unfamiliar and non-words aloud, poor accuracy in reading regular or irregular words, and visual errors in reading and writing.<br>- **Surface dyslexia:** It "is a deficit in the lexical route, which forces the reader to read aloud via the sublexical route, though grapheme-to-phoneme conversion" (Friedman & Coltheart, 2018, p. 20), i.e. it is characterized by the tendency to read words using grapheme-phoneme rules. Also, according to Charolles (2011, p. 6), this type of dyslexia is categorized when "irregular word reading is impaired but pseudoword reading is spared".<br>- **Mixed dyslexia:** It refers to individuals with cumulative impairment of both phonological and surface dyslexia (Charolles, 2011; Zoubrinetzky et al., 2014). |
| Phonological dyslexia (difficulty in acquiring the lexical or sublexical procedures, or both, due to neurobiological, phonological or visual-perceptive problems) | |

In order to understand the foundation of these subtypes of acquired and developmental dyslexia, it is important to explain the double-route model of

reading. In this regard, Charolles (2011, p. 6) stated that "in this framework, written words can be processed either through a lexical reading route (also called the orthographic procedure) or a sublexical reading route (also called the phonological procedure)". The *lexical route* permits direct access to the visual identification and meaning of words in the readers' mental lexicon and is very useful when reading familiar words. When using the *sublexical route*, the meaning or visual form of a word is not activated as in the *lexical route*. In this process, reading proceeds from grapheme-to-phoneme conversion rules; in other words, the first letters are identified and then they become sounds.

Ziegler et al. (2008) postulated that the *lexical route* "is necessary for the correct pronunciation of irregular words while the non-lexical route is necessary for the pronunciation of novel words and non-words" (p. 152). It is also important to highlight that these two procedures are interactive in nature, thus in order to be a skilled reader one needs to use appropriately both procedures (Castles & Coltheart,1993).

Data on acquired dyslexia have performed a fundamental role in the development of this model because they revealed that these two processes can be selectively affected, the phonological procedure for *phonological dyslexia* and the orthographic procedure for *surface dyslexia* (Sprenger-Charolles & Serniclaes, 2003). In addition, various studies demonstrate that these subtypes are also identified in developmental dyslexia (Charolles, 2011; Castles & Coltheart, 1993; Zoubrinetzky et al., 2014).

In the literature focused on dyslexia, various other types of classification of acquired dyslexia are identified, per the location of the brain injury (Rebelo, 1988 as cited in Ferreira, 2011), as well as developmental dyslexia because this population is not homogeneous, as pointed by Ferreira (2011). However, it is not scope of this work to include a discussion of these categorizations.

### *2.3.4 Educational Implications for Dyslexia*

School is the place where the symptoms of dyslexia are first identified since it is where reading and writing are prioritized activities (C. Alves, 2014). Analogously, Teles (2004) postulated that dyslexia is perhaps the most frequent cause of school failure, but it is not identified or treated appropriately in most of cases. Therefore, in the school setting, complaints about reading and/or writing activities, as well as demotivation, anxiety, and frustration are observed among learners because of their difficulties with words, sentences, and meanings (Al-Lamki, 2012).

These implications of dyslexia may be a concern at an early age and also during adolescence and adulthood since the disorder "remains throughout the lifetime of the individual" (Martino et al., 2011 as cited in Rizzato, 2015, p. 119-

120). Hence, schools may provide specific interventions to both younger and older students with dyslexia, considering the different expressions of the disability/difficulties according to age.

In face of the persistent difficulties in academic skills of students of any age, teachers may not perceive/comprehend the causes of the problems, and students may avoid school. Thus, it is imperative to discuss *the importance of teachers and the proposal of pedagogical actions to work with this target-population.*

(i) Teachers' Importance

Teachers are indispensable in this process, by identifying and, subsequently, being able to understand and assist students with dyslexia in their schooling process (Duarte & Souza, 2014). Therefore, it is imperative that teachers understand the difficulties in reading and writing that students with this SLD may have, in order to create a positive environment in which these learners could be engaged in the learning process. It is thus relevant to highlight the fundamental role of the teacher. Lima (2012) and Riddick (1996) stated that teachers need to get specific training to know the signs of dyslexia and to cope with the learners' difficulties. They do not need to be specialists on SLDs, but it is essential that they know dyslexia and the students' dyslexic difficulties (Ianhez & Nico, 2002), and also how to adapt teaching strategies and use alternative means of assessment to benefit these learners.

Educators are at the forefront of the schools, so they need to embrace two main ideas: (i) to assess their students' competencies and difficulties; and (ii) to adopt a wide variety of strategies and support learners with dyslexia to overcome their learning difficulties. After all, as claimed by Riddick (1996, p. 31), "there is no blueprint for providing support for children with SLD". Consequently, "each school needs to formulate its own plans based on its own circumstances". By understanding this second point, i.e. the need to adopt appropriate teaching interventions, it is possible to promote strategies for increasing motivation and encouragement.

These appropriate learning conditions are as important as any other kind of remediation (Demonet et al., 2004). This is why teachers need to become more aware of the fact that dyslexia is a serious impairment in literacy, and also need to get more training about creative and innovative learning strategies aimed to diminish the students' difficulties.

Furthermore, teachers can also support students by helping with the social and emotional side of dyslexia (Ryan, 2018) and the perception of this disorder (Majer, 2018). Regarding the emotional side, Casserly and Gildea (2015) revealed some relevant findings related to the students' positive disposition toward learning when taking special reading classes. They also showed how this disposition is

connected, mostly with teachers' attention, and the appropriate interventions provided when teachers are aware of the nature of the difficulties experienced by these learners with SLDs. Thus, when parents and teachers perceive emotional constraints, they may offer continuous and consistent encouragement and support in order to help students with dyslexia-related emotions (Ryan, 2018).

In reference to perception, Majer (2018) claimed that it is a crucial part of learning because teachers' attitudes of inclusion of students with dyslexia may vary according to their perceptions. Thus, "The corollary being that perception plays a significant role in the learning process, impacting upon teacher pedagogy, students' perceptions of themselves and subsequently learning" (Majer, 2018, p. 29). Additionally, teachers' perceptions influence the students' self-concept; therefore, since learners can be affected by their teachers' impressions, it is imperative that teachers learn about dyslexia in order to modify their teaching approaches and, in turn, enable the learners' academic achievements.

(ii) Pedagogical Interventions

In the opinion of Shaywitz et al. (2008, p. 14-16): "Explicit, intense, systematic, and developmentally appropriate interventions are effective and provide an evidence-based approach in treating dyslexia", which means that interventions focused on students with dyslexia in regular and/or special classes help these learners progress in learning decoding and comprehension, as well as writing.

According to IDA (2017), appropriate interventions can be developed from important academic modifications so that students with dyslexia can succeed, e.g. giving extra time for completing activities, adjusting assignments or promoting alternative types of assessment. General education and special education teachers may provide accommodations such as: involving *materials*, with adaptations in the amount of work, writing directions, use of adequate fonts, selection of essential information, supplement practice activities, glossaries, reading guides, audio recording, and use of assistive technology; *interactive instructions*, such as inclusion of explicit teaching procedures, simplification and repetition of directions, daily routines, handing out copies of the lessons and graphic organizers, combining verbal and non-verbal information, making reviews, balancing the types of work dynamics, use of the whiteboard to write key points/sentences/words, and use of mnemonic for instructions; and *students' performance*, when teachers change the response mode, provide lessons outline, embolden the use of calendars/assignments books or graphic organizers, sit learners next to them, use peer-mediated learning, allow for flexible work times, and implement other additional practices to meet their responsibility to encourage pupils in the process of learning.

In view of all these accommodations, it is clear that students with dyslexia may respond better when appropriate techniques aligned with their necessities and skills are used. As such, it is also relevant understanding the preferences of this type of students. According to Alsobhi et al. (2015), learners with dyslexic difficulties benefit from lessons with visual elements; hence, educators may consider this preference when planning the learning process in order to improve pupils' learning. Clearly, thinking about their preferences points to the importance of a previous need analysis with the purpose of defining real needs and abilities, which also allows for recovering the learners' self-stem and motivation (Solitto, 2008). In this regard, educators may adopt multisensory (Silva, 2004), systematic, and cumulative methods (Associação Brasileira de Dislexia [ABD], 2016) using various tools in order to keep these pupils motivated and engaged in the literacy tasks.

In summary, it may be a challenge to engage students with dyslexia in literacy activities. There must be a pluralization of resources and schooling interventions in teaching and learning of reading, mainly with digital technologies that can facilitate the use of multimodal texts, and consequently multisensory stimulation to provide effective reading/writing learning.

### *2.3.5 Emotions and Perceptions of Students with Dyslexia*

There are various studies about the emotional effects of dyslexia on children and adults with dyslexia (Rizzato, 2015). These studies consider how students with reading impairment may feel about themselves and their difficulties in the academic context, and also help us think about how learners with dyslexic difficulties perceive themselves and how these negative emotions influence their lives and commitment to learning.

Connected with these questions, Casserly (2012, p. 11), from the perspective of her study, postulated the importance "of exploring the relationship between children's reading difficulties and their socio-emotional perceptions and functioning". That is, schools may work on literacy and socio-emotional aspects aiming to help students with dyslexia be successful in learning (Riddick, 1996) since these learners may have improved their self-stem, self-confidence, and attitudes towards learning. Accordingly, Rizzato (2015) concluded that adolescent students with dyslexia also have emotional difficulties caused by their learning impairment, thus they need attention on both reading and emotional difficulties. Emotional problems such anxiety because of their frustration about failing at school may be explored in research studies, and also addressed in teaching interventions in order to make learners feel motivated about academic activities.

Another important study, conducted by Eissa (2010), revealed how dyslexia negatively influences adolescent students' emotions, including self-esteem, causing sentiments of failure and feelings of being different from their peers. This

study may contribute to the generation of awareness about the importance of early identification and proper and systematic psycho-educational interventions in order to "help these adolescents achieve school grades at a level that is suitable for their intelligence" (Eissa, 2010, p. 23).

Research conducted by Singh et al., (2015, p. 49) concluded that "there is a greater degree of emotional disturbances […] Emotional difficulties occur when the children are unable to cope with the educational demands". That is, students with dyslexia have to face emotional problems, specially when the pressure to learn reading and writing grows at school. With respect to this, the emotional side seems to be one of the most missed areas in dyslexia. For this reason, parents and teachers may offer continuous and consistent encouragement and support in order to help students with their dyslexia-related emotions (Ryan, 2018; Weissman, 2014).

Perception is important to learning because it affects students' motivation and academic achievements (Majer, 2018); therefore, understanding how learners perceive their dyslexic difficulties can help teachers in the development of more efficient pedagogical strategies.

In her doctoral thesis, Majer studied the students' and teachers' perceptions of dyslexia. Her findings show us that students with dyslexia perceive their disorder as a medical condition and a lifelong disability. Also, students could name most of the characteristics of dyslexia and value the label of dyslexia. These results, according to the author, provide the "student voice" and contribute to the debate about dyslexia. The study also shows the importance of the label *dyslexia* to the learners' self-concept, "[…] the label dyslexia providing students themselves with self-definition and personal understanding […] (Majer, 2018, p. 195).

Riddick (1996) focused on hearing students' and their parents' voices in order to get a clear understanding of what living with dyslexia is. Her work presented results about student's perceptions and emotions concerning their difficulties due to dyslexia, highlighting their underestimated difficulties as well. According to this author, her study could hopefully enable those working in schools to reflect and redefine the kind of support offered to students with dyslexia and their families.

Thinking about students with dyslexia-related emotions and the perceptions about their own learning, the study by Casserly and Gildea (2015) revealed some relevant findings related to the students' positive disposition toward learning when taking special reading classes, highlighting how this disposition is mostly connected with teachers' attention and the appropriate interventions provided. When teachers are aware of the nature of difficulties experienced by those learners with SLDs, they understand the real needs of these pupils, and receive specific training, it is possible to create teaching strategies that enhance students' learning and mainly improve their self-esteem and positive attitudes towards it.

In summary, teachers, parents, and the school in general, should not forget that, in the academic context, the biological factors of learning difficulties associated with emotional and social factors result in low emotional well-being, manifested as lack of motivation, anxiety, or low self-esteem. Thus, people with dyslexia need to be in classes with stimulating teachers who help improve the student's self-esteem.

## 2.4 Gamification as an Educational Approach

### *2.4.1 Definition*

Discussing gamification in education is necessary to understand this concept. In the literature, the following main definitions of gamification characterize this strategy.

**a) Gamification is based on the use of game elements in non-game environments.**

The Association for Project Management (APM, 2014, p. 6) points out that gamification "is the use of game thinking and game mechanics in a non-game context in order to engage users, solve problems and drive behavior [...]". Also, for Deterding et al. (2011), the gamification concept refers to the use of game elements in non-game contexts.

These definitions show two interesting components for an effective understanding of gamification, namely "game elements" and "non-game contexts".

**b) Game elements**

It refers to any characteristic element in most games (Deterding et al., 2011), such as points, badges, levels, etc.

**c) Non-game contexts**

From this expression, it may be understood that gamification involves the application of the elements and logic of games in different contexts, such as in marketing campaigns, business services, portals, and especially in education.

d) **Gamification is a strategy focused on people, using the logic of games to promote engagement and motivation**.

According to Zichermann and Cunningham (2011), gamification is a strategy that explores the levels of engagement of an individual, motivating him/her. Boer (2013) postulated that "Gamification is the use of game elements and game thinking in non-game environments to increase target behavior and engagement" (p. 4). Deterding et al. (2011) and Xu (2012) also emphasized that gamification may

promote user engagement, motivate people and encourage behavior change. The aspects and emphasis in these definitions refer to an emotional point of view, allowing people to believe that gamification is a strategy that provides improvement of services, contents, and contexts based on positive psychological effects on the users. Of these emotional effects, engagement and motivation may be highlighted, which reflect into better performances, more energy and interests, and a positive attitude or enthusiasm.

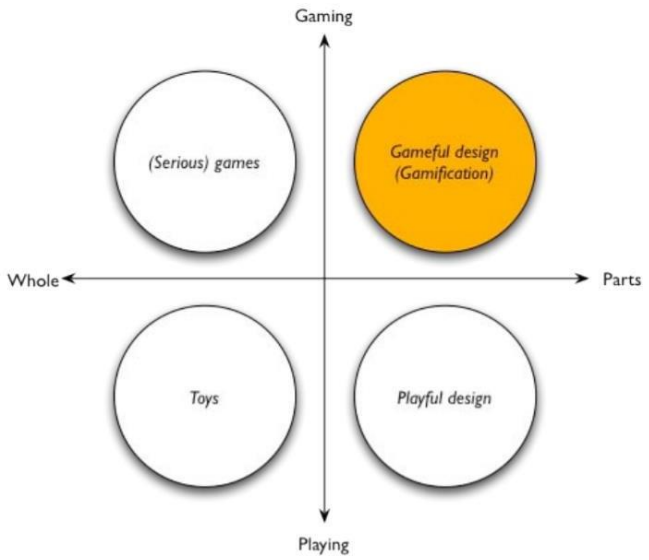
Indeed, scholars (such as Busarello et al., 2014; Zichermann & Cunningham, 2011) endorsed that it is possible to motivate and engage people through gamified applications and/or systems, more precisely because game design can help reproduce the benefits achieved with the act of playing.

**e) Gamification is not a full game**

Boer (2013) postulated that "Gamification is about using game elements outside games. A full game is not gamification" (p. 5). Thus, when thinking of educational practice, gamification is different from an educational game (Deterding et al., 2011), i.e. when we talk about gamification we are not referring to the use of educational games in pedagogical practice. Since gamification is not a game, then we can infer that it is a strategy that makes use of gaming mechanism and strategies.

Deterding et al. (2011) also placed gamification between several subjects in this area in order to make a clear distinction from toys, playful design, and serious games, as illustrated in Figure 3:

**Figure 3 -** "Gamification" between game and play, whole and parts




Source: Game Design Elements to Gamefulness: Defining "Gamification" (Deterding et al., 2011)

One axis distinguishes between play and games, and the other one differentiates between a complete game and use of game elements. Gamification is placed in a more gaming-like (than playful-like) and less whole game position. This figure also demonstrates that gamification is different from playful design, toys and entertainment, and serious games because it does not offer a whole gaming experience (Boer, 2013).

Regarding the definition of gamification, Kapp et al. (2014, p. 108) defined: "Gamification is using game-based mechanics, aesthetics, and game-thinking to engage people, motivate action, promote learning, and solve problems". This concept highlights keywords that denominate game principles and strategies, such as *game-based mechanics, aesthetics,* and *game-thinking,* which are used in gamification with the purpose to help users feel engaged and motivated, solve problems, and also learn.

For the educational purpose of this research work, the Kapp and colleagues' definition was adopted because it also includes that this exploitation of game strategies in schools' activities may induce learning.

### *2.4.2 Types of Gamification*

According to Kapp (2013), there are two types of gamification, as described below.

(i) **Structural gamification:** It is the use of game mechanics and insert game elements irrespective of the learning content. According to Kapp (2013. p. 109), "The content does not become game-like, but the structure around the content does. The primary focus for this type of gamification is to motivate learners to go through the content and to engage them in the process of learning through rewards". Hence, in this kind of gamification the content itself is game-like and not a game because the original content is not modified.

In this type of gamification, it is common to use game elements as points, badges, levels, and achievements; "it also typically has a leaderboard and methods of tracking learning progress as well as a social component where learners can share accomplishments with other learners and brag about what they have achieved" (Kapp, 2013, p.109).

A good example of this type of gamification are online badge-based courses, in which the learners may perform tasks in order to earn badges and create their own collections.

(ii) **Content gamification**: It means "the application of game elements and game thinking to alter content to make it more game-like" (Kapp et al., 2014,

p. 110), i.e. although it becomes in content similar to a game, it does not turn it into a game.

This form of gamification uses game mechanics such as storytelling, feedback loops (Zichermman & Cunninghan, 2011) or challenges with the purpose to engage learners/users. It also uses achievements, but rewards are used as spurs to encourage learners to continue in the learning activity. Kapp et al. (2014, p. 110) cited "adding story elements to a compliance course or starting a course with a challenge instead of a list of objectives" as an example of this content gamification.

In addition, some authors, including Dubey (2017), postulated that content gamification is also comprehended as a "serious game"[10] template, since this kind of gamification turns content into a game.

In summary, it is possible to note that the main difference between these two types is the treatment of content. It is important to know that both of them provide a gaming experience, but their design methodologies are different.

### *2.4.3 Gamification Design Elements*

Games are composed of essential elements on which we work when creating a gamified design. In order to discuss these tools, it is relevant to provide answers to the following questions:

*What are game elements?*

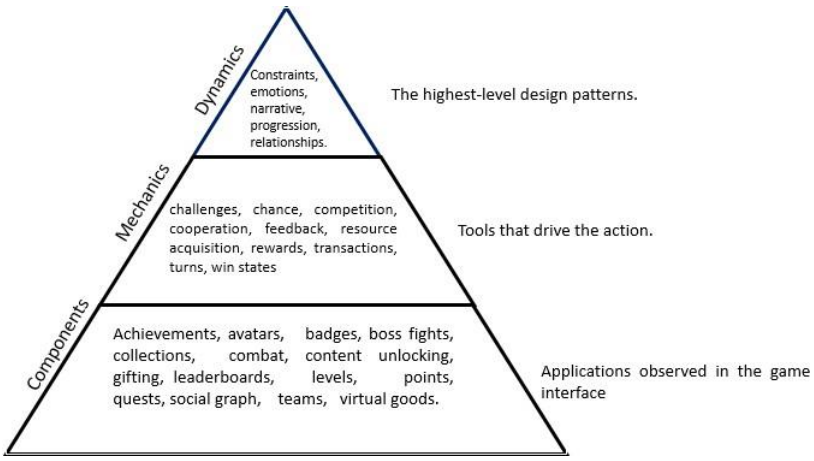
Game elements are the "set of game components that are found in several different kind of games" (Simões et al., 2015, p. 0296). In the opinion of Deterding et al. (2011), "any *element* that can be found in the *game* is the *game element"* (p. 4); therefore, game elements may be considered as all the elements *characteristically* associated with the majority of the games. The authors, however, highlighted this definition with "much room for debate over what is "characteristic" for games" (p. 4).

*How are game elements classified?*

Starting with the classification of game elements, Werbach and Hunter (2012) represented them in a pyramid, as seen in Figure 4:

[10] "[…] educational (or serious) games are specifically designed to teach people about a certain subject, expand concepts, reinforce development, or assist them in drilling or learning a skill or seeking a change of attitude as they play" (Battistella & Wangenheim, 2016, p. 8).

**Figure 4 -** The Pyramid of Game Elements




Source: Adapted from Werbach and Hunter (2012)

As claimed by these authors, this representation suggests that a designer should start gamifying a solution from the top to the bottom of the pyramid, since dynamics provides motivation and is based on mechanics. In turn, mechanics is the "verb of action", because it is responsible for driving player engagement in the game. The game components are the manifestation of mechanics itself.

Zichermman and Cunninghan (2011) described game elements from the mechanics, dynamics and aesthetics (MDA) framework, in which:

- **Mechanics** are the applications observed in the game interface, such as badges (medals), points, levels, ranking, pressure, avatar, etc.;
- **Dynamics** are the interactions between the player and the mechanics, i.e. what happens with the player applies the mechanic rules;
- **Aesthetics** refers to how game mechanics and dynamics interact and make the player feel when playing.

In Deterding et al. (2011) the game elements are presented in a Level Model that categorizes them into five levels of abstraction, as shown in Table 2:

**Table 2:** The Level Model

| Level | Description | Example |
|---|---|---|
| Game interface design patterns | Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations | Badge, leaderboard, level |
| Game design patterns and mechanics | Commonly reoccurring parts of the design of a game that concern gameplay | Time constraint, limited resources, turns |

| | | |
|---|---|---|
| Game design principles and heuristics | Evaluative guidelines to approach a design problem or analyze a given design solution | Enduring play, clear goals, variety of game styles |
| Game models | Conceptual models of the components of games or game experience | MDA; challenge, fantasy, curiosity; game design atoms; CEGE (core elements of the gaming experience) |
| Game design methods | Game design-specific practices and processes | Playtesting, playcentric design, value conscious game design |

Source: Adapted from Deterding et al. (2011)

In this model, the authors categorized the game design elements (levels) with the purpose to explain that gamification does not refer solely to the use of interface elements such as badges, points or levels, but to "borrowing useful principles and design methods" (Fitz-Walter, 2019) from games.

*Which are the game elements?*

After analyzing a set of more than 100 gamified applications, Werbach and Hunter (2012) concluded that a considerable number involved points, badges, and leaderboards, which they named the PBL triad, as shown in Figure 5:

**Figure 5** - The PBL Triad


Source: Elaborated by the authors

In addition, studies by Zichermman and Cunnighan (2011) showed that game mechanics involves various tools that elicit meaningful responses (aesthetics) from the users. They highlight, as shown in Table 3:

**Table 3** - Game Elements

| Game element | Description |
|---|---|
| Points | They value the players conquests in a game and are seen as central for all the gamified system. Zichermman and Cunnighan (2011) stated that there are five-point designs in gamification: experience points, redeemable points, skill points, karma points, and reputation points. |
| Level/progression | A game level is a part of a game. It represents the players' progress in a gamified experience, and also serves as a signal of where a player stands in a gaming journey. |
| Leaderboard | An element used to make comparisons. Zichermman and Cunnighan (2011) also mentioned two types: the no-disincentive leaderboard and the infinitive leaderboard. |
| Badges | Badges are "digital artifacts that have some visual representation – which are awarded to users who complete specific activities" (Antin & Churchill, 2011). They are excellent elements to encourage engagement and motivate students in learning tasks (Balci et al., 2018). |
| Challenges/missions and quests | These elements provide directions for what the player may do in the gamified experience. |
| Avatar | Avatars graphically represent a player's character (Werbach & Hunter, 2012). |
| Feedback and reinforcement | This element is a fundamental part in a game or gamification process, because it returns information to players about their situation or status in the gamified experience. |
| Engagement loops | Creating and keeping motivating emotions contribute to a continuous process of player re-engagement. |
| Customization | It can be done in various ways and permits players to change the system items. |

There are various others game elements mentioned in other studies; however, it is not the purpose of this work to provide an extensive list.

As seen in this section, game design elements represent the fundamental aspect for any gamified solution (Muntean, 2011). However, as gamification is about meaningful learning, "the integration of game mechanics and dynamics should make sense and be all harmonically tied together" (Schmitz et al., 2012) in order to motivate learners and raise their engagement in learning process.

### *2.4.4 Motivation and Engagement Constructs*

Gamification has as the main goal to motivate and engage people in order to help them change their behaviors, develop abilities or stimulate innovation. Gamification is about involving users at an emotional level with the purpose to keep them motivated to achieve defined goals (Simões et al., 2015). Its potential is founded on "comprehensive motivational support and on invoking flow experiences" (Karimi & Nickpayam, 2017, p. 35). These postulates indicate that gamification can affect emotions and, consequently, contribute to an individual's motivation and engagement flow.

Motivation and engagement are oftentimes used indistinctly in the literature; however, they are two different constructs and one influences the other (Alexiou & Schippers, 2018).

Engagement means being absorbed in an activity. There is no specific definition for this construct, so Benyon et al. (2005 as cited in Whitton, 2011, p. 598) described it as:

> being concerned with all the qualities of an experience that really pull people in—whether this is a sense of immersion that one feels when reading a good book, or a challenge one feels when playing a good game, or the fascinating unfolding of a radio drama.

This construct is discussed in the gaming literature as *game engagement*, used as "indicator of game involvement" (Alexiou & Schippers, 2018; Brockmyer et al., 2009). Engagement is also split into two types: emotional and cognitive engagement. According to Alexiou and Schippers (2018, p. 2549), "cognitive engagement refers primarily to the focus of attention, while emotional engagement stresses the role of emotions and feelings in supporting the desired cognitive processes". The authors justify this distinction due to a better understanding of the effects of game elements on generating affective aspects that could support or impede investment in learning.

Engagement is a highly relevant concept discussed in the gaming literature (Sweetser & Wyeth, 2005) because it is "one of the most prominent qualities of digital games" (Alexiou & Schippers, 2018, p. 2549). The levels of engagement can vary according to the activities and the game element design applied to a solution; therefore, as seen in the literature, engagement may be understood as referring to levels of attention, interest, happiness, anxiety, and other feelings when the learner is involved in a gamified activity.

Motivation has been studied in various fields such as psychology and education. It is considered to be a key concept in gamification (Kapp, 2013) because, from the perspective of motivational psychology, it is important to explain the motives behind people's behaviors.

Concerning the relationship between the concept of motivation and gamification, Zichermman & Cunninghan (2011) stated that the mechanisms found in games work like the individuals' motivational force contributing to their engagement in various ways and contexts. Schmitz et al. (2012) also postulated that gaming patterns contribute to learners' motivation. Karimi and Nickpayam (2017, p. 35) believe that gamification is "a persuasive technology that attempts to influence user behavior by activating individual motives via game-design elements". With this in mind, it is important to consider firstly the definition of motivation, and secondly what its importance is in studies of gamification.

Motivation is defined as the "reasons that underlie behavior" (Guay et al., 2010, p. 712), what "moves a person to make certain choices, to engage in action, to expend effort and persist in action" (Dörnyei & Ushioda, 2011). Being motivated means to be moved to act. If a person does not feel impetus or inspiration to act, he/she is considered to be unmotivated (Ryan & Deci, 2000b). On the other hand, a person who feels energized to do something is claimed to be motivated (Zisimopoulos & Galanaki, 2009).

For that matter, motivation is perceived as a very relevant concept in Education, since it works as an "engine" impelling student in the process of learning. In the words of Ryan and Deci (2000b), it refers to the reasons why students engage in different school activities. From this authors' perspective, motivation significantly affects the learning process because it provides *impetus* to initiate an activity and, subsequently, provides the *force* to move along the learning process.

Motivation, as an incredible influence on people's behavior, has been discussed by many researchers around the world and, according to Dörnyei and Ushioda (2011), researchers have been avoiding a consensus about the understanding of motivation. To these authors, motivation cannot be explained by only one theory, so it is important to emphasize that several studies in the social, educational, and psychological fields discuss the complexity of motivation and its relationship with context, culture, and people individually.

Zisimopoulos and Galanaki (2009) postulated that motivation is roughly a unitary construct because humans are motivated by different types of motives, either internal or external, therefore motivation varies in level and in orientation. Ryan and Deci (2000a) asserted that people are motivated when they value an activity or just because they are constrained to do things as well. In this regard, in the gamification literature, authors such as Zichermman and Cunninghan (2011), Werbach and Hunter (2012), and Karimi and Nickpayam (2017) highlighted that Psychology divides motivation into two types:

- **Intrinsic motivations** come from "our core self and are not necessarily based on the world around us" (Zichermman & Cunninghan, 2011, p. 26). It means "to engage in an activity for its own sake" (Zisimopoulos & Galanaki, 2009, p. 33). In this subtype, motives are "personal enjoyment, interest, or pleasure […]" and "motivation within individuals tends to vary across subject areas, and this domain specificity increases with age" (Lie, 2011, p. 35);

- **Extrinsic motivations "**refer to doing something because it leads to a separable outcome" (Ryan & Deci, 2000b, p. 55). People are moved to act because of motives such as points, money, punishment, etc.

Extrinsic motivation can efficiently work to motivate students. In fact, in our lives most of the work we do is related to being rewarded. For instance, at school, people traditionally study with the purpose to get enough points to pass; at work, we perform better in order to earn a salary, i.e. individuals are motivated by external motives to succeed or avoid any kind of punishment. However, as stated by Werbach and Hunter (2012), it is imperative to use external motives in the learning context parsimoniously, since there are also disadvantages, e.g. extinguishing intrinsic motivation when the learning situation relies on extrinsic motivation. Thus, although rewards are an essential part of game design, they are not what *keeps* someone engaged in a game.

On the other hand, intrinsic motivation is the kind of motivation that is lasting and sustainable because it may help with persistence in activities, improved performance, heightened vitality, self-esteem, and general well-being (Ryan & Deci, 2000b).

Finally, engagement and motivation are related to each other and represent the core of gamification. Considering that student engagement means that learning is improved when a learner is involved with commitment – interested, dedicated, and absorbed in the game activities – it is important to understand that motivation implies the reasons to be engaged (Alexiou & Schippers, 2018). Therefore, efforts to increase learners' intrinsic motivation tend to start with extrinsic motives that help increase involvement and participation.

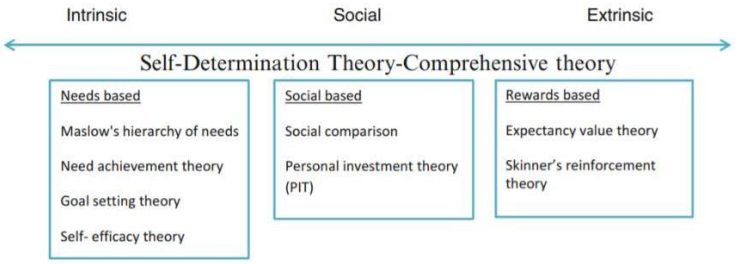
### *2.4.5 Theories Supporting Gamification in Learning*

#### 2.4.5.1 The Proposed Model of Motivation in Gamification

Ritcher et al. (2015), and Karimi and Nickpayam (2017), provided a brief review of the *Proposed Model of Motivation in Gamification.* According to these authors, there are two dominant clusters in the literature that help determine players' motivation: extrinsic and intrinsic motivation. Also, the social aspect, as they postulated, is relevant in games because "competition, social interaction, or cooperation may influence player behavior" (Karimi & Nickpayam, 2017, p. 24). Hence, as shown in Figure 6, the model presents extrinsic motivation on one end of the spectrum, which is the focus of the Expectancy Value Theory and Skinner's Reinforcement Theory; on the other end, intrinsic motivations are the focus of Maslow's Hierarchy of Needs, Atkinson's Need Achievement Theory, as well as Bandura's Self-Efficacy Theory and Goal Setting Theory. In the center of the spectrum, the theories that explain the social side of games – Festinger's Social Comparison and Personal Investment Theory (PIT) – are presented. Also, the authors considered the Self-Determination Theory (Ryan & Deci, 2000b) as an extensive approach that

contemplates extrinsic and intrinsic motivations in a continuum, as seen in figure 6:

**Figure 6** - Model of Motivation in Games (based on Ryan & Deci, 2000b)




Source: Karimi and Nickpayam (2017)

An extensive discussion of these theories is not the scope of this work, so they are, as well as their relationships to game and gamification, briefly summarized in Table 4, based on Karimi and Nickpayam (2017, p. 25-32), and Ritcher et al. (2015, p. 37-39):

**Table 4** - Theories of Motivation According to Karimi and Nickpayam (2017) and Ritcher et al. (2015)

| Needs based (intrinsic motivation) | Social Based (social aspect) | Rewards based (extrinsic motivation) |
|---|---|---|
| *Hierarchies of Needs*<br><br>A theory proposed by Abraham Maslow, which categorizes human needs into five hierarchical needs. Hence, an individual must first satisfy the physical, safety, and social needs before reaching more complex levels related to ego and self-actualization. Associating them with gamification, Siang and Rao (2003) illustrated that players also have a hierarchy of needs, postulating that, at the bottom level, players try to understand the game rules. After that, they need safety. In the third level, players may feel comfortable with the game, so this level is called belongingness need. The next level refers to feelings of self-esteem that individuals may feel when playing. In the fifth, they need to understand and know more about the game. The next level is an aesthetic need that is related to graphics and visual and sound effects, etc. In the end, there is self-actualization, i.e. the players are comfortable with being creative and do anything possible within the game boundaries. | *Social Comparison Theory*<br><br>This theory was first proposed by Leon Festinger, who suggested that individuals usually evaluate themselves in comparison with other people. Regarding games and gamification, rankings are used to compare the players' score/status with that of other players in the same situation. This comparison promotes competition, so that players can be engaged in competing with others with the purpose of mastering tasks. In addition, gameplay is determined by permanent evaluation, which includes the perception of how a present position of a player is in contrast to others' position and what may be expected next in the competition. Thus, the players' self-esteem can change according to this continuous evaluation and social comparison. | *Expectancy Value Theory (EVT)*<br><br>According to this theory, motivation to assume a certain behavior is determined by two elements: (i) expectancy, i.e. the belief in one's abilities to succeed in a task; and (ii) value, i.e. the belief in potential benefits after performing a task. In this approach, these two variables are both responsible to keep an individual motivated, influencing the choice of achievements, engagement/perseverance, and performance. |
| *Need Achievement Theory*<br><br>This theory was developed by David C. McClelland and his associates | *Personal Investment Theory (PIT)* | *Skinner's Principle of Partial Reinforcement*<br><br>In the Skinner theory, behavior is a product of |

| | | |
|---|---|---|
| and is based on two psychological principles: to achieve success and to avoid failure. According to this approach, individuals will take part in a task according to their intrinsic motivation to be successful or avoid a situation if their fear of failure is higher than their motivation to participate in an activity. Regarding game and gamification, Karimi and Nickpayam (2017) mentioned the system of achievements providing motives for the player to be engaged in different challenges, and also the adjustments of the tasks' difficulties with the purpose of regulating the probability of failures and success of players in a game. Additionally, the authors refer to the levels and progression of games as mechanics related to this theory. | Basically, this theory of motivation states that three key components determine a person's engagement in a given situation: personal incentives (extrinsic or intrinsic motives), sense of self (goal-directedness, competence, self-reliance, and social identity), and perceived options (opportunities and barriers). In gamification, incentives such as badges, points, and other kind of rewards are motivational triggers that keep players interested and engaged, leading to repeated use. | reinforcements that can be partial or continuous. According to this researcher, partial reinforcement works more efficiently than continuous reinforcement, since it can be more effective in sustaining desired behaviors. In gamification and gameplay, rewards based on a "variable ratio schedule" and surprising feedback can be effective in engaging users/players. |
| *Goal Setting Theory*<br><br>It refers to the establishment of goals in order to affect performance. This theory claims that "difficult, specific, context appropriate, and immediate goals, rather than long-term goals, motivate to achieve more" (Ritcher et al., 2015, p. 38). In gamification, goals represent an essential part because the type and quality of goals can affect players' motivation. Hence, goals may be challenging enough, feedback and rewards may be provided, and the individuals must have the necessary skills to achieve the specific goals. | | |
| *Self-Efficacy Theory*<br><br>This theory refers to the beliefs on our own abilities to face challenges and complete a task successfully. In gamification, judgment of self-efficacy is also common and includes the observation about own and others' performance in playing. The way people see their self-efficacy determines the selection of challenges, effort spent, and persistence in a task. | | |

The other theory encompassed in this model of motivation is the Self-Determination Theory, which considers both extrinsic and intrinsic motivation on a continuum from internal to external motives (Ryan & Deci, 2000b), as seen in the next subsection, *The Self-determination Theory*.

2.4.5.2 The Self-determination Theory

The interaction between extrinsic forces and intrinsic motives is the foundation of the Self-Determination Theory, an approach created by the psychologists Ryan and Deci in the 1970s.

Legault (2017, p. 1) provided a complete definition of this theory. Let us explore it in parts:

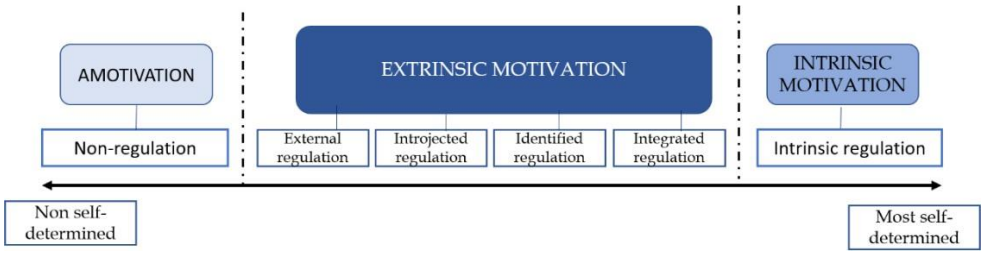
*Self-determination theory (SDT) is a broad theory of human personality and motivation concerned with how the individual interacts with and depends on the social environment.*

In other words, SDT is interested on how individuals are involved with the social environment by studying *personality* and *motivation.*

*This theory is founded in the division of motivation in two subtypes: intrinsic and extrinsic. SDT defines intrinsic and several types of extrinsic motivation and outlines how these motivations influence situational responses in different domains, as well as social and cognitive development and personality.*

This theory is about types and proposes that motivation is multidimensional and relies on a continuum, including types ranging from amotivation and extrinsic motivation to intrinsic motivation, as shown in Figure 7:

**Figure 7** -The Self-determination Continuum Showing the Different Types of Motivation




Source: Based on Ryan and Deci (2000b)

On one end of this continuum there is the concept of *amotivation*, which represents lack of any impetus for a specific behavior/action. On the other end, there is *intrinsic motivation*, the most self-determined behavior, which is "highly autonomous and represents the prototypic instance of self-determination" (Ryan & Deci, 2000b, p. 72). Covering the continuum between amotivation and intrinsic motivation is extrinsic motivation, which varies from external to integrated regulation. These types are explained by Ryan and Deci as: (i) external regulation

– It is the least autonomous, because it is totally controlled by external incentives; (ii) introjected regulation – When individuals act in order to avoid negative feelings or to increase self-esteem; (iii) identified regulation – When an action/behavior is consciously valued by a person; and (iv) integrated regulation – The most autonomous form of extrinsic motivation, which appears when regulations are fully integrated into personal beliefs, values, and needs.

According to the authors, as the person advances through this continuum, his/her motivation becomes more self-determined and less controlled.

*SDT is centered on the basic psychological needs of autonomy, competence, and relatedness and their necessary role in self-determined motivation, well-being, and growth. Finally, SDT describes the critical impact of the social and cultural context in either facilitating or thwarting people's basic psychological needs, perceived sense of self-direction, performance, and well-being*

This theory is concerned with individuals' "inherent growth tendencies" (Ryan & Deci, 2000a, p. 68), which means they are motivated for growing and change by the three mentioned innate and psychological needs: *autonomy* (the need to feel free to control our lives and behavior); *competence* (the need to be effective in dealing with the environment), and *relatedness* (the need to be close with people and have affectionate relationships with peers). These *needs* are instinctive and essential to provide optimal growth and social integration.

The dynamical interaction of the individual with social environment nurtures the inherent potential of individuals (Ryan & Deci, 2000a). When this nurturing is adequate, meaning that basic needs (autonomy, competence, and relatedness) are fulfilled, there is a positive growth towards motivation; on the contrary, when the basic needs are not met, the individual may be "demotivated, ineffective, and detached" (Legault, 2017, p. 1).

Concerning the type of motivation, to Ryan and Deci (2000a, p. 70) intrinsic motivation is associated with better learning, good performance, and well-being; therefore, it is relevant to study the conditions "that elicit and sustain, versus subdue and diminish, this innate propensity". According to these researchers, the satisfaction of the three basic needs – autonomy, competence, and relatedness – when people are involved in an activity helps increase intrinsic motivation.

The need of *autonomy* refers to being in control, thus a person may feel more motivated when he/she controls his/her environment. In this regard, individuals may feel more intrinsic motivation when they are free to make choices about what and how to perform an activity than when they are not. The need of *competence*, i.e. the need of being effective in dealing with the performance of our actions and achieving positive results, is also favorable to stimulate intrinsic motivation. Ryan and Deci (2000a, p. 70) assured that "feelings of competence will not enhance

intrinsic motivation unless accompanied by a sense of autonomy", which means that being autonomous and acting according to their own selves may make people want to engage and continue to perform a task with a sense of commitment. Thus, their actions emanate from their own capacity of making decisions and competence in carrying on a certain activity.

Ryan and Deci (2000a) postulated that, although autonomy and competence are more salient to produce intrinsic motivation, the third need – relatedness – also supports the expression of that kind of motivation. This need refers to social relationships and also to greater purposes, such as *making the difference* (Werbarch & Hunter, 2012).

As discussed, intrinsic motivation is important to keep individuals interested in activities. Hence, this type of motivation is more desirable in learning (Lie, 2011). However, does it mean that extrinsic motivation is not of value? Extrinsic motivation counts because almost all activities are motivated, at least in part, by motives outside the action itself (Dahlstrøm, 2018). Moreover, according to the SDT, extrinsic motivation can vary greatly in degree, ranging from a more autonomous form to a less autonomous form, and also lead to high performance and well-being, although the focus relies on doing something because of verbal, virtual or tangible rewards (Ryan & Deci, 2000a).

Therefore, extrinsic motivation also presents advantages, since extrinsic rewards can help people engage in tasks that they do not consider interesting, i.e. extrinsic motivators are able to encourage positive performances when the tasks themselves do not genuinely motivate people (Werbach & Hunter, 2012).

In gamification specifically, Zichermman and Cunningham (2011) stated that "gamification works better if and when we can align intrinsic motivation and extrinsic rewards, and we should strive to achieve that wherever possible […]" (p. 28). The authors also stated that: "[…] we should accept players and their motivational states as they are, and try to help them get to where they would like to go, as well as where we'd like them to be" (p. 28). That is the idea of applying gamification in learning solutions with the purpose to use extrinsic motivators to support and raise the learners' sense of achievement, interest, curiosity, and autonomy.

#### 2.4.5.3 Flow Theory

How is flow defined?

Flow, as proposed by Csikszentmihalyi (1990), is a psychological state in which individuals are so involved in an activity that nothing more around them matters; the experience itself provides such sense of enjoyment and great pleasure. So, flow occurs when people are totally engaged in a task. Csikszentmihalyi named

flow the autotelic experience, which is to do something for its own sake, a concept related to the intrinsic motivation field (Diana et al., 2014).

Flow can occur with complex or simple tasks and is understood as a process.

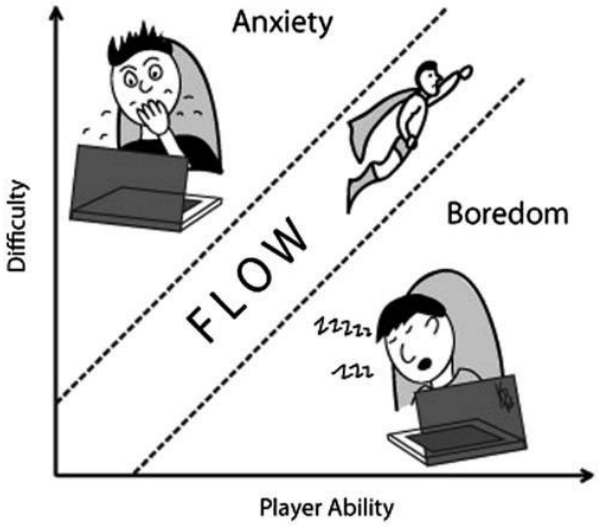
Csikszentmihalyi created nine dimensions that represent the state of flow, as described below.

- Challenge-skill balance: to experience flow, it may be a balance between the perception of a challenge and individual skills;
- Action-awareness merging: the feeling of oneness between the activity and awareness (Jackson, 2012 as cited in Brühlmann, 2013);
- Clear goal: to enter a state of flow, it is required that people feel what they are supposed to do (Jackson, 2012 as cited in Brühlmann, 2013);
- Unambiguous feedback: immediate and clear feedback is essential for complete engagement (Diana et al., 2014);
- Concentration on task: attention is focused in the task "Because flow produces harmony within the self, attention can be invested totally in the activity at hand" (Csikszentmihalyi, 1988, p. 32);
- Sense of control: it generally includes the sense of empowerment and the feeling of liberating oneself from the fear of failure (Brühlmann, 2013);
- Loss of self-consciousness: when in state of flow, a person does not worry about others' opinions, but keeps focusing on goals (Brühlmann, 2013);
- Distortion of the sense of time: the focus on the activity changes the notion of time, so "The clock no longer serves as a good analog of the temporal quality of experience" (Csikszentmihalyi, 1988, p. 34);
- Autotelic experience: the flow experience is intrinsically rewarding (Csikszentmihalyi, 1988) and does not rely on extrinsic motivators.

In fact, the most important dimensions in an experience are *challenges* and *skills*; therefore, according to Csikszentmihalyi (1990), flow occurs when there is a *balance* between these two dimensions. In subsequent studies, this author pointed out that "to experience flow, challenges and skills must not only be in balance, but must also exceed levels in a way that one must increase the complexity of the activity by developing new skills and taking on new challenges" (Sanchez, 2009, p. 14), i.e. flow arises when challenge and skills are high.

Kapp (2013) highlighted the "flow" diagram proposed by Csikszentmihalyi (1988), in which the balance between *challenges* and *skills* is illustrated. Individuals are in the flow channel when they experience positive feelings and deep enjoyment beyond boredom and anxiety (Csikszentmihalyi, 1988), as seen in Figure 8:

**Figure 8 -** Flow, the State Between Boredom and Anxiety




Source: Kapp (2013)

Is it possible to anticipate when an activity will result in a flow experience? Diana et al. (2014) stated that there are no answers to this kind of question because flow depends on feelings of happiness, enjoyment, and satisfaction, so not all activities bring pleasure to everyone (Csikszentmihalyi, 1988).

Csikszentmihalyi (2001) enlightened that there are activities, e.g. dancing, sailing, singing, playing and so on, "designed to make optimal experience easier to achieve", so that they are conducive to flow (p. 94). They make engagement and concentration easier because they are distinct from the "paramount reality" of day-to-day life. Because of this function of providing pleasure and happiness, these flow activities "help participants and spectators achieve an ordered state of mind that is highly enjoyable" (p. 94).

In his study, Csikszentmihalyi (2001) also mentioned that flow activities such as games, whether they involve competition or not, promote a "sense of discovery" and transport a person to new realities. "[…] It pushed the person to higher levels of performance, and led to previously undreamed-of states of consciousness" (p. 94-95). This elevation of the self is the key to the flow state.

At school, learning is generally perceived as a boring activity, so the use of gamification is also studied as an opportunity to provide this "happy state" to learners, where they could be in a voluntary effort to accomplish a challenging task. Thus, how can gamification provide flow experiences?

Kapp (2013) stated that game designers want players to have flow engagement. They cannot guarantee that a player will achieve the flow state, but they can create conditions in which the flow state may occur. Hence, the concept of flow may be a *guidepost* for the use of gamification in education so that instructors and designers explore game mechanics/strategies in educational environments to encourage the flow state in students. Likewise, Simões et al. (2015) also concluded that the use of a

workable framework for gamification in a Social Learning Environment (SLE) course promoted an increase in students' disposition to experience flow, and consequently an improvement in learners' motivation and engagement.

Sweetser and Wyeth (2005) designed a model for evaluating enjoyment in games named *GameFlow*. According to them, the model is based on the eight elements evidenced in gameplay – concentration, challenges, skills, control, clear goals, feedback, immersion, and social interaction – and includes a set of criteria relating to the elements of flow (Csikszentmihalyi, 1990), as shown in Figure 9:

**Figure 9** - Mapping the Elements from Gaming Literature to the Elements of Flow

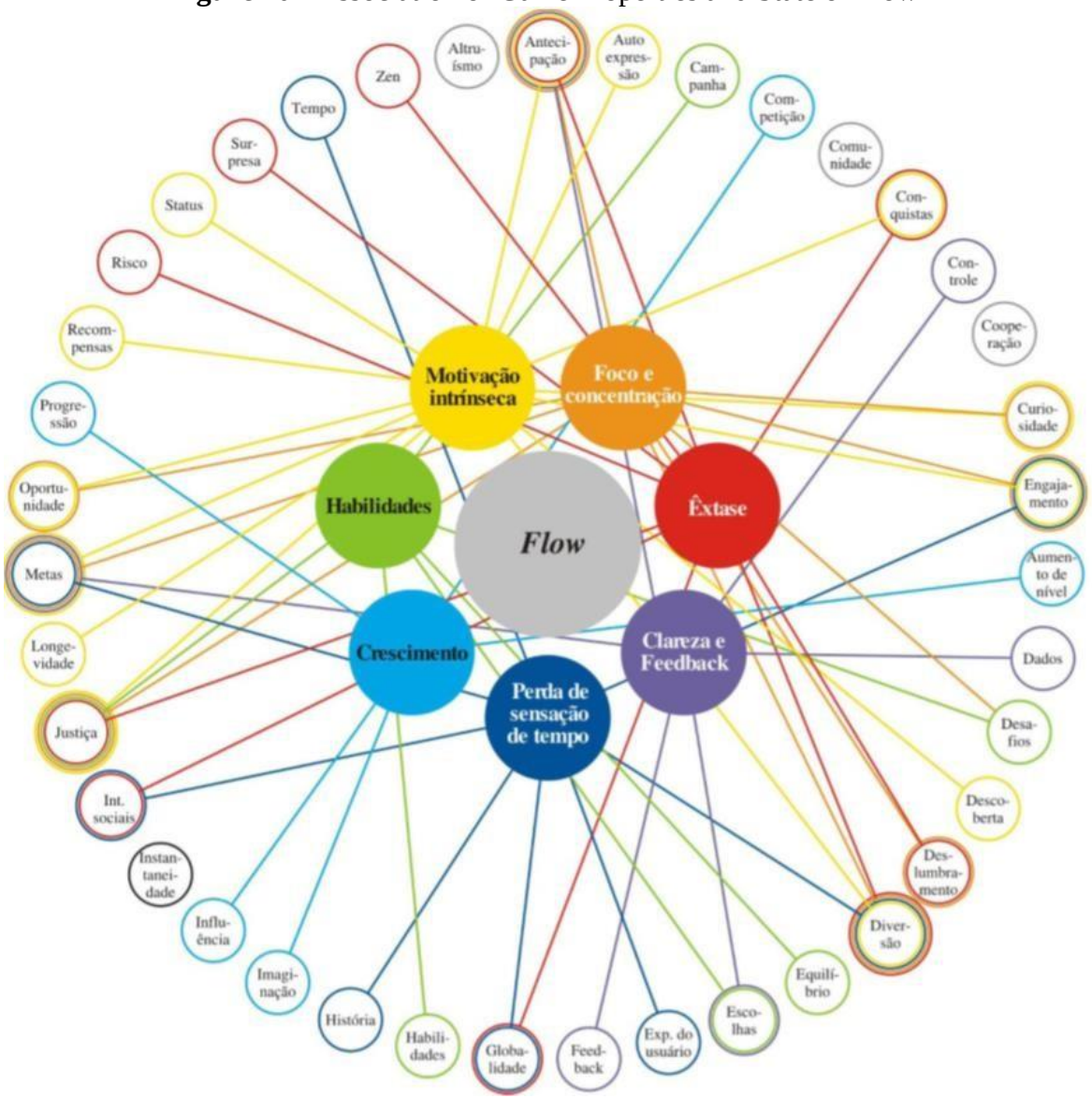
| Games Literature | Flow |
|---|---|
| The Game | A task that can be completed |
| Concentration | Ability to concentrate on the task |
| Challenge Player Skills | Perceived skills should match challenges and both must exceed a certain threshold |
| Control | Allowed to exercise a sense of control over actions |
| Clear goals | The task has clear goals |
| Feedback | The task provides immediate feedback |
| Immersion | Deep but effortless involvement, reduced concern for self and sense of time |
| Social Interaction | n/a |

Source: Sweetser and Wyeth (2005)

The validation of the model revealed a comprehension about enjoyment in real-time strategy games, besides providing an understanding of the model as an evaluation tool for reviewing enjoyment in games.

Diana et al. (2014), on their hand, explored the relationship between gamification and theory of flow. Their work revealed gamification characteristics that can contribute to flow experiences, as illustrated in Figure 10:

**Figure 10 -** Association of Game Properties and State of Flow




Source: Diana et al. (2014)

In the opinion of Diana et al. (2014), the characteristics of flow – focus/concentration, ecstasy, feedback, skills, growth, loss of sensation of time, and intrinsic motivation – can be reached by means of gamification properties, as loops of engagement, time, progression, opportunities, stories, feedback, fun, discoveries, status, goals, among others.

2.4.5.4 Feedback

According to Hattie and Timperley (2007, p. 81), “feedback is conceptualized as information provided by an agent (e.g. teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding”, i.e. feedback is a

consequence of the learners' performance. It is about giving information back and "encouraging" students to learn from it, hence feedback assumes an important role in the educational process because of its contributions to the ongoing development of individuals in education settings.

Kim et al. (2018) and Sprouls (2011) postulated that the feedback mechanism can be divided into positive and negative regarding the "mood of its content". Thus, when feedback is positive, it is encouraging, supportive, and effective in changing behaviors. On the other hand, negative feedback focusing on improvement of poor performance in some areas can also be effective in learning (Kim et al., 2018). For this reason, in order to motivate students, it is essential to understand that both positive and negative feedback can provide benefic results in learning (Hattie & Timperlay, 2007). Undoubtedly, positive feedback has more long-lasting effects (Sprouls, 2011), so it is much more beneficial to learners; however, when negative, feedback can also be effective if it provides a clear message of amelioration more than only describing poor performance in a task or learning setting.

Regarding the characteristics of effective feedback, Hattie and Timperley (2007) stated that "to be effective, feedback needs to be clear, purposeful, meaningful, and compatible with students' prior knowledge and to provide logical connections" (p. 104). In other words, feedback should have clarity and purpose, i.e. it is about giving clear directions and information *just in time* of a task and never during random conversations. It should also be meaningful, which means it should be related to a task/activity in a learning setting because it "has no effect in a vacuum" (Hattie & Timperley, 2007, p. 82). In addition, it should be *informative* and *supportive* to encourage students positively, and it should be *frequent* and *specific* in order to provide guidance in learning (Sprouls, 2011).

Feedback can be provided by means of verbal (written or oral format) or non-verbal (gestures, facial expressions or using points/badges) communication, or even multimedia (use of videoconference, WhatsApp, etc.) (Kim et al., 2018). There are other ways of providing feedback easily found in the literature. Chan and Lam (2008), for instance, discussed four types of evaluative feedback given by teachers; therefore, it is important that teachers know how to improve their strategies of feeding back to students.

In the opinion of Sprouls (2011), feedback is a valuable tool that can influence motivation and stimulate positive behavior in classrooms. Hence, in regard to gamification, some authors postulated that the feedback system represents a pivotal tool since it provides guidance and orientation about the user's position on its relation to the game mechanics, which regulate internal interaction in the gamified solution (Busarello et al., 2014). Also, Diana et al. (2014) stated that feedback, when presenting clear goals, contributes to intense learner engagement in a gamified activity. In addition, Boer (2013) indicated that instant feedback helps students see their progress in a process of gamification. Kickmeier et al. (2014, p. 3) mentioned that the use of

game mechanics/strategies in gamification is related to formative feedback, the core of success in education, which means to "focus on the goal of providing learners with constructive and helpful information about achievements, learning paths, learning pace, individual strengths and weaknesses in order to individualize and optimize learning activities".

Finally, feedback as a crucial tool in education, and particularly in gamification, may be strategically used by educators in order to help students understand their performance and to feel enthusiastic to improve that performance in some areas. Hence, as pointed out by Kim et al. (2018), teachers should "understand the characteristics of students and context to design feedback" (p. 44).

There are other learning theories that have impact on gamification, but it is not purpose of this work to include a wide discussion of them. The approaches considered in this section helps us understand why using game strategies/mechanics in learning processes can be motivating and engaging.

### *2.4.6 Game Strategies Supporting or Affecting Motivation and Engagement*

As gamification is seen as an approach used to foster motivation (Sailer et al., 2013), it is possible to find a range of studies on the effects/impact of game mechanics in learners' motivation. For instance, Seaborn and Fels (2015), in their study about gamification in action, found that the initial gamification frameworks developed are based on psychological theories, as SDT and intrinsic and extrinsic motivations, although these constructs are yet rarely studied. Another study, by Dahlstrøm (2018), showed that although gamification can be seen as a legitimate strategy to increase performance, there is rare evidence about how it can affect intrinsic motivation.

Other studies revealed positive results and the contributions of gamification to motivation, as that conducted by Merkle et al. (2017) about how intrinsic motivation and need satisfaction, the two most appealing aspects in the framework of gamification, are affected by the use of game mechanics. They developed an online experiment, in which they examined the effect of points, leaderboards, and levels, as well as the participants' causality orientation, on intrinsic motivation, competence, and performance. The main findings showed that "game elements did not significantly affect competence or intrinsic motivation, irrespective of participants' causality orientation" (Merkle et al., p. 525). Nevertheless, the game elements points, levels, and leaderboards seemed effective in increasing performance. Thereby, these game mechanics function as extrinsic incentives.

Papp (2017) also studied the effects of gamification mechanics on the motivation and learning of primary and college students. The researcher used mixed methods (e.g. experience points, challenges, and team quests game mechanics) to collect data over two years during Business Communication and Mathematics classes

experiencing the introduction of gamification. As the main results, she reported that students in both classes "found the gamified approach to be engaging, motivating and a preferred method to learn" (Papp, 2017, p. 3199).

By contrast, a study by Hanus and Fox (2015) presented some negative results. The researchers conducted a longitudinal study of intrinsic motivation, social comparison, satisfaction, effort, and academic performance, in which they compared two online courses – one of them received a gamified curriculum, with leaderboards, badges, and competition, and the other had a curriculum without game mechanics. As results, they showed that "students in the gamified course showed less motivation, satisfaction, and empowerment over time than those in the non-gamified class" (Merkle et al., p.152), which suggests that designers and teachers may be careful "when applying certain gamification mechanics to educational settings" (Merkle et al., p.152).

In the gamification literature, we can also find studies highlighting the contribution of single game elements as motivators, as the one by Sailer et al. (2013), in which the authors focused on how and why diverse game mechanics can address different motivational mechanisms, and consequently promote motivation. In this regard, the authors present the motivational functions of elements as points, badges, leaderboards, progress bars, quests, and avatars.

These results, as presented by the authors, can be used in effective gamified solutions; however, when referring to the use of gamification in learning, it is crucial to take into consideration the context that will be gamified and the user who will experience the gamification. Thus, the big challenge in creating gamified artifacts is properly stimulating the two types of motivation, separately or together, since an effective combination of intrinsic and extrinsic motivation increases the level of player's motivation and engagement (Busarello et al., 2014).

In game mechanics, an awareness about the relationship between the different components is crucial, since in an "interaction with each other they can have varying and complex motivational effects" (Sailer et al., 2013, p. 35). In addition, as stated by Dahlstrøm (2018), gamification should be used to provide personalized motivational experiences to different individuals in different backgrounds in order to be a useful strategy. To motivate users, gamification must be more than giving points, badges or providing feedback. It should be about promoting meaningful experiences that enable these elements to support users towards a sense of competence and autonomy.

Existing research studies have also shown the contributions to game or gamification engagement of primary and secondary schools, and also among undergraduate students.

Simões et al. (2015) reported a study in which the state of flow was used as an engagement measurement by applying a questionnaire founded on Dispositional Flow Scale-2 with a gamified SLE in a primary education setting. According to the authors, this controlled experiment tested if a gamified version of a SLE provides

more engagement than a non-gamified version. Findings of the experiment pinpoint that gamification applied to SLE contributes to students' engagement and motivation.

Nand et al. (2019) investigated the effectiveness of gamification when teaching numeracy at a primary school in New Zealand. They studied the effects of engaging computers from the students' perspectives and verified if the application of elements, such as levels of difficulties, feedback, and graphical presentation, to an educational tool could ameliorate students' learning. Two versions of the gamified tool of the Java-based open source program based on "Who wants to be a millionaire" TV show were created – a feature enriched game (FEG) and a feature devoid game (FDG) with no extra features. The study was conducted with a total of 120 pupils divided into a control group and a test group, each with 60 learners. Answers to a pre-test and a post-test and the frequency and duration of interaction were used as measurements of the efficacy of the tool. The main results indicate increased effectiveness with FEG in improving students' engagement and learning.

In a Brazilian study conducted by Silva et al. (2015), a gamified activity was created and applied in high school. A total of 39 students in the 3rd year were divided into seven groups and collaboratively produced a documentary film. A layer of game designed elements, such as ranking, points, badges, and challenges, was applied. The entire process of production was conducted through the fulfillment of missions and, consequently, production of the documentary film. As the main results, the authors pointed the integration of subjects and students' motivation and engagement in the learning activities.

Poondej and Lerdpornkulrat (2016) aimed to verify enhancement of undergraduate learners' engagement in learning by applying gamification strategies to a course in a university in Thailand. The study involved 577 undergraduate students from six classes. Learners were divided into the treatment group, in which three of the classes attended a gamified course, and a control group, in which the other students attended a regular course. Both groups had the same lessons and materials. As the main results, the scholars noted that students in the treatment group were significantly better engaged than participants in the control group. Empirical evidence that application of gamification increases engagement in learning was provided.

Ding et al. (2017) developed a gamified online discussion tool named gEchoLU, aiming to examine the effects of gamification structure on learners' engagement in an online discussion. The main findings revealed that students' engagement increased progressively when they became more familiar with the tool system, and highlighted the fundamental role of teachers in guiding and facilitating the learners' use of the gamified tool.

Finally, Alexiou and Schippers (2018) explored and validated the relationship between the main game mechanics, intrinsic motivation, engagement, and also learning. Their considerations established the contributions of how elements as

proximal goals, use of uncertainty rewards system, frequent feedback introduced in a non-intrusive way, and adaptable challenge levels improve cognitive engagement. Their results also pinpointed how hedonic game elements support the engagement of users by establishing the role of narrative, aesthetics, and core game mechanics in facilitating higher learning outcomes through intrinsic motivation and engagement.

### *2.4.7 Gamification-based Learning*

Gamification is not a new practice at school, although this term was coined only in 2010 (Fadel & Ulbright, 2014). In fact, gamification strategies have been poorly applied for so long in the process of learning by the use of points, rewards, or ranking by simply grading students. Most of us, when students, experienced gamified activities as getting little stars (achievements) or facing different levels for some tasks. Hence, the current interpretation of the gamification as a teaching tool is directed to the use of more sophisticated game components, such as narrative structure, feedback or the dynamics of interaction. A new comprehension of gamification and its relevance in Education, as well as responsibility in the applicability of this strategy, substantiate the process of gamifying learning activities or platforms (Fadel & Ulbright, 2014).

The new signification of this use of game principles and strategies in Education has been deemed as a powerful educational approach used to promote benefits in learning, thus various works highlight the evidence of the efficacy of this approach.

#### *Effectiveness of Gamification*

The proposers of gamified solutions claim that this strategy can reinforce important gains in education, such as problem-solving, collaboration, and communication, besides helping learners being active during learning process, as well as keeping them engaged in the learning activities (Rabah et al., 2018). In these terms, there are evidences of the effectiveness of gamification in the literature and of its benefits to cognitive learnings and the affective domain, such as motivation and emotions.

Regarding *cognitive learning*, researchers are also concerned whether gamification can improve students' learning accomplishments. For this reason, scholars have reported positive results about the contributions of using game mechanics in learning and education in the past years. In Kim et al. *(*2018), improvements in learning in gamified classes and projects/activities as one of the most relevant contribution of gamification in the area of education and learning are discussed. Cheong et al. (2013) studied a gamified learning activity focusing on the dimensions of learning, engagement, and enjoyment, and found that the use of game

mechanics contributed to increased learning. Su and Cheng (2014) revealed that applying gamification elements to a botanical learning process contributed to better learning performance, and also contributed positively to a relationship between learning achievement and motivation. In Papp (2017), college students demonstrated that gamification was a method that helped them learn more than in the conventional course, since the course was modified by the introduction of game mechanics and strategies. Tolentino and Roleda (2017) were parsimonious with their results on the use of gamification in the teaching of Physics. According to them, although gamification may present significant contributions, it is still important to conduct new studies about the risks and benefits of this tool in the learning of this subject. Additionally, Rapti (2013) added that using gamification in e-learning can improve "personal learning and thinking skills" (p. 95).

On the other hand, some studies revealed that gamification design does not present positive effects on learning achievements. Hanus and Fox (2015) explained that the use of gamification to teach college students was less effective than traditional methods. Dominguez et al. (2013) applied gamification in a real educational setting and concluded that there were contributions of gamification to learning outcomes, although they were not significant.

In the opinion of Hamari et al. (2014), gamification strategies can provide positive effects; however, this depends on the context of implementation of a gamified system and also on the quality of the audience. In addition, Kim et al. *(*2018) suggested that the effects of gamification on learning and education vary depending on specific conditions like the characteristics of content and audience. Consequently, it is important to highlight that gamification works, but it cannot be effective in some learning settings.

*Affective Domain*

According to researchers, gamification is also very effective in the affective domain, by providing motivational benefits. This concept of motivation, as seen in the previous section, is vital to the process of starting to learn, and subsequently to the process of acquiring knowledge (Schmitz et al., 2012). In the opinion of Dominguez et al. (2013), the use of gamification may have socio-emotional impact on learners, since these mechanisms of competition and award seem to motivate them. Additionally, Burke (2015) postulated that gamification involves users at an emotional level, aiming to keep them engaged and motivated.

Authors such as Schmitz et al. (2012), Zichermman and Cunninghan (2011), and Zisimopoulos and Galanaki (2009) postulated that game mechanics/strategies motivate and engage students and sustain that engagement for better results. Also, Rapti (2013) explained that gamification can encourage pupils to proceed in a learning process without focusing on results, but feeling free to fail, which "involves

encouraging learners to explore the content, to take chances with their decision making, and to be exposed to realistic consequences for making a wrong or poor decision" (Kapp et al., 2013, p. 179). Lee and Hammer (2014) believed that the use of gamification in education is a joyful experience to learners, and "the blurring of boundaries between informal and formal learning can inspire students to learn in lifewide, lifelong, and lifedeep ways" (p. 4).

The literature demonstrates the contributions of gamification to psychological outcomes, including motivation, attitude, engagement and emotions, and enjoyment (Hamari et al., 2014; Rabah & Cassidy, 2018). Zichermman and Cunninghan (2011) believed that the learning setting that promotes interaction with users' emotions and desires is effective in engaging individuals in the process of learning. Likewise, Mullins and Sabherwal (2018) highlighted the importance of considering emotion in the design of gamified systems, in order to provide both positive and negative emotions and, consequently, promote emotional engagement in gamified experiences.

Overall, this section has presented positive uses of gamification in education and learning. Nonetheless, it is important to emphasize that there are also risks in using this tool. According to Kim et al. (2018), gamification can be dangerous because of the unpredictability of users' behavior. Some of the ways to achieve goals found by the users are not intended to be part of gamification; thus, educators may consider using techniques in the learning setting to reduce possible behaviors outside the gamified experience. Toda et al. (2018) raised an interesting point about the *dark side* of the gamification by conducting a systematic mapping study to identify the negative effects of gamification in education. As findings, they showed mainly that the use of the PBL approach can have a negative effect when it is not well designed or sustained by motivational and instructional theories. In addition, Hyrynsalmi and Kimppa (2017), referring to the use of game elements everywhere, including in educational settings, emphasized the importance of studying the negative impact of gamification, mainly its ethical side.

In summary, as stated by Dichev and Dicheva (2017), the educational advantages of gamification to the motivational domain and its relationship with learning achievements are still not well understood, which does not mean that this strategy may not be effective in a specific learning context. What this means is that researchers have not yet confirmed its educational benefits. Therefore, educators should try gamification considering the changes in activities when adding game mechanics and how this could negatively or positively affect their pupils. Incrementally, they surely should think about the pedagogical goals of using gamification in their classrooms.

Anyhow, Dichev and Dicheva (2017) stressed that it is necessary to expand the use of gamification with the purpose of exploring the effects of including game

mechanics/strategies across different educational settings; it is also imperative to understand and be aware of how the target-students learn best in order to create a successful gamified experience. Thus, using gamification appropriately with a specific group of learners, and with defined pedagogic goals, make it possible to observe the effectiveness of this strategy.

#### 2.4.7.1 Gamification in Learning of Students with Dyslexia

Games, such as video games, board games or other kind of games are considered important in the learning process of students with dyslexia because they contribute to the development of reading skills (Marques, 2014). For that reason, there are many great studies in the literature about the use of games to help children/teenagers with dyslexia overcome their difficulties in reading.

Some contributions to the learners with dyslexia are revealed as improvements in attention ability and reading accuracy through the use of action video games (Franceschini et al., 2015), effectiveness in supporting grapheme-phoneme correspondences, decoding skills, and improvements in reading for second-grade learners with impairment (Ronimus et al., 2019). Also of note are serious games designed and tested with the goal to detect dyslexia in pre-reading children (Gaggi et al., 2012), a game application with word exercises for children with dyslexia (Rello et al., 2012), the design and testing of a web-based game (Dytective) used for early detection of dyslexia (Rello et al, 2016), and the design of a game (Dyseggixia) that comprises word exercises in Spanish (Rello et al., 2012).

Although the literature presents a variety of benefits of games for individuals with dyslexia, when referring to gamification, it is a small number of works focusing on the application of game design elements in the learning context among students with dyslexia (as presented in Paper I). These studies revealed how gamification can contribute to the development of academic skills in this specific population.

According to the authors, gamification has the potential of motivating and engaging students with dyslexia in the process of learning. Gooch et al. (2015, 2016) conducted a study using a platform named ClassDojo with children with dyslexia, and showed that gamification can improve learners' motivation mainly due to the pedagogical appropriation and creative use of the platform by teachers. Saputra (2015) found that the implementation of a gamified model called Lexipal, which applies game elements as levels, rewards, theme, and clear goals, fosters the engagement of children with dyslexia. Rello et al. (2019) used an online gamified test to predict risk of dyslexia in Spanish children, which revealed that the disorder can be screened by using a computational approach.

Additionally, the company Learning Dragon announced in 2018 the creation of a gamified platform – dyslexia dragon - with the purpose of helping learners with dyslexia with reading and spelling skills (Kronk, 2018). In a more recent work,

Dymora and Niemiec (2019) presented a Java application for mobile devices as a gamified tool to support rules of spelling and orthography learning among students with dyslexia. The results reveal that the gamified application can support students with dyslexia learning.

In view of the contributions presented above, it is possible to provides two reasons for further exploring the use of gamification in the learning process for students with dyslexia:

(i) According to researchers, individuals with dyslexia are generally demotivated (Carvalhais, 2010; Gooch et al., 2015, 2016). Despite the students' disabilities or difficulties, motivation seems to be associated with interesting academic activities (Dev, 1997). As gamification was founded as a strategy used to promote motivation and engagement (Deterding et al., 2011, Zichermman & Cunninghan, 2011), it is important to explore it as a pedagogical tool in order to create a balance between intrinsic and extrinsic motivation (Ryan & Deci, 2000b);

(ii) The support of gamification may not be limited to motivation and engagement, but may be extended to learning achievements so it can also be effectively used to promote learning in the special education setting with the goal to improve students' engagement in the learning of reading (Saputra, 2015) and to enable them to read faster and more efficiently (Franceschini et al., 2015).

As seen, it seems beneficial to explore gamification with students with learning disabilities, such as dyslexia. For this reason, it is imperative to know the target-students and their needs, and what skills they need to develop. Based on these necessities, the goal would be adding a layer of game mechanics to teaching strategies/resources, and accordingly observe the advantages and also disadvantages of gamification to both motivation and cognitive learning achievements. In effect, the exploitation of this strategy may be "aligned to educational purposes" to "act as a powerful engagement factor in education contexts" (Da Rocha Seixas et al., 2016, p. 59).

# 3

# METHODOLOGICAL PATH

## 3.1. Paradigm, Nature, and Method of the Study

This study's methods were guided by the Social-Critical Paradigm, of a more interventional nature due to the inclusion of values and ideology (Coutinho, 2016). Concerning the nature of the study, it is a qualitative research focusing on discovering meanings in the individual actions and in the social interactions (Coutinho, 2016). This study is assumed to be qualitative because it focuses on meaning as a central concept (Coutinho, 2016), without the goal of seeking certainties in the use of gamification to support reading among students with dyslexia, but aims to understand the meanings built in the context investigated.

In this context, a Case Study was developed, in which the methodological strategies of the Design Thinking approach were adopted.

*Case Study*

A Case Study is defined as the intensive exploration of a case (Bryman, 2012) or specific event (Merriam, 1998), through contextual analysis of limited events and their relationships (Yin, 2015). Cohen et al. (2005) postulated that this method "provides a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles" (p. 181).

Understanding the given definition of a Case Study, it is important to highlight the case. Merriam (1998) stated that one of the more outstanding points in a Case study is the case definition (Yin, 2015). Regarding this, she defined a case as "a thing, a single entity, a unit around which there are boundaries" (Yin, 2015, p. 27). Also, Stake (2005) stressed that "the case to be studied is a complex entity located in a milieu or situation embedded in a number of contexts or backgrounds" (p. 449).

Merriam (1998) gave two main reasons to justify the need for selecting a case. The author pointed that a case may be selected because (i) it is a problem of interest, a sample, and a hypothesis; and (ii) its study permits new understandings about a specific phenomenon. Therefore, two cases were selected in this study − two students in two different schools – that were circumscribed to (i) the organizational sphere, since it was developed in two Brazilian public schools; (ii) the geographic context, because it was restricted to the city of Belém, in the state of Pará, Brazil; and (iii) the temporal scope, since it was conducted in a specific period of time, October/2017 to April/2019, as presented subsequently in this chapter.

*The Design Thinking Approach*

Design Thinking (DT) is a non-linear approach used to define new solutions in order to solve problems (Carrol, 2014). It is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success (Brown, 2017).

According to Brown (2017) and Brown and Wyatt (2010), DT is best thought as a system of overlapping spaces, more than a set of sequential steps. There are three spaces to focus on: *inspiration,* i.e. the problem of inspiration to the designer; *ideation,* which means the process of generating ideas; and *implementation,* or the way that "leads from the project stage to the people" (Brown & Wyatt, 2010, p. 30). These spaces are not taken sequentially, but projects may iterate through inspiration, ideation, and implementation as many times as the designers need to listen to the users, refine ideas, and redefine prototypes.

The DT process foments several competences in its spaces, as follows.

- *Inspiration:* In this starting point, designers try to build empathy and understand people and the "situation, the problem or challenge it is set in" (Scheer et al., 2011, p. 12). Hence, in this space, designers develop empathy and learn how to recognize people's thoughts, feelings, needs or intentions;
- *Ideation:* In this second space, designers work as a team, spending time interpreting all the information gathered in the *inspiration space* and defining the problem, and forthwith they brainstorm as a team with the purpose to generate ideas and transform the "knowledge about the problem and its origin into actionable problem solving ideas" (Scheer et al., 2011, p. 12). In this process, designers learn how to work together and apply the information gathered from users;
- *Implementation:* This last space occurs "when the best ideas generated during ideation are turned into a concrete" (Brown & Wyatt, 2010, p. 31). It is about experimentation and making the ideas tangible and actionable (Scheer et al., 2011). In this space, it is time for prototyping, testing, and getting feedback from the users.

Iteration is an important characteristic because DT is fundamentally an exploratory process in which designers find unexpected results. These new findings can be integrated into the project, but sometimes the designers' team may feel motivated to re-think andalign the project before new insights (Brown, 2017). Hence, as pointed by Dam and Siang (2018), as a smooth, iterative, and adaptable process, the different spaces of DT are constantly in iteration and do not follow any sequence in a project.

DT is based on fundamental mindsets summed up bellow.

- Empathy: Bringing empathy to the designers means that the team needs to prioritize the users' needs in order to create relevant solutions (Gasparini, 2015);
- Human centeredness: DT focuses on making people "the source of inspiration and direction for solving design problems" (Rauth et al., 2010, p. 03);
- Collaboration: DT is built upon collaboration directed to the use of multidisciplinary teams that embrace diversity of thoughts, individual styles, and expertise in order to create greater solutions (Carrol et al., 2010);
- Mindfulness of process: This mindset means to be "mindful of process" (Rauth et al., 2010, p. 03) and to know what is occurring, where designers are in the process and the aims of the project;
- Culture of prototyping: This mindset "focuses on being highly experimental, building to think and engaging people with artifacts" (Carrol et al., 2010 p. 41);
- Show, don't tell: This mindset in based on not explaining the solution, but letting the users experiment with the prototype;
- Bias toward action: It is "a focus on action-oriented behavior, rather than discussion-based work" (Rauth et al., 2010, p. 3).

In Education, thinking like a designer and using different kinds of skills such as conceiving, designing, and creating products (Buchanan, 1999; Watson, 2015) is a constructivist approach (Scheer et al., 2012). This construct of new learning strategies can help students and teachers work together to develop innovative projects through an entire process of encouraging the exploration of ideas, development of empathy, and creative thinking.

Paper II provides more discussion about the use of Design Thinking in this research.

## 3.2. Research Context and Participant Characterization

### *3.2.1. Research Context*

The Brazilian Educational law, Lei de Diretrizes e Bases (LDB - 9.394/96), assures access to quality education for all Brazilians from a pluralistic perspective, providing accessibility to all students with special needs. Chapter 5 addresses Inclusive Education; art. 58, section 1, highlights the specialized educational support services in a regular school.

Decree no. 7.611/2011 (November, 17, 2011) defines specialized educational services as a set of activities that may be developed in Multifunctional Resource Rooms, which are spaces equipped with diverse pedagogical tools, furniture, and

equipment aimed to the necessities of the students, and located in the same school where the learner is attending regular classes, or in another school outside of the regular school hours. The target audience defined in this decree is learners (i) with a disability (physical, mental, visual, auditory, sensorial or intellectual); (ii) with a disturbance (such as autism and autism spectrum disorders); and (iii) gifted children/teenagers. Students with Specific Learning Difficulties, such as dyslexia, dyscalculia or dysortographia, are excluded, as stated by Martins and Tonini (2011).

In view of this decree, the educational public system of the city of Belém, capital of the state of Pará, in Brazil, fostered the Centro de Referência em Inclusão Educacional Gabriel Lima Mendes (Crie) (see Figure 11). This center emerged with the goal of promoting and fostering the inclusion of students with disabilities in regular classrooms of the municipal schools of Belém. The work is performed by means of nucleuses and Programs and Projects serving the target audience, i.e. the special needs students and their families.

**Figure 11:** Centro de Referência em Inclusão Educacional Gabriel Lima Mendes (Crie)


Source: http://criebelem.blogspot.com/

The center provides specialized educational assistance through its 67 allocated Multifunctional Resource Rooms (SRM) in schools, benefiting around 1200 students with disabilities – physical, hearing, visual, intellectual, and multiple disabilities, and deaf-blind students and students with autism spectrum disorders and those with high skills/gifted[13] (Crie, 2017)

As pinpointed previously, there is no regulation in Brazil about inclusion of learners with dyslexia under the special assistance of Special Education. Hence, they are not considered to be part of the target public assisted in Special Education centers. The Crie helped us identify schools and teachers who assist students with dyslexic

[13] Information collected from: Centro de Referência em Inclusão Educacional Gabriel Lima Mendes. (2017, September 11st). *O que é o Crie?*. CrieBelém. http://criebelem.blogspot.com/

difficulties. The selection criteria for these participants were: a) having some instruction or practical experience with students with dyslexia; and b) being currently assisting students with a technical clinical report of dyslexia. After this screening work, only three teachers, from different schools, were identified, each one assisting a student with dyslexic difficulties.

The Crie authorized the development of our study and routed us to three schools, where we presented the research protocol (Appendix I) to teachers, parents, and students and also enrolled them as participants in the study. One of the students was not authorized to participate in the research because of her mental disability; thus, we conducted a case study involving the two other educational institutions screened, which we called *Case 01* and *Case 02*.

Figures 12 and 13 illustrate the schools and Multifunctional Resource Rooms:

*Case 01*

The Multifunctional Resource Room has been operating since 2008 and is used to assist 28 students with disabilities – Autism Spectrum Disorder, Intellectual Disability, Physical Disability, Tourette's Syndrome, and Central Auditory Processing Disorder. It is located in Elementary School Francisco Nunes, as shown in Figure 12:

**Figure 12 -** Research Context – Case 01


Source: Elaborated by the authors

*Case 02*

The Multifunctional Resource Room has been operating since 2009 and is used to assist 27 students with disabilities – with Autism Spectrum Disorder, Intellectual Disability, Physical Disability, Tourette's Syndrome, and Central Auditory Processing Disorder. It is located in an elementary school named República de Portugal, as shown in Figure 13:

**Figure 13** - Research Context – Case 02


Source: Elaborated by the authors

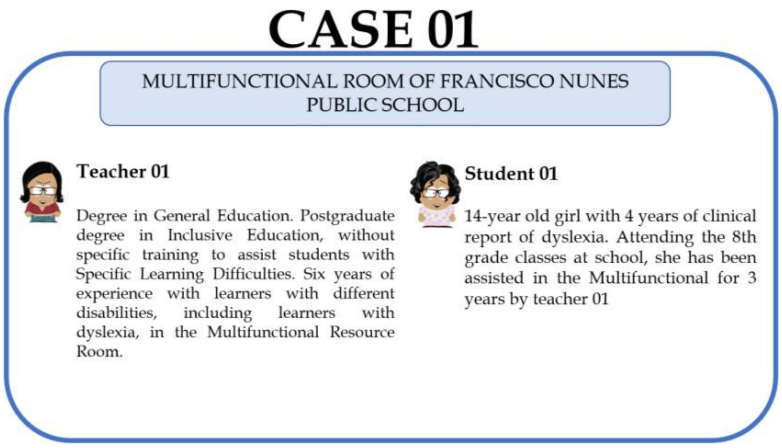
In the Multifunctional Resource Rooms, teachers developed weekly sessions for the students to attend. In the first phase of the study, teachers allowed us to work with the students one hour per week, over six months, of total access to the rooms so that we could conduct participant observation with them and the students with dyslexia. Consequently, all the research activities were conducted during those sessions. After that period, we had to schedule dates and times for each new session or activity in the fourth study stage.

### *3.2.2. Participants*

The participating teachers had all postgraduate degrees in Inclusive/Special Education. The students participating in the research project needed educational support due to academic difficulties caused by dyslexic difficulties; both are adolescents with the same level of literacy.

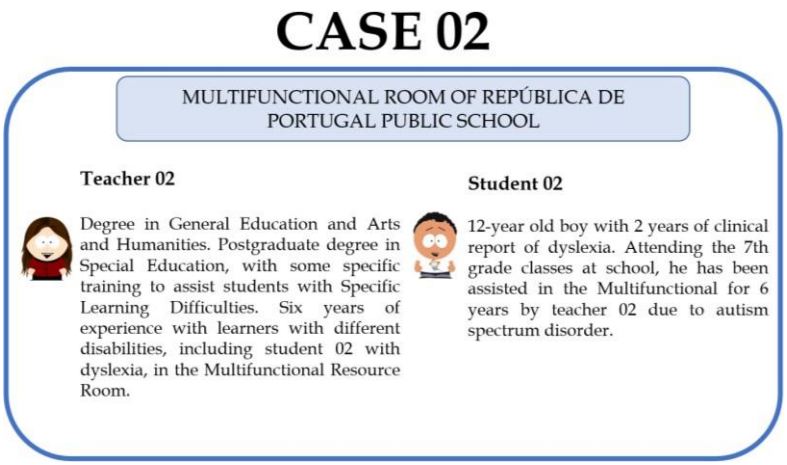
The participants in this study are presented below in Figures 14 and 15:

**Figure 14** - Participants of Case 01




Source: Elaborated by the authors

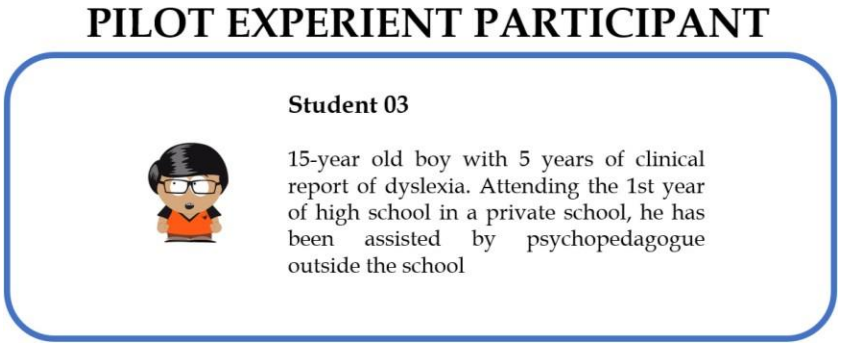
**Figure 15 -** Participants of Case 02




Source: Elaborated by the authors

The prototyping phase required a pilot-experience, in which another student was recruited as a volunteer to experience the prototype developed, as seen in Figure 16:

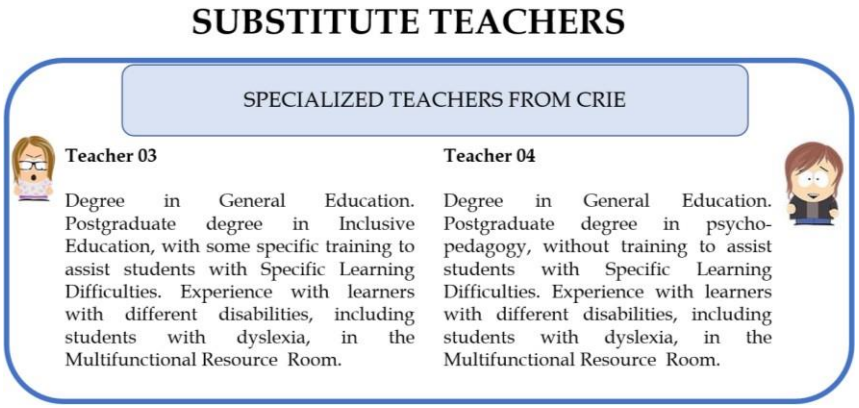
**Figure 16** - Participant of pilot-experience




Source: Elaborated by the authors

In the phase of iteration, when the digital testing of the artifact was conducted, teacher 01 got sick and was estranged of school activities. Thus, as a substitute was needed, we considered it was correct to replace teacher 02 as well. Consequently, we recruited two new teachers with experience in assisting students with dyslexia to participate in this phase, as shown in Figure 17:

**Figure 17** - Substitute teachers in the iteration phase




Source: Elaborated by the authors

All participants received documents with information on the project research, specifying the goals and methodology, and provided consent to participate in this research project as well (see Appendix I).

### 3.3. Model of Analysis and Research Design

As an extension of the research problem, and based on Quivy and Campenhoudt (2005), a model of analysis was created for this proposal. It is presented below in Table 5:

**Table 5** - The Research Model of Analysis

| CONCEPTS | DIMENSIONS | COMPONENTS | INDICATORS |
|---|---|---|---|
| ***Gamification contributes to the engagement and motivation of students with dyslexia from Brazilian schools*** | Motivation | Intrinsic | - demonstration of energy and enthusiasm in participation for inherent interests or personal satisfaction |
| | | Extrinsic | - willingness to perform the activities because of interest in external rewards |
| | Engagement | Cognitive | - demonstration of concentration and participation |
| | | Emotional | -expression of interest and enjoyment |
| ***Gamification contributes to the learning outcomes of students with dyslexia from Brazilian schools*** | Knowledge | | - previous knowledge in reading<br>- grammar knowledge<br>- linguistic knowledge |
| | Skills | Reading comprehension skills | - summarization<br>- comprehension<br>- inferences/conclusions from the text |
| | | Reading decoding skills | - word identification<br>- lexical awareness<br>- vocabulary |

Two main concepts were created, which function as a "construction-selection" (Quivy & Campenhoudt, 2005) and aim to determine and specify the concepts, dimensions, components, and indicators proposed as organizational structures from which the research activities were developed.

This model of analysis generated two main propositions that were verified in this research project, as presented in Table 6.

**Table 6** - Research Problem and Propositions

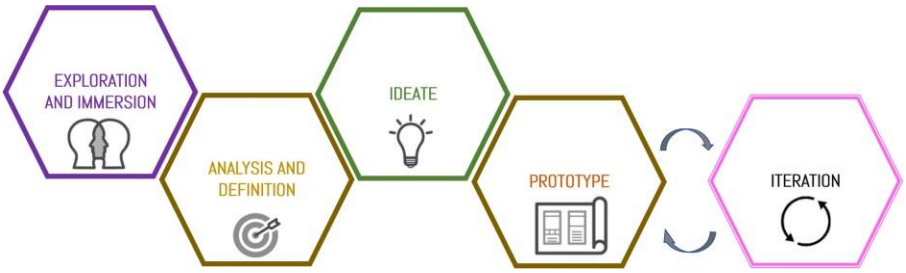
| **Research Problem**<br>*How can the use of gamification mechanisms support reading learning of students with dyslexia from Brazilian schools?* | |
|---|---|
| **Proposition 1**<br><br>The case study will show that the gamification strategy contributes to the motivation and engagement in reading of students with Dyslexia from Brazilian schools | **Proposition 2**<br><br>The case study will demonstrate that the use of gamification contributes to the learning outcomes of students with Dyslexia from Brazilian schools |

The study design based on the two propositions made it possible to identify the best techniques/instruments, and also the kind of information that should be collected.

### 3.4. Study Phases

Although the DT phases are not chronologically predefined, three main phases were linearly conducted and prototyping iteration phase was created, as shown in Figure 18:

**Figure 18** - Research Phases




Source: Elaborated by the authors

- **Phase of Exploration and Immersion** – In this first stage, we *immersed* in the schools' background with the purpose to know the educational context of assistance, and focused on learners' schooling experiences in order to *explore* their specific reading difficulties due to dyslexia.
- **Phase of Analysis and Definition** – After phase 01, we conducted this second step, in which all the data gathered in the phase of *immersion and exploration* were analyzed and crossed, so that we could identify patterns of reading difficulties and

characterize the scenario of Specialized Educational Assistance for students with dyslexia in Brazil.

- **Phase of Ideation** – In this stage, we conducted co-creation sessions with students, teachers, and the researcher in order to generate ideas to conceive and design the gamified prototype.
- **Phase of Iterative Prototype** – This phase involved consolidating the ideas generated at the ideation stage and testing/evaluation. It should be noted that since DT is an iterative and non-linear approach, the results generated in the first test were used to obtain the participants' feedback (Cavalcanti, 2014), i.e. their understanding, thoughts, and feelings, in order to empathize, and thus redefine/modify the prototype and test it again.

## 3.5. Techniques and Tools

### *3.5.1. Data Collection Tools*

In this research, data triangulation was conducted by applying different techniques/tools for data collection, as follows.

*Participant Observation*

Initially, observation is believed to be one of the main data collection techniques of a Case Study (Martins, 2008). According to Denzin (1978 as cited in Ludke & André, 1986), participant observation is a field strategy that simultaneously combines documentary study, interviews, and participation and direct observation of the research locus. Hence, we conducted participant observation in this research project, because it allowed us to be in straight contact with the investigated object. In the words of Ludke and André (1986), "a experiência direta é sem dúvida o melhor teste de verificação da ocorrência de um terminado fenômeno"[15] (p. 26), i.e. this technique allows us to observe and interpret the phenomenon.

Some aspects of this type of strategy in this research project were considered:

- **Researcher's involvement:** The investigator's role in an observation situation can fluctuate in a continuum between observer and participant (Bogdan & Biklen, 1994). From this perspective, being just an observer of the activities was first prioritized. However, because of the specificities

[15] "direct experience is undoubtedly the best test for verifying the occurrence of a specific phenomenon." (Free translation)

of the context, the researcher must be a participant-observer (Ludke & André, 1986);

- **Length of stay:** One meeting per week, over 3 to 6 months, was established;
- **Notes:** According to Bogdan and Biklen (1994), after completing the observation work, it is necessary to record in writing what was heard, seen, and experienced. Thus, in this study, we took notes, which comprised two main parts: description of the actions and reflections – analytical, methodological, ethical concerns, changes in the observer's perspectives and elucidations;
- **Observation content**: It is important to understand that observing is a thorough examination that requires attention in collecting data and behavior in the field. Hence, we focused on the description of participants, places, and activities. The reflexive parts focused on analytical and methodological reflections, and also on any necessary elucidations.

In this process of participant observation, the following data collecting instruments were applied:

a. Interviews: The option for this instrument was motivated by the possibility of understanding the meanings constructed by the individuals in the context of the investigation (Martins, 2008), so that in this type of study the case is not comprehended the same way by all the participants (Stake, 1995). Hence, we applied *semi-structured interviews* (Bogdan & Biklen,1994) focused on a theme about which we created a script with main questions, which were complemented by other questions raised during the interview. According to Manzini (1990), this kind of interview can collect information more freely, and the answers are not conditioned to a set of alternatives. We also conducted *non-structured interviews* (Yin, 2015), which are used to explore a theme more widely, according to the interviewee's point of view, and also to understand the specificities of a case (Boni & Quaresma, 2005);

b. Documentary analysis: Considered to be a relevant technique to better understand the case and corroborate the evidence found in the use of other instruments (Martins, 2008), this data collection technique is not about materials (e.g. books, articles, etc.), but about non-edited materials, personal (letters, diaries) or official (reports, teaching diaries, course plans) records, and involves reading and analysis of these documents;

c. Scale-based questionnaire and open-questionnaire: We used a Likert scale to measure students' motivation, engagement, and impressions about their own learning after testing the gamified resource. The format

used comprised a series of statements that focused on issues or themes about the gamified resource. We followed Bryman (2012)' orientation to: create statements and not questions, relate the items to the same theme, and state interrelated scale items.

With respect to the open-questionnaires, we considered them as a relevant instrument for gathering data, so they were applied by the teachers and students as tool to evaluate the gamified resource.

### *3.5.2. Data Analysis*

The Content Analysis technique, defined as "um conjunto de técnicas de análise das comunicações que utiliza procedimentos sistemáticos e objetivos de descrição do conteúdo das mensagens"[16] (Bardin, 2009, p. 40), was applied. Its goal is to provide comprehension of the meanings emerging from communication and categorizing data in themes/categories that help understand what is behind the discourses (Câmara, 2013).

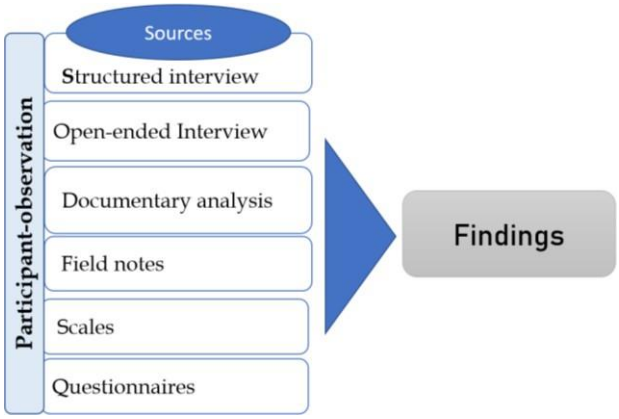
The process of analyses fulfilled the three analytical phases, as directed by Bardin (2009): pre-analysis, material exploration, and results treatment and interpretation.

### *3.5.3. Data Triangulation*

The Triangulation strategy can be the use of multiple sources of evidence to collect data about the same subject and strengthen its analysis (Flick, 2005b). Using a variety of instruments for data collection in a case study is a way of ensuring the research validity (Yin, 2015). Figure 19 illustrates the application of various sources aiming to converge evidence in this work:

[16] "a set of communication analysis techniques that uses systematic and objective procedures to describe the content of messages." (Free translation)

**Figure 19 –** Convergence of Evidence in Data Triangulation




Source: Elaborated by the authors

In the process of triangulation, the detailed Content Analysis from each source of evidence was provided after data collection. The qualitative results are presented in tables, and quantitative information is compiled in graphs and tables. Based on the analysis, key findings were identified for each phase's source of evidence and triangulation by comparing and contrasting them according to the research objectives.

The scope of triangulation in this qualitative work was just about validation of data through the crossover of information from the different sources, as well as capturing different dimensions and increasing a comprehensive understanding about the study object.

### 3.6 Reliability and Validity

In qualitative research, data reliability and validity can be judged as doubtful and fragile (Ullrich et al., 2012). Hence, how to guarantee the quality of planning and execution of this Case Study was explored.

Concerning reliability, as claimed by Ullrich et al. (2012), the following conditions were considered:

a. Permanence time in field: This case study was developed between 2017 and 2019;
b. Transparency: A detailed description of all instruments used in each phase of this research is provided;
c. Research limitations: The limitations of this study in this document are presented;
d. Detailed description: This work provides detailed description of the whole process in the research diary;
e. Evaluation of data and data analysis: Data evaluation was fostered by supervisors as well;
f. Exploration of meaning: It was explored how meanings arise from the research context;

g. Theorical saturation: Extensive search for theoretical contributions was fostered;
h. Consistency: In this research, the consistency between data and theory was favored;
i. Reflexivity: The theoretical-methodological choices of data collection and analysis were assumed according to the research context of this study;
j. Data triangulation: As pinpointed by Martins (2008), data triangulation, as the result of the application of various instruments in data collection, enchainment of evidences and rigor in all the proceedings, was developed throughout this research.

Martins (2008, p. 93) postulated that "uma pesquisa não é simplesmente válida, porém, será válida para este ou aquele objetivo"[17]; therefore, in order to demonstrate the validity of this study according to its main objectives, the following techniques were applied:

a. Data triangulation in research design;
b. In data generation, persistent participant-observation was conducted; content validation of the interview's guide was performed by the supervisor, and data transcripts were submitted to the supervisor and research participants;
c. In the prototyping phase, content validation was provided. The instruments scale-based questionnaire and open-questionnaire used to collect the participants' evaluations were submitted to three external data assessors. Additionally, a pilot-test was also conducted with an external volunteer;
d. In the analysis, the results were presented in tables and evaluated by the supervisors (Ludke & André, 1986), and were also interpreted, with theorization of findings;
e. For the written presentation, it was defined that all the data should be provided in an appendix, as well as evidences of research interpretations, and detailed descriptions of the research process.

### 3.7 Ethical Regulations

As a research involving collection and analysis of data in which students with dyslexia and teachers were exposed to observation, interviews and pedagogical interaction, the project was submitted and approved by the University of Aveiro's Ethics Committee (see Annex I).

[17] "A research is not simply valid itself, however, it will be valid for this or that aim."

# 4

# GAME-DESIGNED MECHANICS FOR STORYTELLING PROTOTYPE: RESULTS AND DISCUSSION

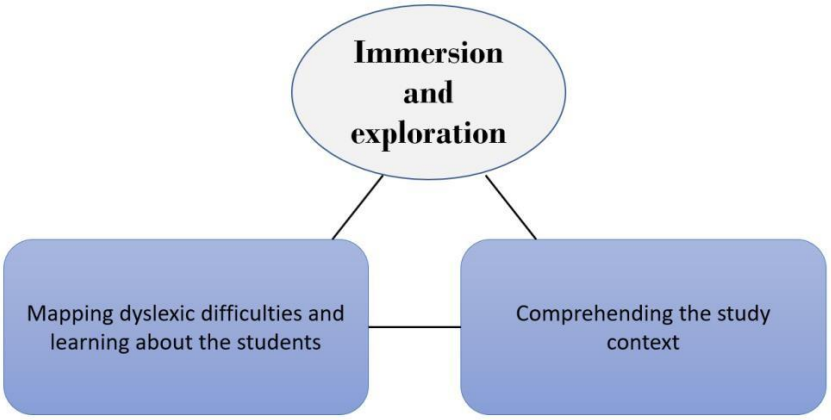
## 4.1. Exploration and Immersion in the Context of Educational Assistance to the Student with Dyslexia

### *4.1.1. Methods*

*Phase Goals*

This phase, named Immersion and Exploration, was a stage of exploratory immersion, in which we aimed to meet two main goals, as shown in Figure 20:

**Figure 20 -** Main Goals of the First Phase of the Study

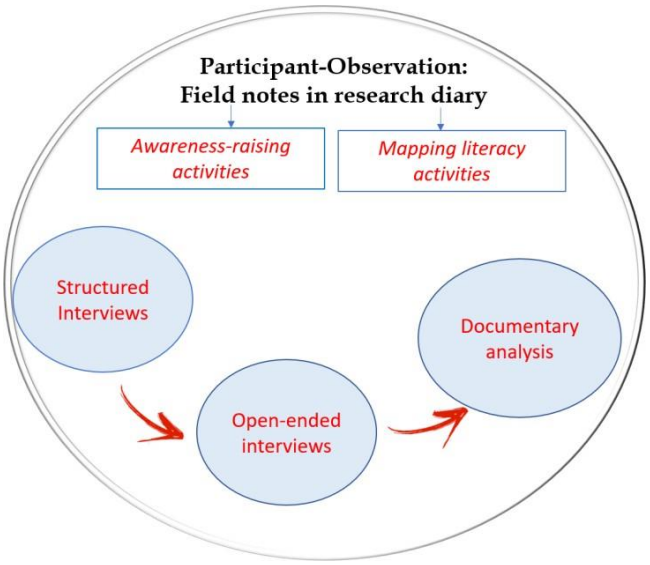



Source: Elaborated by the authors

*Procedures*

To comply with each objective, we used the strategy of participant observation combined with interviews and documentary analysis, as presented in Figure 21:

**Figure 21** - Sequence of Techniques/Instruments Applied in Phase 01




Source: Elaborated by the authors

As dyslexia is not part of the target disabilities of specialized education attendance, after knowing how teachers work, we concluded that we should promote learning situations in order to spend time with students and get to know them and their dyslexic difficulties. Hence, the researcher become a participant-observer, whose goals was creating and applying pedagogical activities with diverse ends, as presented in Table 7:

**Table 7** - Purposes of the Pedagogical Activities Developed in Phase 01

| Type | Activity | Purpose | Means of recording |
|---|---|---|---|
| *Mapping literacy activities (see Appendix II)* | 1. Reading exercises<br>2. Laterality exercises<br>3. Writing exercises<br>4. Spelling activities<br>5. Word dominoes | Verifying learners' main reading/writing difficulties | Recorded in video and in paper |
| *Awareness-raising activities (see Appendix III)* | 1. Notebook with questions for written or oral answers<br>2. Thematic cards for oral activity<br>3. Motivation scale-based questionnaire | Learning about the students, as summarized below:<br>- Students' perception about their practice in reading;<br>- Students' comprehension about their own dyslexic difficulties;<br>- Impressions on educational support;<br>- Learners' feeling about their needs for specialized support in Multifunctional Resource Rooms;<br>- Learners' sentiments about their difficulties | Recorded in audio and in paper |

| | | | |
|---|---|---|---|
| | | compared to other students;<br>- Pupils' motivation to become involved in reading/writing activities;<br>- Pupils' expectations with respect to inclusive educational support at school. | |

We applied these activities with students once per week, under the teachers' supervision, over six months. Additionally, during this phase, we kept field notes of all meetings, prioritizing the description of the participants, Multifunctional Resource Rooms, and the activities applied, as well as reflections about them (see Appendices IV).

Observation was a process that took place throughout the entire stage; in the beginning of the application of this method, Structured Interviews were introduced with the proposal of getting more uniform outcomes from the interviewees (Ludke & André, 1986). We resorted to this type of interview with the purpose of getting to know the informants' perceptions about the students' dyslexic difficulties.

Considering this objective, we conducted interviews with: a) the legal guardians of the adolescents, aiming to obtain the students' schooling history and details on their literacy difficulties from the legal guardian's perspective; and b) teachers, with the purpose of learning about teachers' pedagogical practices in learning situations tailored to students with dyslexia, as checked results, as well as their academic background. Interview scripts (see Appendixes V and VI) containing directed questions based on the literature were used in each interview. These scripts were validated by the research project's supervisor. Most of interviews were video recorded and, subsequently, transcribed. Only Teacher 02 was asked to write her answers to the questions. We highlight that in both cases, the interview was developed based on the same themes and collected by means of similar skills.

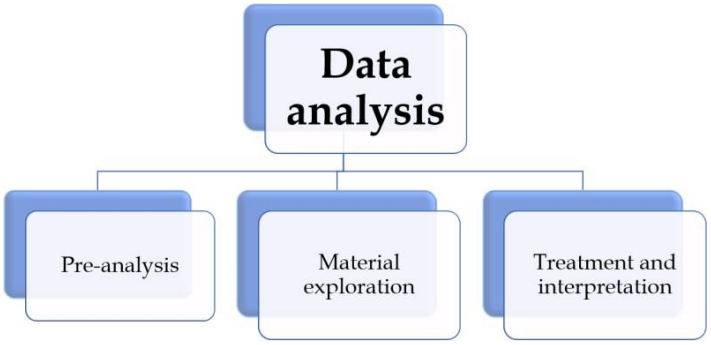
These interviews did not capture enough information about the context of Special Education assistance, hence we also resorted to open-ended question interviews with the two teachers. In this kind of interviews, we planned for three themes concerning the specialized service in the Multifunctional Resource Rooms (see Appendix VII). The instrument was validated by the research project's supervisor, and teachers were asked to tell us about their impressions and beliefs regarding school the student's dyslexic difficulties and needs. This instrument was relevant to our study because it allows for a more widely exploration of a theme, thus an understanding of meaning built by the participants (Martins, 2008). Both teachers' interviews were developed based on the same themes and collected by means of similar skills.

As the last technique, a documentary analysis of two official documents, the Brazilian Education Law (Lei de Diretrizes e Bases – LDB 9394/96) and the Specialized Educational Service Guidelines, decree on Special Education no. 7.611/2011 was performed. To conduct this examination, we developed a guide, also validated by the research project's supervisor, with the purpose of identifying legal information about the context of special education attendance of students with disabilities in Brazil supporting the services offered at Multifunctional Resource Rooms in the city of Belém, Pará, Brazil (see Appendix VIII)

*Data Analysis*

After phase 01, we led stage 2, entitled **Analysis and Definition**, in which all the information collected in phase 01 was analyzed. Thus, to analyze the data from the interviews, and map literacy and awareness-raising activities, the technique Content Analysis, chronologically conducted in three steps according to Bardin (2009), was used. Figure 22 shows these procedures, described below.

**Figure 22** - Content Analysis Phases



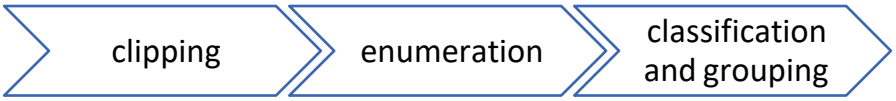

Source: Elaborated by the authors

- *Pre-analysis:* This is a phase to systematize the initial ideas that emerged from the theoretical framework. Thus, to organize the written, video, and audio-recorded materials to be investigated, so that the analysis operations could be conducted, we proceeded to: (i) transcription of the interview data, using the norms for interview transcription as seen in Annex II (Preti, 1999), and in the case of videos generated to record the activities, listing, organization, and analysis of the material, *material identification, cataloguing and archiving, description and transcription of the videos* were conducted; (ii) floating reading, which is the initial reading of the interview's transcription, field notes in the diary and the documents themselves, in order to familiarize ourselves with the content of the texts; (iii) definition of the corpus, including all the data, following the rules of corpus constitution, such as exhaustiveness (with deference of all elements of the corpus), representativeness (the sample is representative of each case), homogeneity (corpora are homogeneous because

they were collected with the same techniques/instruments and deal with the same theme), and relevance (corpora are relative to what is proposed in the study) (Bardin, 2009); (iv) formulation of hypotheses and objectives; and (v) elaboration of indicators to interpret the data provided by the corpora;

- Material exploration: A process of encoding was followed as presented in Figure 23:

**Figure 23** - Process of Encoding




Source: Elaborated by the authors

In clipping, the choice of the context units was made; clipping consists in a unit of "significação a codificar e corresponde ao segmento de conteúdo a considerar da comunidade de base, visando a categorização e a contagem frequencial"[18] (Bardin, 2009, p. 104). Therefore, a thematic selection was made, in which we considered phrases/utterances consisting of meanings, whose presence and frequency throughout the text express specific and relevant meanings for the analysis.

In enumeration, the counting mode selection was made by *presence* as meaningful, and *absence*, since a lack of units also conveys meaning. As claimed by Bardin (2009, p. 114), the presence or absence of a unit may express "um índice tanto (ou mais) frutífero que a frequência de aparição"[19], and also by the frequency of coding units.

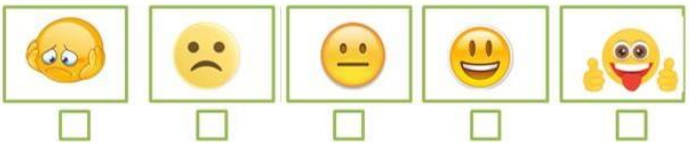
For classification and grouping, we first carried out an inventory by isolating the registration units, and then the data information was distributed into thematic categories. The categories systems were also evaluated by the supervisors of this work, as suggested by Ludke and André (1986), in order to verify if the system was in accordance with the study objectives, and if the data were appropriately classified.

- *Treatment and interpretation*: Inferences and interpretations related to the proposed research objectives were made, just as with regard to theoretical concepts.

[18] "unit of meaning to be coded and corresponds to the content segment from the base community, aiming at categorization and frequency counting" (free translation)
[19] "an index so much (or more) fruitful than the frequency of appearance" (free translation)

The motivation scale-based questionnaire, part of awareness-raising activities, applied to the students was used as an option to get answers about students' motivation to learn. With this purpose, a ludic scale with emojis was designed, as seen in Figure 24, in which each emoji represents a number from 1-5 (left to right).

**Figure 24 -** Design of a Motivation Scale



Source: Elaborated by the authors

The scale-based questionnaire was split into fourteen statements about what students should demonstrate and their level of agreement with each one of them (complete instrument is Appendix III, p. 333-336/340-343). This tool was evaluated and validated by the research project's supervisor and the teacher-participants. Data analysis was performed by calculating the average sum of the values for each student.

All the findings were submitted in the form of tables to the supervisors for review as a criterion for data validation.

### *4.1.2 Results*

#### 4.1.2.1 Mapping Dyslexic Difficulties and Learning About the Students

The process of analysis provided indicators, which were categorized. The analysis grids shown in Tables 8 and 9 are based on the interview guides and according to the research goals for the data provided with the participants' interviews. These grids will guide data presentation, and their categories and subcategories will be illustrated by excerpts of the interviews.

The interviews' transcriptions can be found in the appendices.

(i) Legal Guardians' Interviews

Data obtained in the interviews for each of the categories under analysis are presented in Tables 8[20] and 9 (see transcription of interviews of Legal Guardian 01 – LG1 and Legal Guardian 02 – LG2 in Appendix IX)

[20]It is imperative to say that the symbol '-' used in the table means absence of verbalizations about indicators of reading difficulties related to fluency and word recognition and demotivation in Case 01, and about difficulties in orientation and mapping in Case 02.

- Category Student History Characterization

The frequency of occurrences in both cases is more prominent in indicating the a*ssociation of dyslexia with other disabilities/diseases.* Thus, the legal guardians (LG) enunciated that they associated the literacy difficulties with other disabilities/diseases. The student in case 01 has a disease named neurofibromatosis; therefore, her mother considered her reading/writing difficulties as part of that health condition.

*Age of diagnosis* was another more frequent indicator. Because of her disease, learner in Case 01 only received a clinical diagnosis at the beginning of adolescence, for instance. In Case 02, although the student received support from specialized teachers because of his academic difficulties since he was 6 years old, clinical confirmation was given solely when he was 12 years old.

It is interesting how families face difficulties to get a clinical report in cases of dyslexia, which delays appropriate pedagogical interventions.

Additionally, data from Case 02 also revealed an earlier signal of dyslexia – *late talking.* The oral language delay seems to be a characteristic of children with dyslexia, according to report of LG2.

Concerning the schooling experience, a significant number of verbalizations in this subcategory expressing *initial educational experiences* was found. The interviewer in Case 02 referred to the students' alphabetization at home as well as the first support at school, as milestones in the identification of the learners' literacy difficulties. Concerning Case 01, the discourse fragments revealed the attempt to provide guidance to teachers about how to include a student with dyslexia in the regular classes. According to the informant, this type of gumption did not work so well because some teachers did not cooperate with it.

For the subcategory *Perception of specific pedagogical experiences according to the students' needs*, most of the utterances identified that were related to the schooling experiences conveyed the informants' perception about the existence of distinctive schooling experiences directed to the students' needs. There were also some negative perceptions about teaching resources/strategies and reference to the consulting service at Multifunctional Resource Room as a positive support. At last, some findings revealed an interesting theme about the absence of dialogue between teachers and families.

Table 8 summarizes these results:

**Table 8 -** Analysis Grid of Category Student History Characterization

| SUBCATEGORIES | INDICATORS | UNIT CONTEXT | FR. |
|---|---|---|---|
| **Dyslexia identification** | 1. perception of first difficulties | *com seis anos na alfabetização ela não escrevia nem lia... quer dizer escrever ela nem copiava ne? (LG1)* | 4 |
| | | *porque ele não expressava som nenhum com dois anos de idade... toda criança ela...que eu já tenho outros filhos tenho dois e ele é o terceiro....então a gente percebeu que ele não emitia som nenhum...ele era aquela criança calminha... eh::...geralmente não reclamava não chorava...todo tempo calado...então foi que a gente percebeu (LG2)* | 3 |
| | 2. association with other disabilities/diseases | *sempre foi...eh::...lenta...sabe assim ela sempre foi ...sempre foi a última da sala a desenvolver as tarefas, então assim não sei se por conta da neurofibromatose...como eu já tinha lido sobre a doença e tudo...aí eu assim...eu sinceramente achava que ela não iria ler ... era uma coisa que ela iria ..eu sei eu sei que tem pessoas que não conseguem ler, então eu achava que ela seria uma dessas pessoas pelo jeito dela (LG1)* | 5 |
| | | *e eu ia colocar ele numa escola pra surdo ...ela disse "não"...tem um/aquela escola ali em São Braz...ela disse "não tem que colocar ele numa escola normal porque o G* não é surdo" (LG2)* | 3 |
| | 4. late talking | ---------___ | - |
| | | *ele já estava com três pra quatro anos ... até então ele não emitia nada de som (LG2)* | 7 |
| | 5. age of diagnosis | *quando ela chegou aos onze anos... que ela começou a desenvolver a puberdade a adolescência... aí eu voltei as atividades porque é a fase mais crítica da doença ... e aí quando a gente voltou a fazer todos os exames ... aí ela já tava com onze anos... já tava na segunda série ... e aí a gente começou a fazer outros exames... a fazer outras pesquisas e aí ela foi diagnosticada com a dislexia (LG1)* | 4 |
| | | *quando nós percebemos esse problema dele né?... porque ano passado que teve o laudo dele... até então ninguém tinha ainda fechado o laudo dele (LG2)* | 1 |
| **Schooling experiences** | 1. first educational experiences | *a psicopedagoga me deu um guia... que eu chamo de manual de instrução... e ela me orientou que eu desse esse guia de instruções para todos os professores dela... toda vez que ela fosse entrar na escola eu desse a gente dá essa orientação se o professor vai seguir ou não já não é com a gente e aí na outra escola não seguiram (LG1)* | 5 |
| | | *com toda a dificuldade dele eu ainda consegui alfabetizar (LG2)* | 4 |
| | 2. perception of pedagogical experiences tailored to the student needs | *ela sempre foi estimulada a ler e ela ganhava prêmio... uma vez fizeram uma apresentação para ela ler lá na... tem um negócio de sarau da poesia... deram um poeminha para ela ler e tudo mas na hora ela ficou nervosa e tremia e tudo... ela começou a chorar e não conseguia... aí eu fui lá pra frente ler com ela... aí eles disseram pra mim na época que iam trabalhar isso com ela (LG1)* | 5 |
| | | *não dá pra acompanhar como dizem né? ... eles não relatam né?... a gente só vem deixar e depois só buscar... aí não tem diálogo (LG2)* | 10 |
| | | **total** | 51 |

- Category Reading Difficulties

The frequency of verbalizations about reading difficulties represents a small number, but these data are important because they express the legal guardians'

perceptions about reading difficulties, as well as absence of some constraints. Findings are associated with word fluency/decoding problems and reading comprehension; nevertheless, not much information is provided about present-day difficulties, since the data express more the past problems and scarcity for some common dyslexic difficulties, as seen in Table 9:

**Table 9** -Analysis Grid of Category Reading Difficulties

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Past difficulties** | 1. slow and segmented reading | ---------- | - |
| | | *logo no começo sim... no começo era bem lento sim bastante (LG2)* | 1 |
| | 2. omission of letters/words | --------- | - |
| | | *logo no princípio sim…. mas depois não porque eu ficava corrigindo ele (LG2)* | 1 |
| | 3. reverse letters or the order of letters in reading | --------- | - |
| | | *pra trás não (LG2)* | |
| | 4. confusion of similar letters or words | --------- | - |
| | | *logo no início ele confundia bastante (LG2)* | 2 |
| | | **total** | 4 |
| **Current difficulties** | 1. confusion of similar letters or words | *uma professora de português.... foi guardar o material e aí colocou "não mexa"... ai ela perguntou se era com x ou com ch... aí eu disse "mexer" é com x (LG1)* | 1 |
| | | *s ç ... lh... as palavras quando são mais complexas ... entende? é onde ele tem mais dificuldade(LG2)* | 4 |
| | 2. lips movement | --------- | - |
| | | *ele fica às vezes (murmurando) (LG2)* | 1 |
| | 3. reading comprehension | *o problema sempre foi a interpretação (LG1)* | 2 |
| | | *ele tem um pouco... (LG2)* | 1 |
| | | **total** | 9 |
| **Absence of difficulties** | 1. lips movement | *não...ela lê de boca fechadinha (LG1)* | 1 |
| | | --------- | - |
| | 2. difficulties with sequence of letters/alphabet | --------- | - |
| | | *ele lembra direitinho (LG2)* | 1 |
| | 3. grammar difficulties | *NÃO. ...ela não tem (LG1)* | 1 |
| | | *não porque ele começou a ver agora no quinto ano... no quarto... no quinto ano ele viu levemente mas não teve dificuldade (LG2)* | 4 |
| | 4. reading errors of words semantically similar | --------- | - |
| | | *ele nunca teve dificuldades com palavras semelhantes (LG2)* | 2 |
| | 5. "stumbles" through long words | --------- | - |
| | | *não (LG2)* | 1 |
| | | **total** | 10 |

- Category Writing Difficulties

As for difficulties in writing, a small number of verbalizations indicating past and current difficulties were seen, as shown in Table 10:

**Table 10 -** Analysis grid of Category Writing Difficulties

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Writing errors** | 1. past difficulties | *principalmente ela nem conseguia nem sequer completar ... ela às vezes ela fazia frases incompletas (LG1)* | 1 |
| | | --------- | - |
| | 2. current difficulties | *eu tô observando nela são aqueles erros na escrita ... e eu tento corrigir sempre que vejo (LG1)* | 1 |
| | | *na escrita ele tem bastante (LG2)* | 2 |
| | | **total** | 4 |

- Category Memory and Cognition

Table 11 shows the utterances in both cases as indicators of past and current difficulties in laterality, attention, spatial organization and mapping, and absence of these difficulties as well:

**Table 11 -** Analysis grid of Category Memory and Cognition Difficulties

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Past difficulties** | 1. difficulties in distinguish left from right | --------- | - |
| | | *logo agora não… mas antes ele tinha não sabia identificar o que era direita o esquerda (LG2)* | 1 |
| **Current difficulties** | 1. difficulties in distinguish left from right | *Sim sim ela tem... parecida comigo (LG1)* | 1 |
| | | --------- | - |
| | 2. inattention and memory | *a falta de atenção dela eu sempre associei ... até então eu não sabia que era uma característica da dislexia... então eu associei as atividades extracurriculares (LG1)* | 1 |
| | | *nem sempre… quando ele tá muito cansado... porque assim quando ele tá desmotivado tudo bem.... mas tem hora que ele cansa... ele tem o limite dele... aí ele já não sabe.... já não vai prestar atenção (LG2)* | 1 |
| **Absence of difficulties** | 1. difficulties in orientation and mapping | *eu nunca parei para observar isso específico em mapa (LG1)* | 4 |
| | | --------- | - |
| | | **total** | 8 |

- Category Emotional Difficulties

Finally, these types of difficulties are related to the impression of the legal guardians about motivation or demotivation and low self-confidence of the student to perform literacy activities due to dyslexia. The indicators showed the presence or absence of the difficulties, as described in Table 12:

**Table 12 -** Analysis grid of Category Emotional Difficulties

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Self-confidence** | 1. presence of self-confidence | --------- | - |
| | | *ele não tem vergonha de ler... na igreja ele sempre ler... a gente sempre prega (LG2)* | 1 |
| | | **total** | 1 |
| **Motivation** | 2. lack of self-confidence | *tem vergonha de ler... então assim como ela é muito desinibida de brincar de falar... então eles não imaginavam que ela fosse ficar tão nervosa diante do público (LG1)* | 1 |
| | | --------- | - |
| | 1. presence of motivation | --------- | - |
| | | *ele é motivado (LG2)* | 1 |
| | 2. lack of motivation | *e a falta de motivação... pras atividades (LG1)* | 1 |
| | | --------- | - |
| | | **total** | 3 |

(ii) Teachers' interviews:

The tables below show the analysis of the content of the teachers' interviews[21] (see transcription of interviews of Teacher 01 – T1 and Teacher 02 – T2 in Appendixes X and XI):

- Category Teacher Specific Training and Experiences

This category does not present any expressive results, but its relevance consists in indicating teaching training for experiencing pedagogical work with students with dyslexic difficulties. Thus, the data were conveyed in two subcategories: *training for pedagogical interventions in cases of dyslexia,* which conveys information about the lack of instruction in language disabilities, such as dyslexia, throughout the teachers' specialization courses; and *experiences with pedagogical interventions in cases of dyslexia,* indicating little experience with attendance of students with dyslexia, as seen in Table 13:

[21]As in other tables, the symbol '-' means the absence of verbalizations about indicators.

**Table 13 -** Analysis grid of Category Teacher Specific Training and Experiences

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Training for pedagogical intervention in cases of dyslexia** | 1. lack of specific training | ------- | - |
| | | *durante o período em que trabalho na SEMEC ainda não houve formação sobre dislexia, pois pela legislação este público, mesmo tendo necessidades específicas, ainda não são considerados demanda da educação especial (T2)* | 1 |
| | 2. scarce of specific training | *a mesma coisa foi na especialização ...também nós falamos brevemente na parte de distúrbios de aprendizagem... não não não houve uma disciplina específica para trabalhar com a dislexia (T1)* | 3 |
| | | --------- | - |
| | | **total** | 4 |
| **Experiences with pedagogical intervention in cases of dyslexia** | 1. slight experience | *apenas aqui na sala de recursos né? O contrato os alunos que chegam com o laudo de dislexia (T1)* | 1 |
| | | *este é o primeiro aluno que apresenta quadro de dislexia na escola (T2)* | 2 |
| | | **total** | 3 |

- Category Pedagogical Practices

This category is split into four subcategories, which indicate the kind of practices that are developed when assisting learners with dyslexic difficulties. The main findings about this category are related to the type of support given by the teachers to the students with dyslexia in Multifunctional Resource Rooms, since they are not the target public of the assistance.

According to the data, there are two different practices of assistance:

(i) *Consulting service*, which Teacher 01 named "assessoramento". The data express the definition of "assessoramento".

> *o assessoramento é de acordo com a necessidade do aluno... o aluno tá em sala de aula e se ele sentir alguma dificuldade além do normal dentro da sala de aula ele nos procura para nós tentarmos é é mediar esse conhecimento que ele tem na sala de aula...(T1)*

(ii) By adopting a different practice, Teacher 02 reveals *attendance and academic weekly support*, i.e. the teacher books one hour per week to help the learner with academic activities:

Concerning the *students' individual planning, w*hen asked about teaching planning to guide the assistance of students with dyslexia, the informants also express distinct practices. Hence, there is absence of teaching planning given the nature of the "assessoramento" and, on the other side, the teacher of Case 02 expressed that there are diagnostic evaluations and, consequently, individual

planning to provide guidance to assist the learners with their literacy difficulties. Table 14 presents this category's findings:

**Table 14** - Analysis grid of Category Pedagogical Practices

| SUBCATEGORIES | INDICATORS | CONTEXT UNIT | FR. |
|---|---|---|---|
| **Students with dyslexia assistance** | 1. consulting service | *...e nós fazemos apenas o assessoramento né? visto que aqui no Brasil a dislexia não é considerada deficiência... é considerada um distúrbio e não seria o caso do público-alvo... do atendimento educacional especializado... é o público-alvo da sala de recursos para assessoramento... mas não do atendimento (T1)* | 6 |
| | | ------- | - |
| | 2. academic weekly attendance | ------- | - |
| | | *há uma preocupação pessoal em relação às demandas como dislexia, consequentemente, busco por materiais teóricos e práticos para ajudar esta demanda na escola (T2)* | 1 |
| | | **total** | 7 |
| **Students individual planning** | 1. diagnostic evaluation | ------- | - |
| | | *sim, avaliação diagnóstica (T2)* | 1 |
| | 2. pedagogic planning | *não... não tem um planejamento porque é de acordo com a necessidade do aluno né? no momento que ele se vê se vê num/numa dificuldade muito grande o aluno vem e nos procura e nós damos esse suporte pedagógico(T1)* | 1 |
| | | *os objetivos do plano são voltados para atividades de leitura escrita e interpretação de diversos textos tais objetivos são estabelecidos de acordo com as demandas do aluno (T2)* | 3 |
| | | **total** | 5 |
| **Resources and tools** | 1. technological tools | *eu utilizo a internet pra sanar as dúvidas da aluna né? geralmente isso.... normalmente eu faço pesquisa com a aluna ...pelo computador (T1)* | 2 |
| | | *uso de notebook e alguma vezes de celular quando há internet. (T2)* | 2 |
| | | **total** | 4 |

- Category Learners' Dyslexic Difficulties

The data also expressed information about the teachers' perceptions on dyslexic difficulties. The findings are divided into four subcategories: reading, writing, emotional, and memory and cognition difficulties.

Table 15 summarizes the presence or absence of difficulties concerning word fluency/decoding and reading comprehension:

**Table 15** - Analysis grid of Category Learners' Dyslexic Difficulties – Reading Difficulties

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| **Reading difficulties** | 1. difficulties in reading decoding | *presence* | *é... muito frequente (T2)* | 1 |
| | | *absence* | *a questão da nossa aluna... ela tem uma ótima leitura...ela faz uma leitura muito boa (T1)* | 2 |
| | 2. difficult in spelling | *presence* | *frequente (T2)* | 1 |
| | | *absence* | *é pouco... é não frequente (T1)* | 1 |
| | 3. reverse letters or the order of letters in reading | -- | ---- | - |
| | | *absence* | *pouco ou não frequente (T2)* | 1 |
| | 4. difficulties with sequence of letters | -- | ---- | - |
| | | *absence* | *não frequente (T1)*<br>*não e frequente (T2)* | 2<br>1 |
| | 5. confusion of similar letters or words letters omission | *presence* | *fonemas c e s, s e z, f e v, p e b, t e p (T2)* | 2 |
| | | *absence* | *não frequente (T1)* | 2 |
| | 6. lips movement on silent reading | *presence* | *muito frequente (T1)*<br>*muito frequente (T2)* | 1<br>1 |
| | | *absence* | ---- | - |
| | 7. difficulty in reading comprehension | *presence* | *ela não entende... não consegue compreender (T1)*<br>*isso é frequente (T2)* | 3<br>1 |
| | | *absence* | ---- | - |
| | 8. slow and segmented reading | *presence* | *bem frequente (T2)* | 1 |
| | | *absence* | *a leitura é rápida (T1)* | 3 |
| | | | ***total*** | 23 |

The indicator *difficulty in reading comprehension* is emphasized as a meaningful difficulty of the student. According to the data, this difficulty originates in "fast reading":

> *a questão da interpretação dela é que ela realiza a leitura muito rápida (T1)*
> *ela quer ler tudo muito rápido então ela não compreende o que ela leu (T1)*

This difficulty, in the opinion of Teacher 01, also contributes to a possible dyscalculia:

> *não pelo fato dela não ter aprendido a matemática, mas é muito mais pela insegurança... pela não compreensão a incompreensão do que pede cada comando de questão que eu indico mais que seja discalculia (T1)*

Thus, in Case 01, the oral reading is not slow and laborious; however, although the student is able to read fast, she is not able to focus on content and comprehend the text. There are two indicators of difficulties in writing, as shown in Table 16:

**Table 16** -Analysis grid of Category Learners' Dyslexic Difficulties – Writing Difficulties

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| **Writing difficulties** | 1. difficulties in dictation | *presence* | *de cópia é frequente (T1)*<br>*é frequente (T2)* | 1<br>1 |
| | | *absence* | ----- | - |
| | 2. mirror-writing | *presence* | *é sim frequente (T2)* | 1 |
| | | *absence* | *não apresenta isso (T1)* | 1 |
| | | | ***total*** | 4 |

These findings highlight how dyslexia also impacts students' writing skills, according to the teachers' perception. Dictation appeared as a common theme for both students, possibly pinpointing constraints on morphological awareness.

Data also expressed perception of difficulties in memory and cognition, as summarized in Table 17:

**Table 17 -** Analysis grid of Category Learners' Dyslexic Difficulties – Memory and Cognition

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| Difficulties in memory and cognition | Difficulties in distinguish left from right | *presence* | *ela tem dificuldades (T1)* | 2 |
| | | *absence* | *não frequente (T2)* | 1 |
| | Difficulties on memorization | *presence* | *a questão dela é mais a memorização... ela lembrar o que ela leu, neh? ela lembrar o que ela viu em sala de aula (T1)*<br>*é frequente (T2)* | 3<br>2 |
| | | *absence* | ---- | - |
| | | | ***total*** | 8 |

The results in Table 17 indicate that left-right confusion is not a problem to both students; therefore, it is a difficulty that may appear or not with dyslexia. Difficulties with memorizing content are frequently reported in reading, which may be deemed worrying given its connection with the storage and use of information when reading.

The data do signal a very small number of utterances indicating emotional difficulties; however, in this work, these findings are considered relevant to demonstrate the teachers' perceptions on the learners' feelings. The content is related to *lack of motivation and problems* with *self-confidence*, as seen in Table 18:

**Table 18** -Analysis grid of Category Learners' Dyslexic Difficulties – Emotional Difficulties

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| Emotional Difficulties | Low self-confidence | *Presence* | *ela se julgava incapaz de realizar uma avaliação em sala de aula... né... chegando a chorar... chorar muito em sala de aula (T1)* | 2 |
| | | *Presence* | *é muito frequente (T2)* | 1 |
| | Lack of motivation | *Absence* | ----- | - |
| | | *Presence* | *Muito frequente (desanimado e desmotivado) (T2)* | 1 |
| | | | ***total*** | 4 |

According to the results, the emotional consequences of dyslexia difficulties can be a constant in the students' lives, so this specific difficulty can lead to feelings of low self-confidence and demotivation. These findings may be considered important since they can be related to the failures in reading and participating in literacy activities.

The data analysis partially attested the suppositions (Sp.1, Sp.2 and Sp.3) arisen after the first reading of the interviews' content.

Sp1: The findings show that student in Case 02 presents more word fluency/decoding difficulties than student in Case 01. It was observed that they have some reading experience with other similar difficulties, such as comprehension/interpretation and confusion of letters. Common writing difficulties were also reported, with similar difficulties with laterality and memorization as well;

Sp2: Regarding the pedagogical assistance provided to learners with dyslexic difficulties, it was evinced a scarcity of specific pedagogical support in specialized education and, consequently, a lack of specific teaching strategies;

Sp3: The students also presented other difficulties such as demotivation and low self-confidence. In Case 01, T1 and LG1 are in accordance regarding emotional difficulties such as low self-confidence and demotivation. Nonetheless, in Case 02, LG2 and T2 reported different perceptions about those emotional difficulties. While P2, the teacher, assures that student 2 has low self-confidence and is demotivated, LG2, the legal guardian, claimed that the student shows motivation and self-confidence when performing oral reading.

During the field research, reading and writing activities were developed in order to evince students' difficulties, as described in Appendix XII (389-403; 412-426). In the beginning of participant observation, the pedagogical activities were improvised by teachers throughout the meetings, with the purpose of demonstrating the students' difficulties in reading; however, specific and directed activities with learning goals were also organized and implemented, as presented in Table 19.

**Table19** - Specific and Directed Activities Developed During Participant Observation

| Activity | Learning Goal |
|---|---|
| Word dominoes | To verify reading fluency, inversion of words/syllables and spelling |
| Designation of images | To evaluate the recognition of phonetically similar letters |
| Text reading | To assess word fluency, comprehension, omission of letter/syllables and inversion, reduction and addition of letters. |
| Silent reading | To observe if there are lips movement during silent reading |
| Lateralization | To verify if there are difficulties in spatial coordination |
| Sequence difficulties | To check if the students have difficulties in sequencing |
| Writing | To evaluate the presence of writing-mirror, difficulties in dictation, inversion of syllables/letters. |
| Spelling | To verify difficulties on spelling |
| Reading of long words | To check if there are "stumbles" through long words |
| Game of similar words | To check for errors in reading and identifying semantically similar words |

During the participant observation, the implementation of the activities was described as field notes in our research diary; hence, in conjunction with the interviews, presence or absence of dyslexic difficulties were bespoken from the analysis of the field notes. The research diary is presented in Appendix XII.

The analysis of data provided indicators subject to an operation of coding (Bardin, 2009). Tables 20-22 show the analysis grid of the field notes and the frequency of occurrences associated with the different categories and subcategories:

a. Category of Evidence of Reading Difficulties

This category evinced presence and absence of common dyslexic difficulties in reading decoding, and also in reading comprehension, for both cases according to the data, as seen in Table 20. The results pinpoint a significant number of frequencies of decoding/reading fluency difficulties for student 02 (S2), while a number of 16 records point to a lack of some reading decoding difficulties for student 01 (S1). The data also show a higher number of reading comprehension difficulties for learner 01, whereas student 02 did have a small number of difficulties concerning this reading skill.

**Table 20** - Analysis grid of Field Notes – Reading Difficulties

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| **Decoding/reading fluency difficulties** | 1. confusion of similar letters or words | Absence | *ausência de confusão de letras similares (S1)* | 1 |
| | | Presence | *fez com dificuldade, confundindo alguns grupos como [q] e [g], 'eca' com 'cea'... (S2)* | 1 |
| | 2. reverse of letters in reading | Absence | *não houve inversão de sílabas (S1)* | 2 |
| | | Absence | *não fez inversão de sílabas (atividade dominó de palavras) (S2)* | 1 |
| | 3. spelling | Absence | *ausência de dificuldade em soletração (S1)* | 3 |
| | | Presence | *teve dificuldade em pronunciar os sons de várias palavras (S2)* | 6 |
| | 4. omission of letters/words | Presence | *da leitura de 16 palavras houve supressão de [u] em 'roupa' e de [r] em 'rabada' (S1)* | 5 |
| | | Presence | *omissão de letra e sílaba como em "baralhado", "funciado", "pesiana", "sumercado" (S2)* | 4 |
| | 5. letter exchange | Presence | *nas 25 palavras houve apenas troca de /f/ por /v/ na palavra 'faca" (S1)* | 2 |
| | | Presence | *fazendo trocas de morfema [o] para [u] e [c] para [t] (S2)* | 5 |
| | 6. slow and segmented reading | Absence | *a discente consegue ler rápido, não demonstrando muitas dificuldades de decodificação (S1)* | 8 |
| | | Presence | *fez a leitura lenta com várias dificuldades, como silabação em muitas partes (S2)* | 11 |
| | 7. lips movement on silent reading | Absence | *a aluna fez leitura rápida sem qualquer movimento labial(S1)* | 1 |
| | | Presence | *o discente fez a leitura fazendo movimento labial (S2)* | 1 |
| | 8. "stumbles" through long words | Absence | *leu e pronunciou as palavras sem tropeços (S1)* | 1 |
| | | Presence | *teve dificuldades em pronunciar palavras mais longas do texto (S2)* | 5 |
| | | | **total** | 57 |
| **Reading comprehension/ interpretation** | 1.general comprehension | Presence | *apresentou dificuldades para compreender todas as partes do que havia lido (S1)* | 10 |
| | | Absence | *demonstrou boa compreensão (S2)* | 5 |
| | 2. meaning of words semantically similar | Presence | *houve dificuldade de compreensão de apenas uma palavra dos 12 pares de palavras semanticamente semelhantes lido (S1)* | 3 |
| | | Presence | *o aluno demonstrou não relacionar nomes a imagens em palavras como 'lápis', 'perfume', 'torta' e 'arara' (S2)* | 6 |
| | 3. meaning of words | Presence | *a discente reforça que conhece a palavra, mas não o sentido (S1)* | 3 |
| | | Presence | *não reconheceu o sentido de um número pequeno de palavras, como 'eclosão' e 'tamar' (S2)* | 2 |
| | 4. semantic function of punctuation | Presence | *falta de compreensão da função semântica dos diversos sinais de pontuação (S1)* | 4 |
| | | --- | ------- | - |
| | | | **total** | 33 |

b. Category of Evidence of Writing Difficulties

Table 21 summarizes the small number of occurrences indicating presence and absence of the different types of writing difficulties found in the field notes. The findings point to writing errors for learner 02, while student 01 did not show any mistakes.

**Table 21 -** Analysis grid of Field Notes – Writing Difficulties

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | FR. |
|---|---|---|---|---|
| **Writing errors in word copying** | 1. mirror-writing | Absence | *sem dificuldade em escrever o ditado (S1)* | 1 |
| | | Presence | *tem dificuldade em copiar o que ouve (S2)* | 1 |
| | 2. spelling errors | Absence | *nem escrita em espelho (S1)* | 1 |
| | | Absence | não escrita em espelho (S2) | 1 |
| | 3.inversion of syllables/letters | Absence | *ausência de inversão de sílabas ou letras (S1)* | 2 |
| | | -- | ----- | - |
| | 4. reduction or addition of letters in writing | -- | ----- | - |
| | | Presence | *acréscimo de letras. Como em 'le[i]tras'(S2)* | 2 |
| | 5.omission of letters/syllables | -- | ----- | - |
| | | Presence | *omissão de letra/sílaba como em 'baralhado', funcionado', 'pesiana' 'sumercado' (S2)* | 5 |
| | | | **total** | 13 |

c. Category of Evidence of Difficulties in Memory and Cognition

The data also evinced the presence and absence of difficulties in memory and cognition in both cases, as summarized in Table 22. The findings show that learner 01 presents the greatest number of occurrences related to attention and memory disfunction and problems with directions provided on paper.

**Table 22 -** Analysis grid of Field Notes – Difficulties in Memory and Cognition

| SUBCATEGORIES | INDICATORS | P/A | CONTEXT UNIT | Fr. |
|---|---|---|---|---|
| **Inattention** | 1. lack of concentration | Presence | *a docente chamou a atenção da aluna sobre as dificuldades de concentrar durante a leitura (S1)* | 3 |
| | | -- | -------- | - |
| **Left-right confusion** | 2. difficulties in distinguish left from right | Presence | *confundiu esquerda com direita nas letras a e c do exercício (S1)* | 3 |
| | | Presence | *revelou dificuldades do aluno nesse sentido (S2)* | 2 |
| **Memory for sequences** | 3. difficulties with comprehension of sequences | Presence | *fez a identificação dos dias da semana, mas não sequencialmente (S1)* | 2 |
| | | Absence | *observou a sequência adequadamente (S2)* | 2 |
| | | | **total** | 12 |

Data analysis confirmed the suppositions posed after the first reading of the field notes, as stated below:

*Reading Difficulties*

Our first supposition regarding reading difficulties posed that the student in Case 02 presents more word fluency/decoding difficulties than student in Case 01, while the latter presents more difficulties in comprehension/interpretation. It was evinced from data from Case 01 a greater number of utterances revealing problems with comprehension; in Case 02, the most prominent verbalizations are categorized as slow and segmented words, as seen in Table 20, a specific difficulty with reading decoding. Problems with *omission of letters/words* and *letter exchanges*, such as difficulties in word fluency, showed up only one time in single words in two different activities performed by the student in Case 01. Thus, these manifestations seem not significant enough to be included in the student's repertoire.

*Writing Difficulties*

The supposition related to writing difficulties was associated with the identification of errors in word copying in Case 02 because of the learners' word/decoding difficulties. Thus, problems with copying because of spelling errors, reduction or addition of letters in writing, and omission of letters/syllables were identified in the data.

*Memory and Cognition*

The first reading supposition led to the observation of difficulties with memorization and other cognitive aspects. Thus, in the process of analysis, the indication of presence of other difficulties, specifically *inattention*, in Case 01, was seen as a problem that generates inability to comprehend a text.

The data from the interviews and field notes provided two types of difficulties: *reported* and *evidenced difficulties.* Both were assumed as relevant to map the students' dyslexic difficulties and understand their constraints and real experience with reading. The findings revealed that learners have some specific difficulties in reading and writing, but they are able to read accurately.

After mapping the dyslexic difficulties, activities were developed with the purpose of learning more about the students' perspectives. These kinds of tasks were named **awareness-raising activities**. All of the data (Appendix XIII) provided by these activities were analyzed. This process of analysis generated important categories for our understanding of the students' perspectives, as presented in the tables below:

- Category: Perception About Practice and Habits of Reading

This category classifies the indicators expressing a positive impression about learners' reading ability and interest on reading. Although the students enjoyed the practice of reading and the contact with written texts, the data revealed that they also have low self-confidence regarding reading aloud, as shown in Table 23.

**Table 23** - Analysis grid of Category Perception About Practice and Habits of Reading

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Perceptions about the own reading practice** | reading ability | *eu acho que leio bem quando não preciso ler em voz alta (S1)* | 1 |
| | | *leio ótimo. Não sabia ler eu trocava as letras e hoje não troco tanto ela (S2)* | 1 |
| **Perception about fears and interests in reading** | appreciation of reading | *eu gosto porque eu acho muito legal quando o texto não tem imagem eu fico imaginando como seria a imagem (S1)* | 3 |
| | | *gosto porque podemos aprender mais coisa da vida e também a aprender o que já aconteceu na história humana (S2)* | 3 |
| | interest in reading spaces | *eu gosto de bibliotecas da escola e um lugar calmo onde tem um monte de livros legais pra ler (S1)* | 1 |
| | | *eu gosto e não frequento (S2)* | 1 |
| | fear of reading aloud | *eu fico com vergonha porque eu não sei como vai sair a minha leitura (S1)* | 2 |
| | | *vergolha, tenho medo de erra eu tive lendo (S2)* | 2 |
| | | **total** | 14 |

- Category: Difficulties due to Dyslexia

The verbalizations classified into this category enable the understanding of how learners perceive their difficulties in reading decoding and comprehension, distinguishing between past constraints and also improvements throughout schooling. When asked about the strategies used to deal with dyslexia, a list of sentences was given to the students, e.g. asking for peers' help or to read slowly, based on the study conducted by Riddick (1996). Thus, they should choose the strategies they used and talk about them. Learners mentioned their use of strategies like "avoiding to engage in activities", such as reading aloud, writing long words and doing exercises during classes because of time limits, and the strategy of "asking for help" from teachers and classmates made those students feel comfortable demonstrating their needs due to dyslexia in class, as summarized in Table 24.

**Table 24 -** Analysis Grid of Category Difficulties due to Dyslexia

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Past difficulties** | 1. 'scramble' of letters | *eu embaralhava as Le::TRAS... (S1)* | 1 |
| | | --------- | - |
| | 2. confusion of capital and lowercase letters | *às vezes eu misturava maiúsculo com minúsculo (S1)* | 1 |
| | | --------- | - |
| | 3. confusion of letters | *eu confundia as letras...é::... (S1)* | 1 |
| | | *r com p... (S2)* | 3 |
| | 4. later literacy | *e também eu di/demorei a aprender a ler (S1)* | 1 |
| | | ------- | - |
| | 5. omission of letters | ------- | - |
| | | *eu engolia as letras... (C2)* | 1 |
| | 6. dictation | ------- | - |
| | | *ANTES eu/eu tinha...tinha dificuldade em em ditado (S2)* | 1 |
| | 7. punctuation | ------- | - |
| | | *eu não sabia o que era pontuação...ção (S2)* | 1 |
| | 8. spelling | ------- | - |
| | | *antes não sabia como soletrar (S2)* | 1 |
| | 9. reading comprehension | ------- | - |
| | | *eu...eu não::....não entendia...entendia mais (S2)* | 1 |
| | 10. general difficulties in reading/writing | ------- | - |
| | | *que...que tinha dificuldade ...escrita...eu ti/eu tinha dificuldade em leitura... leitura... é::... e também de escrita (S2)* | 1 |
| | | ***total*** | 13 |
| | 1. inattention | *só quando tem silêncio eu consigo ter concentração e foco (S1)* | 1 |
| | | *barulhos de colegas eu não consigo ler (S2)* | 4 |
| | 2. punctuation | *eu não consigo colocar vírgula ou ponto parágrafo (S1)* | 1 |
| | | *até hoje eu não consigo entender" [pontuação] (S2)* | 1 |

| | | | |
|---|---|---|---|
| **Current difficulties** | 3. reading comprehension | *de entender algumas palavras difíceis do texto (S1)* | 1 |
| | | *não consigo, algumas palavras são difíceis (S2)* | 2 |
| | 4. math | *e matemática também eu tenho dificuldade (S1)* | 1 |
| | | ------- | - |
| | 5. omission of letters/syllables | *esqueço sílabas (S1)* | 1 |
| | | *acrescentar letras (S2)* | 1 |
| | 6. dictation | ------- | - |
| | | *mas hoje em dia eu consegui melhorar no ditado (S2)* | 1 |
| | 7. spelling | ------- | - |
| | | *soletrar (S2)* | 1 |
| | 8. confusion of letters | ------- | - |
| | | *hoje....hoje consigo entender ...mas...mas leva tempo (S2)* | 1 |
| | 9. scramble of letters | *depende do tamanho da palavra (S2)* | 1 |
| | | *a dislexia é uma dificuldade de ler e entender (S1)* | 1 |
| | 10. comprehension of dyslexia as a literacy impairment | *a dislexia é uma dificuldade de ler e entender (S1)* | 1 |
| | | *dislexia que a informação mas demora a reter o processamento auditivo de leitura e escrita (S2)* | 1 |
| | | ***total*** | 17 |
| **Strategies to copy with dyslexia** | 1. asking for peers' help | *eu peço ajuda dos colegas (S1)* | 1 |
| | | *eu peço ajuda pros colegas (S2)* | 1 |
| | 2. avoiding to read aloud | *eu evito ler em voz alta (S1)* | 1 |
| | | *evito ler em voz alta (S2)* | 2 |
| | 3. asking for teachers' help | *às vezes eu peço ajuda do meu professor (S1)* | 2 |
| | | *eu peço ajuda mais...os/os...professores (S2)* | 1 |
| | 4. asking help for specialized teacher | *e da/... e aqui na sala de recursos (S1)* | 1 |
| | | *peço ajuda da professora na sala de recursos (S2) soletro as palavras* | 2 |
| | 5. reading slowly | *aí repito tu::do de novo com mais calma que às vezes eu leio com pressa para terminar mais rápido...e::...quando eu leio devagar eu entendo (S1)* | 1 |
| | | ------- | - |
| | 6. avoiding to write long words | ------- | - |
| | | *eu:: eu evito:: escrever as palavras muito longas... (S2)* | 1 |
| | 7. spelling of words | ------- | - |
| | | *soletro as palavras(S2)* | 1 |
| | 8. asking for doing homework | ------- | - |
| | | *peço pra fazer exercícios em casa (S2)* | 1 |
| | | ***total*** | 15 |

- Category: Educational Support Experiences

Bearing in mind the schooling experiences, students were also asked about their impressions of the educational support they have been receiving throughout their school life. The results express a special meaning, by informing about the support of teachers and peers as important school figures, and the aspects associated with teaching, such as tasks, strategies and tools, as presented in Table 25. Additionally, perceptions of own actions/behaviors at school and the contributions of parents are

signaled. The findings do not reveal any type of specific teaching strategy or learning activities considering the learners' necessities:

**Table 25** - Analysis grid of Category Impressions about Educational Support

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Teaching support** | 1. absence of interest on student's condition | *só o de artes e o de português sabe (S1)* | 4 |
| | | -------- | - |
| | 2. individual attention | *quando eu vou lá mesa… eles me explicam melhor e eu entendo melhor (S1)* | 5 |
| | | *explicam de novo pra mim...tem paciência (S2)* | 3 |
| | 3. verbal orientation | *eles falam que eu prestar mais atenção (S1)* | 2 |
| | | *não falam::... perto/perto de mim isso aí...isso (S2)* | 4 |
| | 4. forwarding to SRM | -------- | - |
| | | *encaminham pra sala de recursos (S2)* | 3 |
| | | ***total*** | 21 |
| **SRM support** | 1. specialized teacher support | -------- | - |
| | | *[pede ajuda] professora... eu::... eu não/eu não .... tô conseguindo ...entender (S2)* | 1 |
| | 2. welcoming place | *aqui tem todas as atividades (S1)* | 2 |
| | | *dá pra gen:::te ...a gente ficar no...no nosso cantinho...pra gente ..gente... ler...estudar (S2)* | 5 |
| | | ***total*** | 8 |
| **Learning activities** | 1. efficient tasks | *exercícios... (S1)* | 4 |
| | | *passa um exercício do livro (S2)* | 3 |
| | 2. non efficient tasks | *a prova... é a prova é difícil (S1)* | 4 |
| | | *Prova (S2)* | 3 |
| | 3. feared activity | *apresentações em sala de aula...eu não gosto de falar em voz alta ...fico nervos/...nervosa (S1)* | 1 |
| | | *ler em voz alta (S2)* | 1 |
| | | ***total*** | 16 |
| **Perspectives about teachers** | 1. good teacher | *ele trata a gente bem...com paciência (S1)* | 5 |
| | | *conversava...paciente...engraçado (S2)* | 2 |
| | 2. bad teacher | *ele é estressado...ele não tem paciência com a gente não (S1)* | 3 |
| | | *ele... não... não ajudava (S2)* | 2 |
| | 3. teacher harassment | *a mesma professora...ela falou que meu trabalho tava feio e que eu era burra (S1)* | 7 |
| | | -------- | - |
| | | ***total*** | 19 |
| **Technological resources** | 1. tools and medias | *vídeo a gente assistia mais na sala de informática... e na biblioteca também (S1)* | 3 |
| | | *usava computador (S2)* | 3 |
| | | ***total*** | 6 |
| **Teaching strategies** | 1. use of blackboard | *ah ele escreve no quadro a gente copia e ele explica (S1)* | 1 |
| | | *escreve ...escreve no quadro (S2)* | 1 |
| | 2. tests | *passou uma prova pra gente que não tinha nada a ver com o filme mas tinha a ver com os assuntos que eu tin/que a gente tinha estudado (S1)* | 1 |
| | | -------- | - |

| | | | |
|---|---|---|---|
| | 3. text study | *ah ele manda a gente ler um texto (S1)* | 2 |
| | | -------- | - |
| | 4. computer classes | *informática a gente não vai (S1)* | 3 |
| | | *a informática ela não tá pegando (S2)* | 2 |
| | | ***total*** | 10 |
| **Peers' support** | 1. lack of knowledge of students' condition | *nem todos...alguns (S1)* | 2 |
| | | -------- | - |
| | 2. supportive classmates | *às vezes eu peço às vezes a minha colega pergunta se eu não entendi" (S1)* | 3 |
| | | *eu gosto de interagir com a com a com a ... com as crianças menores da minha idade (S2)* | 1 |
| | 3. animosity | -------- | - |
| | | *zombam pra ....((longa pausa)) ele::s nunca conversaram comigo sobre .... sobre a minha dificuldade .... mas zombam (S2)* | 5 |
| | 4. negative labelling | -------- | - |
| | | *lento (S2)*<br>*tartaruga (S2)* | 4 |
| | 5. verbal support | *nem todos os meus colegas sabem que tenho dislexia (S1)* | 5 |
| | | *nunca fui ..... chegado pra conversar sobre isso com eles (S2)* | 1 |
| | | ***total*** | 12 |
| **Perception of parents** | 1. supportive | *meus pais...minha mãe e meu pai...eles me ajudam ...é eles me ajudam muito (S1)* | 7 |
| | | *ajudam (S2)* | 2 |
| | 2. guiders | *que eu tenho que me esforçar mais (S1)* | 4 |
| | | *falam pra mim melhorar (S2)* | 1 |
| | | ***total*** | 14 |
| **Learning behavior** | 1. participation in activities at SRM | *esqueço... às vezes eu fico com preguiça aí eu faço ... do outro dia e do dia que eu não fiz (S1)* | 1 |
| | | *no atendimento eu::... eu faço as atividades... atividades como leitura ....escrita ...ou ou de matemática (S2)* | 2 |
| | 2. fulfillment of homework | *quando eles [os pais] me cobram eu faço (S1)* | 1 |
| | | *dever de casa (S2)* | 1 |
| | 3. behavior in the regular classes | *eu quando eu sento na cadeira de trás é mais difícil prestar atenção (S1)* | 1 |
| | | *eu ouço...eu fico:: em silêncio (S2)* | 3 |
| | | ***total*** | 9 |

- Category: Learners' Feelings and Thoughts

This category contributes to a discussion about the learners-participants' characteristics by showing indicators of both students' emotions and thoughts concerning the Multifunctional Resource Rooms, teacher-student and peers-student relationship, their own dyslexic difficulties, and schooling activities. In the analysis, all the expressions of sentiments or considerations given in the answers by the learners were considered. Table 26 shows examples of the presence of each subcategory's utterances:

**Table 26 -** Analysis grid of Category Students Feelings and Beliefs

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Feelings of inclusion of learners with dyslexia in specialized assistance** | 1. SRM as an educational space | *eu gosto muito da sala de recurso eu queria que tivesse atendimento...(S1)* | 5 |
| | | *é bom... dá pra mim conversar fazer as provas tranquilo pra não fazer nada de errado (S2)* | 3 |
| | 2. teacher support | *bem, me deixa mais calma(S1)* | 1 |
| | | *animado porque ela me ajuda pra mim aprender para não fazer besteira pra não fazer nada de errado (S2)* | 1 |
| | 3. absence of regulation of pedagogic assistance of students with dyslexia | *eu fico um pouco triste porque não e sou eu que tenho deslexia (S1)* | 1 |
| | | *triste porque poderia atender outras crianças com dislexia (S2)* | 1 |
| | | ***total*** | 12 |
| **Feelings about relationship at school** | 1. teachers | *só sinto dificuldade...aí eu vou lá com eles...eles me explicam aí eu não consigo entender (S1)* | 5 |
| | | *eu eu gosto daqui..eu me sinto calmo...tranquilo (S2)* | 1 |
| | 2. classmates | *eu fico legal... como amigos (S1)* | 3 |
| | | *mais alguns eu gosto...alguns eles...eles são comportados dá/dá pra mim trabalhar .... mas outros.... não não tenho paciência vou tentar conversar com eles (S2)* | 6 |
| | | ***total*** | 15 |
| **Feelings about schooling activities** | 1. most appreciated classes | *a de geografia ciências história de educação física.... todas são legais (S1)* | 1 |
| | | *as aulas que eu mais gosto são ciências, história...português.... geografia...matemática mais ou menos. filosofia (S2)* | 5 |
| | 2. less appreciated classes | *matemática e português não é legal (S1)* | 2 |
| | | *matemática (S2)* | 3 |
| | 3. tests and exercises | *eu fico nervosa (S1)* | 2 |
| | | *isso que é coisa estressante (S2)* | 11 |
| | | ***total*** | 24 |
| **Feelings about dyslexic difficulties** | 1. anxiety | *e às vezes eu fico ansiosa pra entender melhor (S1)* | 1 |
| | | ------- | - |
| | 2. discontent | *eu acho ruim...as dificuldades (S1)* | 1 |
| | | ------- | - |
| | 3. stress | ------- | - |
| | | *"estresse" (S2)* | 1 |
| | | ***total*** | 3 |

- Category: Expectations about School Support

The students were asked about their expectations at school. Table 27 summarizes the expressions of their expectations based on their needs. The results show that most of the indicators pinpoint aspects expressing expectations related to *regular class assistance.* Additionally, there are frequencies of utterances in the subcategory *relationship at school* that reveal a very important point concerning the need of peers' and teachers' attention.

**Table 27** - Analysis grid of Category Expectations of Schooling Inclusion

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **SRM assistance** | 1. inclusion of assistance | *eu acho que ia ser legal ter uma hora de atendimento (S1)* | 1 |
| | 2. inclusion of resources | *computador pra atividade de informática (S2)* | 1 |
| | | ***total*** | 2 |
| **Regular classes assistance** | 1. computer class | *eu queria que a minha turma tivesse aulas de informática (S1)* | 2 |
| | | *atividade de informática (S2)* | 1 |
| | 2. longer classes | *eu queria que tivesse mais tempo nas aulas (S1)* | 1 |
| | | -------- | - |
| | 3. inclusion of technological tools | ------- | - |
| | | *computador pra qualquer atividade... televisão, videogame (S2)* | 2 |
| | 4. extension of tasks to home | ------- | - |
| | | *que todos os professores passassem a atividade pra casa (S2)* | 1 |
| | | ***total*** | 7 |
| **Relationship at school** | 1. relationship with teachers | *eu queria mais atenção dos professores na sala de aula (S1)* | 1 |
| | | *ter aula de reforço que eu teria mais atenção (S2)* | 2 |
| | 2. relationship with peers | *eu queria ter mais atenção do meus colegas pra entender melhor as atividades (S1)* | 1 |
| | | *me olhasse e visse como uma pessoa normal (S2)* | 1 |
| | | ***total*** | 5 |

In order to try to evaluate the students' motivation degree to participate in the schooling learning activities, the results of application of a motivation scale-based questionnaire are presented in Tables 28 and 29 (see Appendix XIII, p.498-501 e 518-521):

**Table 28** - Results of a Motivation Scale-based questionnaire - Case 01

| **DIMENSIONS** | Score | | | | |
|---|---|---|---|---|---|
| **MOTIVATION TO COMPLY WITH ACTIVITIES** | 1 | 2 | 3 | 4 | 5 |
| Interest on comply with activities | | | | ■ | |
| Interest on activities' content and form | | | | ■ | |
| Connections between teaching strategies and student learning style | | | ■ | | |
| Connections between curriculum content and students' knowledge | | | ■ | | |
| Curriculum content relevance to the students | | | | ■ | |
| | | | | | **3,6** |
| **ENGAGEMENT TO LEARNING** | | | | | |
| Dedication to the activities | | | | ■ | |
| Desire to practice what was learned at school | | | | ■ | |
| Excitement to learn new skills | | | | | ■ |
| Self-confidence on own learning | | | | ■ | |
| | | | | | **4,2** |
| **MOTIVATION FOR ACHIEVEMENTS** | | | | | |
| Contributions of personal commitment to reading/writing learning | | | | ■ | |
| Interest on rewards, as compliments, punctuation and approval | | | | | ■ |
| Personal interest for developing knowledge through reading | | | ■ | | |
| Sense of challenge promoted by schooling activities | | | | ■ | |
| Personal encouragement to reading/writing practice | | | | ■ | |
| | | | | | **4** |

**Table 29** - Results of a Motivation Scale-based Questionnaire - Case 02

| DIMENSIONS | Score | | | | |
|---|---|---|---|---|---|
| **MOTIVATION TO COMPLY WITH ACTIVITIES** | 1 | 2 | 3 | 4 | 5 |
| Interest on comply with activities | | | | | |
| Interest on activities' content and form | | | | | |
| Connections between teaching strategies and student learning style | | | | | |
| Connections between curriculum content and students' knowledge | | | | | |
| Curriculum content relevance to the student | | | | | |
| | | | | | **4,8** |
| **ENGAGEMENT TO LEARN** | | | | | |
| Dedication to the activities | | | | | |
| Desire to practice what was learned at school | | | | | |
| Excitement to learn new skills | | | | | |
| Self-confidence on own learning | | | | | |
| | | | | | **4,5** |
| **MOTIVATION FOR ACHIEVEMENTS** | | | | | |
| Contributions of personal commitment to reading/writing learning | | | | | |
| Interest on rewards, as compliments, punctuation and approval | | | | | |
| Personal interest for developing knowledge through reading | | | | | |
| Sense of challenge promoted by schooling activities | | | | | |
| Personal encouragement to reading/writing practice | | | | | |
| | | | | | **3,6** |

The numbers in these tables are presented only with the average calculations for each student, without any statistical treatment. As shown in Tables 28 and 29, in general the scores did not differ significantly between the two student-participants. A closer look at the agreement between the two shows that learner 01 expressed the type "nor motivated, nor demotivated" in three items of *motivation to comply with activities* and in one of *motivation for achievements.* As for student 02, he had low scores in two items of *motivation for achievements.* The rest of the scores vary between 4 and 5, corresponding to the types "motivated and very motivated".

The process of analysis provided a redefinition of the initial challenge of this investigation. Therefore, by understanding that gamification has to do with processes and not results only, we decided to focus on strategies that could contribute to: (i) the students' engagement in a gamified process aimed at expanding their awareness about their own reading difficulties; and (ii) to the learners' motivation to deal with their reading difficulties through the application of game design and game mechanics to a storytelling.

In these terms, the challenge was redefined as:

| |
|---|
| Using Design Thinking as methodological inspiration to develop organized activities that result in a final engaging gamified narrative. |

4.1.2.2. Comprehending the Study Context

In the process of immersion and exploration, it was considered relevant to know the context of Special Education in Brazil, in order to understand the reasons of non-inclusion of learners with dyslexia in Multifunctional Resource Room attendance. Open-ended interviews with teachers were conducted and a documentary analysis was also developed with the purpose of obtaining information on the Brazilian regulations and SRM functioning.

The results of the examination of the teachers' interviews are presented hereinafter, according to categories arisen during the process of analysis. Transcriptions are on Appendix XIV.

- Category of Specialized Service in the Multifunctional Service Room

As summarized in Table 30, this category reveals central information about the functioning of the SRM, highlighting the target public of the attendance and also emphasizing that students with dyslexia, despite their need for support in special education, are not part of the SRM demand. This emphasizes a lack of regulation of inclusion of SLD learners in special assistance at school. Additionally, this category embraces verbalization to characterize the teachers' practices. Interestingly, the two volunteer teachers of this research assumed different practices to support students with dyslexia. Therefore, notwithstanding the attendance rules of the SRM, they also dedicate time to relieve these pupils' learning difficulties.

**Table 30** -Analysis grid of Category Specialized Service in the Multifunctional Service Room

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Training for pedagogical intervention in cases of dyslexia** | 1. exclusion of students with dyslexia of special education | *sim como a legislação brasileira não incluía o aluno com dislexia no atendimento educacional especializado... (T1)* | 1 |
| | | *é uma demanda bem especifica que trata sobre as pessoas com deficiência as pessoas com transtorno de espectro autista e as pessoas com outras habilidades de superdotação ... (T2)* | 7 |
| | 2. exclusion of other disabilities of special education | ---------- | - |
| | | *recentemente a gente recebeu um aluno com laudo de síndrome de tourette....a demanda não inclui ele também (T2)* | 5 |
| | | ***total*** | 13 |
| | 1. duration | *geralmente a atividade ela dura entre meia hora ou trinta e cinco minutos (T1)* | 1 |
| | | *como a minha demanda e relativamente grande esse ano eu optei por fazer um atendimento de uma hora... por toda a semana e uma vez por semana (T2)* | 1 |
| | | *atendo uma vez por semana (T1)* | 1 |

| | | | |
|---|---|---|---|
| **Attendance of special education demand** | 2. frequency | *e toda semana eles vêm realizar uma atividade comigo (T2)* | 1 |
| | 3. operation | *eu vejo se há alguma necessidade da sala de aula ou (há) alguma atividade que ele não tenha realizado para a sala de aula (T1)* | 3 |
| | | -------- | - |
| | 4. support work to regular classes | -------- | - |
| | | *o que eu tenho percebido ao longo desse trabalho que eu tenho desenvolvido com eles... a gente não faz o reforço escolar mas eu percebo algumas dificuldades que precisam ser trabalhadas pra eles compreendam algumas coisas dos conteúdos que são feitos em sala regular (T2)* | 4 |
| | 5. students' participation | *a maioria dos alunos ja entra na sala pedindo pra ir pro computador (T1)* | 5 |
| | | ------- | - |
| | | ***Total*** | 16 |
| **Practice of advisory to students with dyslexia** | 1. consulting service | *se ele sente a necessidade de ter um apoio pedagógico... em qualquer disciplina desenvolvida na sala de aula... ele vem a sala de recursos... apresenta a necessidade dele e nós o auxiliamos naquele momento... de acordo com a necessidade dele (T1)* | 5 |
| | | ------ | - |
| | 2. functioning of advisory service | *aqui e realizada... as vezes a leitura da prova... porque geralmente eles têm um pouco de dificuldade com a leitura da prova (T1)* | 4 |
| | | ------ | - |
| | | ***Total*** | 9 |
| **Regular attendance of students with dyslexia** | 1. individual support | ------ | - |
| | | *eu disponibilizo mesmo que isso não conte como um aluno dentro do sistema... que é um sistema especifico do cadastro da aluno da SEMEC que e o Siga...(T2)* | 5 |
| | 2. justification of inclusion of students with dyslexia and other disabilities | ------- | - |
| | | *tem alguns conceitos que teoricamente me dão suporte pra eu poder justificar o atendimento com essa demanda (T2)* | 5 |
| | *3.* contributions of individual assistance | -------- | - |
| | | *algumas (pessoas) não vão ter necessidade.../ mas o aluno em questão ... no caso que tu estás acompanhando... a gente acompanha ele desde os seis anos de idade... e a gente percebe o quanto o atendimento ajudou ...não só na questão da aprendizagem ... mas na questão da autoestima a questão da autoconfiança e da autonomia pra realização de algumas atividades que ele não tinha... (T2)* | 4 |
| | | ***Total*** | 14 |
| | 1. assistant's profile | *são alunos de graduação geralmente de licenciatura que podem acompanhar um aluno com deficiência (T1)* | 2 |
| | | -------- | - |
| | 2. students with disabilities supported by teacher's assistant | *e geralmente são alunos autistas... que são alunos que têm um pouco mais de dificuldade de interagir... de permanecer em sala de aula... tem dificuldade na comunicação (T1)* | 2 |

| | | | |
|---|---|---|---|
| **Service of teacher's assistant** | | -------- | - |
| | 3. teacher's assistant function | *os monitores estão pra facilitar a comunicação desse aluno com a turma e com o professor da sala regular (T1)* | 4 |
| | | -------- | - |
| | 4. work frequency | *os monitores estão na escola todos os dias (T1)* | 2 |
| | | -------- | - |
| | 5. teacher's assistant contributions | *eles também contribuem muito com o nosso trabalho... porque eles já conhecem o aluno... conhecem muito mais o aluno... às vezes muito mais do que o professor da sala regular...(T1)* | 2 |
| | | -------- | - |
| | 6. teacher's assistant payment | *eles recebem uma bolsa para exercer a monitoria na escola (T1)* | 1 |
| | | ---------- | - |
| | 7. teacher guidance | *geralmente quando surge uma situação nova... eu reúno... apresento a eles a situação... pergunto o que eles acham que é a situação (T1)* | 6 |
| | | ------- | - |
| | 8. assistance instruction | *eles já tem uma bagagem muito grande acerca da educação especial porque eles perguntam tudo mesmo (T1)* | 2 |
| | | ------- | - |
| | | ***Total*** | 21 |

- Category Teachers' Actions and Planning in the Multifunctional Service Room

The findings in Table 31 express different actions in assistance planning such as the practice of conducting diagnostic evaluations, as cited by the teacher in Case 02. Furthermore, frequent teaching activities are described, including the ones developed with students with dyslexia according to the kind of support offered to them.

**Table 31 -** Analysis grid of Category Teachers' Actions and Planning in the Multifunctional Service Room

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| | 1. action of need analysis | _____ | - |
| | | *todo início de ano a gente faz avaliação pedagógica pra gente ver que conhecimentos no ano anterior esse aluno manteve e que conhecimento de alguma forma com o período de férias ele por algum motivo possa ter regredido ou se ele manteve essas situações que foram trabalhadas com ele no anterior (T2)* | 2 |
| | 2. objectives of need analysis | _____ | - |
| | | *verificar quais são as situações no sentido da matemática que ele tenha alguma dificuldade (T2)* | 3 |
| | | _____ | - |

| | | | |
|---|---|---|---|
| **Diagnostic evaluation** | 3. contributions of need analysis | *e algumas outras informações que às vezes demandam que a gente construa alguns recursos e que a gente utilize alguns recursos tecnológicos (T2)* | 3 |
| | 4. activities of need analysis | ——— | - |
| | | *eu já fiz avaliação de leitura... escrita e do desenvolvimento das atividades de matemática de observação de imagem ao que se refere aos outros conteúdos da sala de aula (T2)* | 1 |
| | | ***total*** | 9 |
| **Attendance planning** | 1. individual planning | *é o planejamento educacional individualizado de acordo com o perfil do aluno porque um aluno pode ter a deficiência visual mas ele pode conseguir ler e escrever (T1)* | 3 |
| | | *eu ainda estou fazendo atividade avaliativa pra perceber os aspectos pra eu poder construir um plano individualizado pra ele e pensar em que recursos eu vou poder utilizar com ele (T2)* | 2 |
| | | ***total*** | 5 |
| **Teaching activities** | 1. educational games | *nós trabalhamos com jogos pedagógicos, que envolvam o raciocínio lógico-matemát/... o raciocínio do aluno (T1)* | 4 |
| | | ------ | - |
| | 2. writing and reading activities | *então produção textual com a utilização de imagens (T1)* | 2 |
| | | *são diversas atividades ao que diz respeito à escrita à leitura à interpretação textual...(a) compreensão de textos... (T2)* | 1 |
| | 3. internet research | *pesquisam no computador com a utilização da internet (T1)* | 1 |
| | | *alguns fazem apenas pesquisa (T2)* | 2 |
| | 4. curriculum content | ------ | - |
| | | *no caso deles dos alunos que eu atendo na parte da manhã como eles são adolescentes eu procuro trazer alguma coisa do conteúdo ....não necessariamente da sala de aula... mas do ano (T2)* | 1 |
| | 5. handling of computers | *geralmente usamos muito mais o computador com o aluno com dislexia (T1)* | 6 |
| | | ------ | - |
| | 6. tailored activities to students with dyslexia | *vão começar o processo de uso do computador (T2)* | 4 |
| | | *aluno com dislexia.. nós utilizamos mais a pesquisa porque eles surgem com muitas duvidas pra gente... "o que e isso? o que é aquilo? (T1)* | 3 |
| | | ***total*** | 24 |

- Category Integration of Tools and Resources into the Service of Attendance in the Multifunctional Resource Room

Table 32 presents the results of the analysis of verbal content associated with the perceptions and experiences of teachers with the integration of pedagogical resources – analog or digital ones - into the service of attendance at the SRM, including the type of resources used to give support

to learners with dyslexia. The surprising findings reveal an absence of adequate materials for adolescent students and, consequently, a need for the development of their own materials with the students' collaboration. Finally, the malfunction of some resources at the SRM are mentioned as impediment to a better attendance service.

**Table 32 -** Analysis grid of Category Integration of Tools and Resources into the Service of Attendance in the Multifunctional Resource Room

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Equipping of the Multifunctional Resource Room** | 1. well equiped room | *então e uma sala que tem todos os recursos necessários pra todas as faixas etárias(T1)* | 6 |
| | | ------- | - |
| | 2. process of equipment | ------- | - |
| | | *isso tem sido uma situação bem complicada ultimamente devido a própria gestão a própria questão do governo ao próprio repasse do material (T2)* | 8 |
| | 2. contributions to the room equipment | *ainda tivemos um convênio com uma universidade particular. com o curso de terapia ocupacional de uma universidade particular... que nos forneceu material para utilizarmos com os nossos alunos com deficiência (T1)* | 2 |
| | | ------- | - |
| | 4. material used with students of all age | ------- | - |
| | | *a não ser os livros a não ser alguns recursos que são da matemática e alguns que ainda tem alguma dificuldade mais acentuada que eu faço uso de alfabeto silábico alfabeto móvel silabas móveis (T2)* | 3 |
| | 5. necessity of renovation of materials and resources for adolescent learners | -------- | - |
| | | *como eu estou trabalhando agora com a maioria do público que eu atendo e adolescente eu tenho percebido o quanto a sala de recursos precisa de equipamentos e recursos materiais pedagógicos que alcancem a demanda desse público (T2)* | 8 |
| | | ***total*** | 27 |
| **Creation of materials to the Resource Room** | 1. creation of materials with learners | ------- | - |
| | | *às vezes o aluno dependendo da situação dele... ele faz o recurso e eu só faço jogar/fazer o jogo com ele... fazer a atividade (T2)* | 6 |
| | 2. learning goals | ------- | - |
| | | *eu procuro construir junto com eles porque eu trabalho outros aspectos que precisam ser trabalhados tanto do aspecto da coordenação motora fina quanto o aspecto da atenção da concentração e da memória (T2)* | 5 |
| | | ***total*** | 27 |
| | 1. games | *temos muitos jogos, muitas caixas de jogos que os alunos gostam demais... da maioria dos jogos...(T1)* | 1 |
| | | *são os jogos pedagógicos existentes aqui na sala de recursos (T2)* | 1 |

| | | | |
|---|---|---|---|
| **Frequent pedagogical tools** | 2. books | *logo na entrada nos temos livros para os alunos geralmente são livros infantis ...(T1)* | 1 |
| | | ------ | - |
| | 3. tools and toys | *nós temos um calendário com a indicação climática porque dá pra trabalhar... porque alguns alunos não tem a noção de tempo e geralmente também ...o aluno com dislexia 'meio' que se perde no tempo ... então também e trabalho isso com ele....(T1)* | 2 |
| | | ------ | - |
| | 4. television | *a televisão ainda e analógica... então a imagem não está perfeita como as (imagens) das televisões digitais (T1)* | 4 |
| | | *a gente tem televisão (T2)* | 1 |
| | 5. computer | *geralmente o recurso utilizado na sala de recursos e o computador... ne... conectado à internet (T1)* | 5 |
| | | *recurso tecnológico e muito mais o computador (T2)* | 6 |
| | 6. vídeos | *o aluno que tá na aquisição da escrita... a leitura...até mesmo da fala... vídeos com músicas infantis...pra que o aluno desenvolva essa habilidade da fala... (da) escrita e (da) leitura (T1)* | 2 |
| | | ------ | - |
| | 7. computer resources | ------ | - |
| | | *nós temos também scanner na sala de recurso... (T2)* | 2 |
| | 8. assistive technology | ------- | - |
| | | *várias coisas dessa sala s\o tecnologia assistiva (T2)* | 2 |
| | | ***total*** | 27 |
| **Malfunction of the Resource Room** | 1. technological tools out of operation | *seria interessante que estivesse funcionando os dois computadores.... né .... porque não é só o atendimento individualizado ...tem o assessoramento ... que seria interessante mais um computador (T1)* | 2 |
| | | ------- | - |
| | 2. internet access | *desde antes de ontem estamos sem internet... mas ela... normalmente funciona normalmente... normalmente bem (T1)* | *1* |
| | | *a gente não tem o auxílio da internet né? e por conseguinte a gente não tem como baixar jogos tecnológicos pra que a gente possa fazer uso com os alunos (T2)* | 3 |
| | 3. negative consequences of malfunctioning of resources | *.... então se tivesse mais de um computador dava pra eu... a professora... ficar em um e o monitor ficar em outro... já avançando o trabalho pra adaptar mais de uma prova ao mesmo tempo (T1)* | 4 |
| | | *no sentido de pesquisa de ajudar a esclarecer... por exemplo a questão do conteúdo que eles precisam a gente acaba não tendo esse recurso [internet] (T2)* | 2 |
| | 4. lack of dialogue with regular classes about availability of resources | -------- | - |
| | | *ainda não foi solicitado em nenhuma situação por exemplo dos professores da sala regular em relação a esse tipo de recurso pra ser utilizado lá na sala de aula que no meu entender e um recurso que pode ser disponibilizado* | 3 |

| | | | |
|---|---|---|---|
| | | *também assim como qualquer outro recurso que tem (T2)* | |
| | | | ***total*** 15 |
| **Appropriate materials in supporting students with dyslexia** | 1. computers | ------- | - |
| | | *eu uso mesmo o computador como um suporte pra desenvolver algumas atividades com eles... no sentido de agilizar pesquisa... (T2)* | 3 |
| | 2. educational games | ------- | - |
| | | *questão de alguns jogos pedagógicos que eu pesquiso na internet que são interessantes... alguns jogos que são considerados games (T2)* | 1 |
| | 3. apps | ------- | - |
| | | *alguns aplicativos que até no celular a gente consegue baixar são interessantes pra eles desenvolverem na sala de recursos isso ajuda bastante (T2)* | 2 |
| | 4. videos | ------- | - |
| | | *vídeos também dão um suporte pra gente trabalhar determinados conteúdos (T2)* | 1 |
| | | | ***total*** 7 |

Regarding the teachers' verbalizations about the context of specialized education attendance, a documentary analysis of two Brazilian official documents was conducted in order to comply with the following objectives:

a. to investigate the definition of Special Education and its services in Brazilian education organizations regarding the inclusive support provided to students with special needs;
b. to verify the specialized educational service guidelines;
c. to identify learning strategies, objectives, and assessment of teaching planning for students at the SRM, including pupils with dyslexia.

To meet the first objective, the Lei de Diretrizes e Bases – LDB (Lei n. 9.394/1996), Annex III was analyzed. In the study of this document, some categories expressing the content of LDB about Special Education guidelines emerged, as shown in Table 33:

**Table 33** - Analysis grid of Specialized Education Articles of the Lei de Diretrizes e Bases da Educação Brasileira

| CATEGORIES | INDICATORS | CONTEXT UNIT |
|---|---|---|
| **Definition of Specialized Education** | Concept of inclusive education | *Atendimento educacional especializado gratuito aos educandos com deficiência, transtorno globais do desenvolvimento e altas habilidades ou superdotação, transversal a todos os níveis, etapas e modalidades, preferencialmente na rede regular de ensino (Art. 04, p. 09)* |

| | | |
|---|---|---|
| | Target-public | *educandos com deficiência, transtorno globais do desenvolvimento e altas habilidades ou superdotação (Art 04, p. 09)* |
| **Specialized Education service** | Specialized Service at regular classes | *Haverá, quando necessário, serviços de apoio especializado na escola regular para atender as peculiaridades da clientela de educação especial (Art. 58 p. 39)* |
| | External specialized service | *O atendimento educacional será feito em classes, escolas ou serviços especializados, sempre que, em função das condições específicas dos alunos, não for possível a sua integração nas classes comuns de ensino regular (Art. 58, p. 40)* |
| | Starting of the mode offer | *A oferta de educação especial, nos termos do caput deste artigo, tem início na educação infantil e estende-se ao longo da vida, (Art. 58, p.40)* |
| **Duty of Educational System** | Specificities of supporting | *currículos, métodos, técnicas, recursos educativos e organização específicos, para atender às suas necessidades (Art. 59, p. 40)* |
| | Schooling completion | *terminalidade específica para aqueles que não puderem atingir o nível exigido para a conclusão do ensino fundamental, em virtude de suas deficiências, e aceleração para concluir em menor tempo o programa escolar para os superdotados (Art. 58, p. 40)* |
| | Specialized teachers | *professores com especialização adequada em nível médio ou superior, para atendimento especializado, bem como professores do ensino regular capacitados para a integração desses educandos nas classes comuns (Art. 59, p. 40)* |
| | Training | *educação especial para o trabalho, visando a sua efetiva integração na vida em sociedade, inclusive condições adequadas para os que não revelarem capacidade de inserção no trabalho competitivo, mediante articulação com os órgãos oficiais afins, bem como para aqueles que apresentam uma habilidade superior nas áreas artística, intelectual ou psicomotora(Art. 59, p. 40)* |
| | Equal access to social programs | *acesso igualitário aos benefícios dos programas sociais suplementares disponíveis para o respectivo nível do ensino regular (Art. 59, p. 40)* |
| **High skill public** | High skill development policy | *O poder público deverá instituir cadastro nacional de alunos com altas habilidades ou superdotação matriculados na educação básica e na educação superior (Art. 59ª, p. 40)* |

According to the analysis, the LDB makes contributions to inclusive education by guaranteeing the enrolment of students with disabilities and highly skilled students in regular schools. It also states as duties of the Education System to assure the specialized teachers' resources, an adapted curriculum and methods in order to achieve appropriate inclusion of the public with special

needs. Finally, although this document is based on a concept of inclusive education, it emphasizes the target public of Special education, as shown in Table 30 – students with disabilities, global disorders of development, and high skills.

In order to achieve the second objective, Decree no. 7611/2011 (Annex IV), which defines the AEE (Atendimento Educational Especializado[22]) in Brazil, was examined. Table 34 shows the categories and indicators expressed in this document's main guidelines:

**Table 34 -** Analysis grid of Articles of Decree no. 7611/2011

| CATEGORY | INDICATORS | CONTEXT UNIT |
|---|---|---|
| **Conception of Special Education** | Perspective of inclusive education | *...garantia de um sistema educacional inclusivo em todos os níveis, sem discriminação e com base na igualdade de oportunidades (Art. 01º, parágrafo 1)* |
| | Objectives of Special Education services | *I prover condições de acesso, participação e aprendizagem no ensino regular e garantir serviços de apoio especializados de acordo com as necessidades individuais dos estudantes; II garantir a transversalidade das ações da educação especial no ensino regular; III fomentar o desenvolvimento de recursos didáticos e pedagógicos que eliminem as barreiras no processo de ensino e aprendizagem; IV assegurar condições para a continuidade de estudos nos demais níveis, etapas e modalidades de ensino (Art. 3º)* |
| **Specialized Education service** | Target-public | *...considera-se público-alvo da educação especial as pessoas com deficiência, com transtornos globais do desenvolvimento e com altas habilidades ou superdotação (Artigo 1º, parágrafo 1º)* |
| | Definition | *…os serviços de que trata o caput serão denominados atendimento educacional especializado, compreendido como o conjunto de atividades, recursos de acessibilidade e pedagógicos organizados institucional e continuamente* |
| | Way of providing the service | *complementar à formação dos estudantes com deficiência, transtornos globais do desenvolvimento, como apoio permanente e limitado no tempo e na frequência dos estudantes às salas de recursos multifuncionais (Art. 2, parágrafo 01) e suplementar à formação de estudantes com altas habilidades ou superdotação (Art. 2, parágrafo 02)* |
| | Multifunctional Resource Rooms | *As salas de recursos multifuncionais são ambientes dotados de equipamentos, mobiliários e materiais didáticos e pedagógicos para a oferta do atendimento educacional especializado (Artigo 5º parágrafo 3º)* |

[22] Specialized Educational Attendance

| | | |
|---|---|---|
| **Space of attendance of Special Education** | Special Educational Centers | *O atendimento educacional especializado aos estudantes da rede pública de ensino regular poderá ser oferecido pelos sistemas públicos de ensino ou por instituições comunitárias, confessionais ou filantrópicas sem fins lucrativos, com atuação exclusiva na educação especial, conveniadas com o Poder Executivo competente, sem prejuízo do disposto no art. 14." (Art. 8, parágrafo 2º)* |

The analysis of this decree provides an understanding of specialized education from an inclusion perspective in regular schools. Nevertheless, it represents a government policy of exclusion of individual disorders, such as learners with Specific Learning Difficulties.

Additionally, the analysis of LDB and Decree no. 7611/2011 reveals findings that are in agreement with the teachers' verbalizations concerning the target public and the legal foundations of the Specialized Educational Attendance at the SRM, showing that this service does not provide a real inclusion of all individual with special needs.

To achieve the third goal, the teaching plans of both teachers were analyzed separately, given their different practices. The results of the analysis of teaching planning for Teacher 01 are presented in Table 35 (Annex V):

**Table 35 -** Analysis grid of Teaching Planning in Case 01

| Category | Indicators | Context unit |
|---|---|---|
| **Legal bases justification** | Special Education service description | *...sendo um serviço da educação especial que "[...] identifica, elabora e organiza recursos pedagógicos e de acessibilidade que eliminem barreiras para a plena participação dos alunos, considerando suas necessidades específicas" ...* |
| | definition of target-audience | *Alunos com deficiência... com transtornos globais...com altas habilidades* |
| | enrollment condition | *A matricula no AEE é condicionada à matricula no ensino regular* |
| | relevance of SRM | *...pensando nos alunos com deficiência que estão matriculados nas instituições de ensino, tornando evidente que a sala de recursos deve existir nas escolas...* |
| **Teaching objectives domains** | skills/knowledge | *...levar o educando ao conhecimento conforme as suas necessidades e possibilidades* |
| | special needs perception | *Perceber as necessidades educativas especiais dos alunos...* |
| | inclusive purposes | *Compreender o aluno com necessidade específica, assim como os demais alunos, como parte de TODA a escola* |
| | attention to students' individual needs | *Flexibilizar a ação pedagógica nas diferentes áreas do conhecimento de modo adequado às necessidades individuais de cada aluno* |
| | space of pedagogic services guarantee | *Ofertar o atendimento educacional especializado na sala de recursos multifuncionais* |
| | continuous learning evaluation | *Avaliar continuamente a eficácia do processo educativo...* |
| | support for regular classes teachers | *Auxiliar o professor de turma a realizar adaptações de materiais e recursos sempre que necessário...* |
| | written and oral activities | *Atividades que desenvolvam a produção da linguagem escrita* |

| | | |
|---|---|---|
| **Teaching strategies types** | language analysis and reflection | *Reflexão e análise sobre a língua...* |
| | self-perception activities | *Atividades interdisciplinares ... adaptadas que estimulem a percepção dos alunos diante dos problemas por eles enfrentados...* |
| | drawing, painting, collage | *Estímulo à criatividade através de desenhos...* |
| | games | *Estímulo à criatividade através de jogos sucatas...* |
| | role-playing | *Estímulo à criatividade através de dramatizações* |
| | consulting services for teachers | *Assessoramento ao professor do ensino regular sobre os alunos com deficiência* |
| | progress update meeting | *Reuniões para esclarecimento sobre o potencial, as necessidades e as limitações do educando...* |
| | creation of materials and tools | *O planejamento de material didático pedagógico para a organização de recursos e materiais.* |
| | interaction and collaboration | *Limites através da interação e da intervenção* |
| | strategies flexibility | *As estratégias serão modificadas de acordo com as necessidades do educando e progressos alcançados* |
| **Teaching resources** | diversification of materials | *Utilização de recursos pedagógicos variados como: materiais didáticos diversificados, materiais lúdicos e outros instrumentos...*<br>*Utilização de ferramentas como computador ... jogos e brincadeiras* |
| **Assessment** | absence of indication of assessment method | *Not described* |
| **References** | absence of theoretical foundation | *Decreto nº6571 (2008); Diretrizes operacionais da Educação Especial (2008); LDB (1996); Política Nacional de Educação especial (2008)* |

The content summarized in Table 35 indicates that this planning was globally created to embrace all the pedagogical activities developed at the SRM. It focuses on important information, such as justification of legal bases, in order to describe the services offered at the SRM, the legitimate target public, and the conditions for learners' enrolment. The information expressing expected results embraces domains of development of perceptions on the students' needs and difficulties, and continuous evaluation of progress through the development of diverse strategies consistent with the materials and resources available. Interestingly, the plans also involve collaborative work with teachers aiming to assist in the inclusion of students with disabilities in regular classes. In fact, the promotion of interactions and collaborations seems to be aimed at actions as part of work developed with other educators, and at the target students as well.

Assessment is deemed as an important teaching planning element and is absent in this document. Although references to continuous evaluation were found, as in "*as estratégias serão modificadas de acordo com as necessidades do educando e progressos alcançados",* it was not possible to verify how this evaluation would be developed, or how the process of feedback would be conducted. Similarly, references for the theoretical foundations are missing in this planning process. This finding reflects the absence of theoretical bases guiding the entire process of teaching and learning.

Finally, it is easy to verify that planning was created for supporting the pedagogical work of students with any disability, with no specification of

activities adjusted to the different needs of this group of students. Furthermore, as specified in the justification of legal bases, learners with Specific Learning Difficulties such as dyslexia are excluded from this plan.

Table 36 shows the results of the analysis of the teaching planning process of Teacher 02 (Annex VI):

**Table 36** - Analysis grid of Teaching Planning in Case 02

| Category | Indicators | Context unit |
|---|---|---|
| **Teaching objectives domains** | memory and cognition domain | *Desenvolver a memória, atenção e concentração* |
| | language domain | *Desenvolver argumentação e interpretação*<br>*Exercitar oralidade*<br>*Conhecer diferentes gêneros textuais*<br>*Aprimorar a leitura de textos* |
| | psychomotor domain | *Desenvolver a praxia fina* |
| | math domain | *Aprimorar conhecimentos matemáticos* |
| **Attendance planning** | academic load | *45 minutes* |
| | period of attendance | *2018* |
| | weekly frequency | *1 vez por semana (quarta-feira)* |
| | type of attendance | *Individual* |
| **Teaching strategies types** | games | *Jogos matemáticos*<br>*Bingo de números e palavras*<br>*Dominó de palavras e figuras, letras e números...*<br>*Jogo da memória*<br>*Quebra-cabeça* |
| | collage | *Recorte e colagem* |
| | painting | *Pintura* |
| | computer activities | *Atividades no computador* |
| | dictation | *Auto-ditado*<br>*Ditado de pequenos textos*<br>*Autocorreção da escrita no ditado* |
| | creativity and recycling | *Atividades que estimulem a criatividade a partir do uso de material reciclado* |
| | math | *Escrita de números*<br>*Ditado de numerais*<br>*Atividades a partir do uso de material dourado, ábaco* |
| | verbal and non-verbal activities | *Leitura de imagem*<br>*Atividade de linguagem verbal e não-verbal* |
| **Teaching resources** | printed text | *Tiras de frases...*<br>*Atividades impressas*<br>*Fichas numéricas...*<br>*Livros, revistas, jornais...* |
| | midia | *Imagens, vídeos* |
| | school materials | *Pincel, lápis de cor, giz de cera, caneta hidrocor...* |
| | recycled material | *Materiais reciclados* |
| | manipulable materials | *Material dourado, ábaco, tampas de garrafa* |
| | selection of materials needed to be acquired | *tinta, impressora* |
| **References** | absence of theoretical foundation | *no reference* |
| | needed partnership | *Equipe de formação do CRIE*<br>*Professores da sala de aula regular*<br>*Coordenação Pedagógica*<br>*Família* |

| | | |
|---|---|---|
| **Collaborative working indication** | consulting services for teachers | *Professores de sala de aula regular e Coordenadores Pedagógicos* |
| **Expected outcomes** | autonomy in academic activities | *Desenvolvimento de autonomia na realização de atividades em sala de aula e no AEE* |
| | language improvement | *Aprimoramento de leitura Aprimoramento do desenvolvimento da argumentação e interpretação* |
| | math improvement | *Aprimoramento nos conhecimentos matemáticos* |
| | memory and cognition improvement | *Melhoria nos aspectos de atenção, concentração e memória* |
| | psychomotor improvement | *Aprimoramento da praxia fina* |

Teacher 01 develops a plan for each student, including participants with dyslexia; therefore, unlike the results in Table 35, it is clearly seen in Table 36 the specific interventions for the students, considering their needs and difficulties. Even though elements such as theoretical background, assessment, and references are absent, this plan presents a consistent association between learning goals, teaching strategies, selected materials, and expected outcomes. Furthermore, the information surprisingly expresses the importance of collaborative work in order to assure whomever the professionals involved with special education service at the school may be.

## 4.2. Ideation

### *4.2.1. Methods*

*Phase Goals*

This phase aimed at generating ideas for the gamified tool, and it was thus conducted through two main interactive activities: the co-creation sessions and the gamified resource planning.

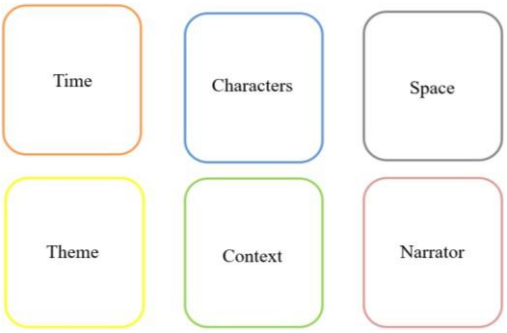
*Procedures*

In this phase, all the process of planning was recorded in the research diary (Appendix XII)

As a first step, two co-creation sessions were conducted with each learner, under supervision of their teachers. In these meetings, tasks around the theme *How will be our story?* were developed. Thus, three missions were presented to the students:

1) In order to get ideas about the story content/structure, thematic cards were presented, as shown in Figure 25:

**Figure 25 -** Thematic cards used in the co-creation sessions




Source: Elaborated by the authors

For each card, pupils made contributions as asked.

2) Learners were asked four questions about game elements they know/like/consider as relevant.
3) Students had to choose, from a list of five games, one or two games to explore and give opinions about what was more important or interesting about their elements.

These tasks allowed the determination of main points that most attracted the attention of learners 01 and 02 within their gamer's style. This identification facilitated the definition of action verbs, according to Figure 31, and contributed to the definition of gamification design.

For the second procedure, after the co-creation sessions, the resource planning (see Appendix XV) with the gamification framework, game principles and tool's design was developed, as presented below.

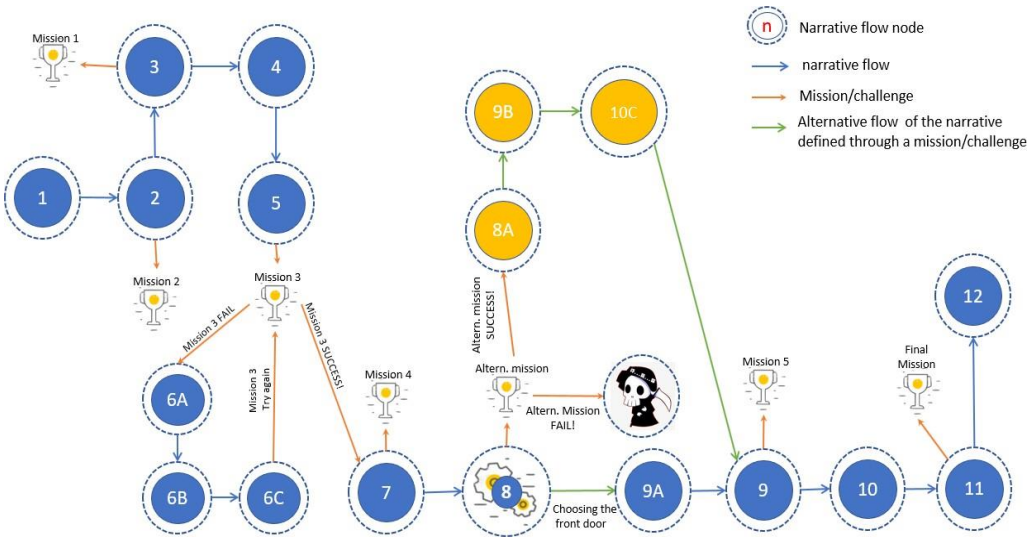
*4.2.2. Results*

The ideas generated in the co-creation phases determined the following:

a) Type of tool: the gamified storytelling

The structure of the Narrative Journey was also created and is presented in Figure 26, in which circles represent the chapters. The figure also shows an alternative path with alternative chapters represented by the orange circles.

**Figure 26** - Narrative Journey




Source: Elaborated by the authors

Based on this structure, the storyline was created. This story, entitled *Piazinho em uma aventura com seres fantásticos da Amazônia*[23], presents as the main character a little boy named Piazinho. He lives in the Amazon region, next to forests and many animals. This character scrolls a scenario populated with fantastic beings from the Amazon legends – Matinta Perera, Boitatá, Mãe D'água, and Fogo do Campo, and lives with some friends a great adventure full of challenges. Students with dyslexia may help Piazinho comply with his missions so that they can progress through the reading journey. The complete story can be found in Appendix XV (p. 533-538).

b) The gamification design framework

After the creation of the story, a framework inspired by the design framework of Werbach and Hunter (2012) was formulated to implement the gamification design. Figure 27 presents our basic framework:

**Figure 27** - The Design Framework


Source: Elaborated by the authors

[23] Piazinho on an adventure with fantastic beings from the Amazon.

This framework is founded on 6 actions starting with 'D' letter: *Define, Determine, Describe, Devise, Don't forget the fun,* and *Deploy*.

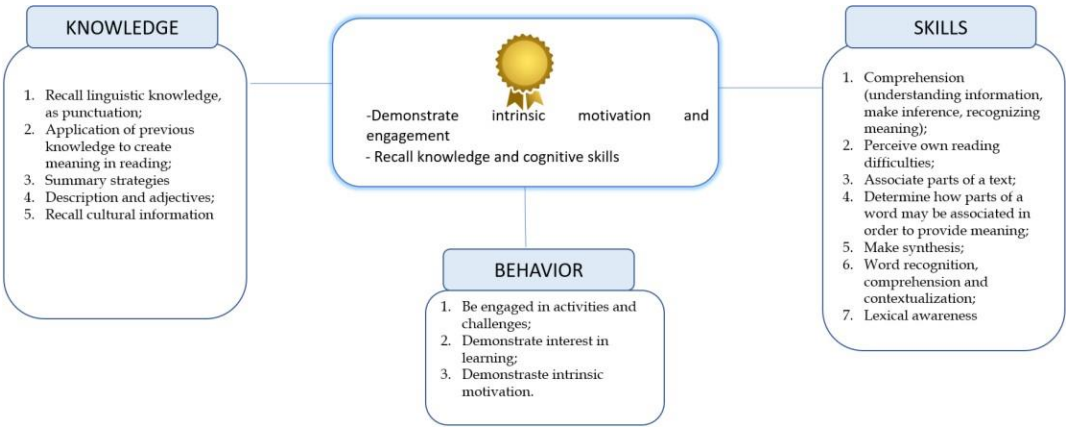
1st Action – Define

It formulated the main learning goals of the gamified prototype: 1. demonstrate intrinsic motivation and engagement; and 2. recall knowledge and cognitive skills.

2nd Action – Determine

It ensured the definition of skills, behavior, and knowledges expected, as seen in Figure 28:

**Figure 28 -** Skills, Knowledges and Behaviors Expected




Source: Elaborated by the authors

These target skills, knowledges, and behaviors are aligned with the learning objectives, and their ways of measurement are presented in Table 37:

**Table 37 -** Learning Objectives and Ways of Measurement

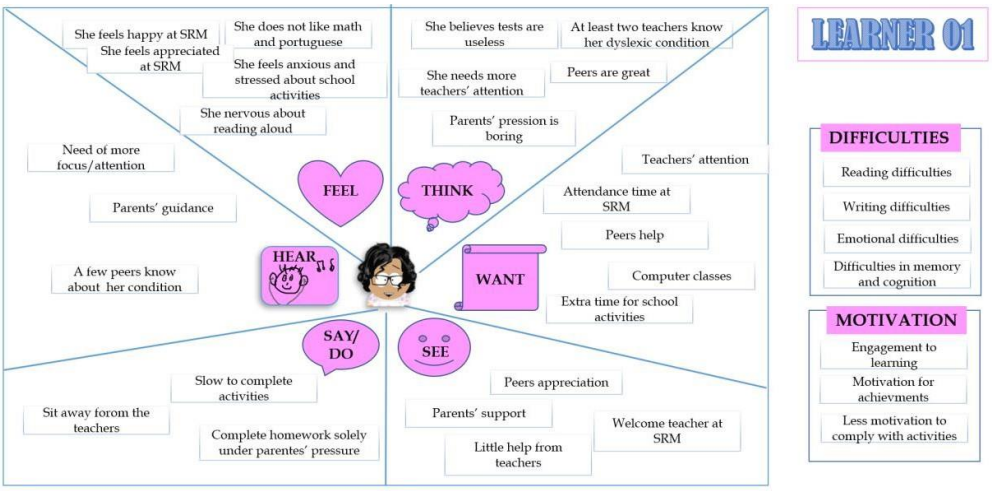
| OBJETIVES | WAYS OF MEASUREMENT |
|---|---|
| Demonstrate intrinsic motivation and engagement | - use of scale-based questionnaire<br>- set of tasks performed by students (video records) |
| Recall knowledge and cognitive skills | - use of open-questionnaire and scale-based questionnaire<br>- set of tasks performed by students (video records) |

3rd Action – Describe

This action built the description of the learners' profiles.
Participants were defined as adolescent students with dyslexic difficulties.

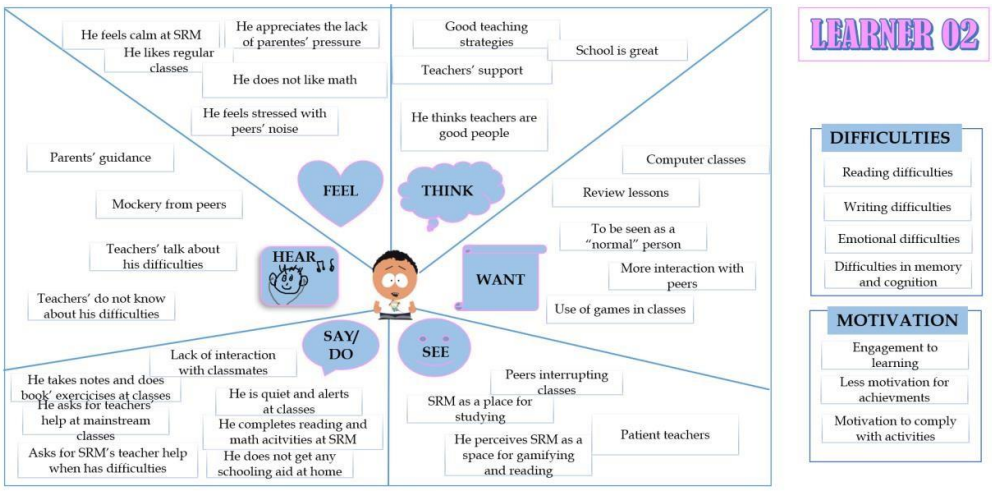
The analysis of the data collected in Phase 01 generated profile maps, inspired in the empathy maps of Design Thinking, according to the students' difficulties, motivations, perspectives, and impressions, as presented in Figures 29 and 30 below:

**Figure 29 -** Profile map of learner 01




Source: Elaborated by the authors

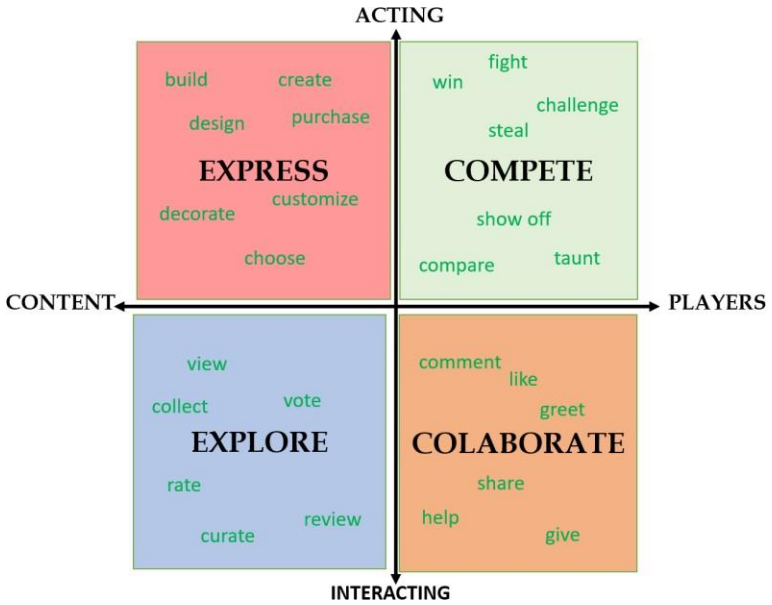
**Figure 30 -** Profile map of learner 02




Source: Elaborated by the authors

In order to help students to achieve the learning objectives and target skills, knowledges, and behavior, it was decided that actions would be enabled by offering specific features in the tool. These actions are named of engagement verbs (F. Alves, 2014), and represent the type of actions intended to be provoked in users for whom a gamified solution is created, as seen in Figure 31:

**Figure 31 -**Type of Actions to be Provoked in Students




Source: Adapted from Alves (2014)

Source: Elaborated by the authors

Therefore, in view of the learners' profiles and promotion of learning situations of reading/writing with the purpose of providing engagement and motivation, it was determined that the gamified tool may provoke in the students actions of: *expressing*, by offering features to give them opportunities for recognition and self-expression; and *exploring*, by motivating learners to gain knowledge by exploring the challenges and the story line.

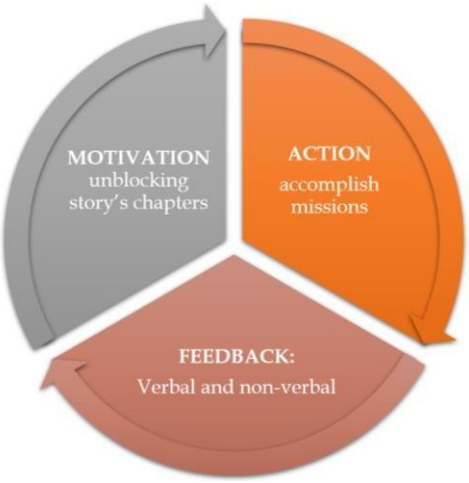
4th Action – Devise

This action executes the creation of activity cycles, which means the development of a leveling system with locked stages with a series of activity loops (Werbach & Hunter, 2012). Thus, it was based upon the basic engagement loop and the way of progression is made and chapters are disclosed.

a. Engagement loop

According to Werbach and Hunter (2012), the engagement loops may present three basic components: motivation-action-feedback. Therefore, three stages for each activity loop were defined, as presented in Figure 32:

**Figure 32 -** Engagement Loop



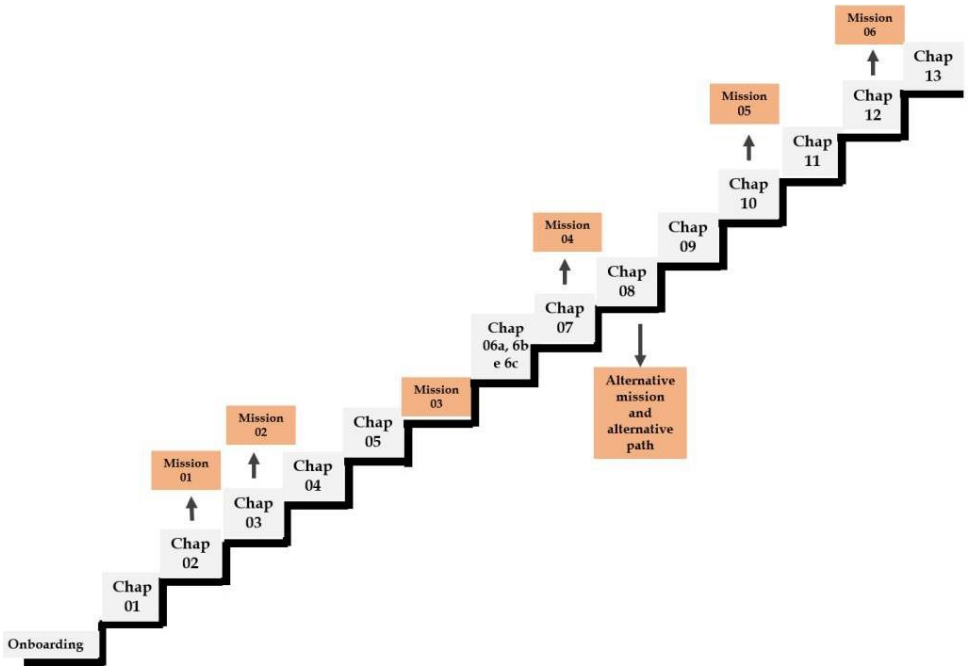

Source: Elaborated by the authors

After defining the engagement loop, the missions were created according to the students' difficulties. The description of the missions can be found in Appendix XV (p. 542-543).

a. Progression stairs

Figure 33 illustrates progression through the entire reading journey, emphasizing the story's chapters and missions. Reading progression through the chapters occurs by unblocking them when a mission is completely fulfilled.

**Figure 33 -** Illustration of Progression Stairs through the Chapters (Chap)




Source: Elaborated by the authors

5th Action – Don't forget the fun

This action allowed the inclusion of elements with the purpose of making the learner enjoy the gamified tool and participate of the activities. Thus, it included features such as:

- Collections of badges;
- Progress display, which helped the student keep engaged;
- Creation of challenges;
- Use of rewards, such as points and badges;
- Constant feedback

6th Action – Deploy

a. The game elements

In Table 38, the design principles of game mechanics and game strategies to be applied to the storytelling are presented:

**Table 38** – Design Principles and Game Mechanics

| **Game Strategies** | **Game mechanics applied** |
|---|---|
| Storytelling<br>Offer learning through a story | Fantastic story |
| Clear goals<br>Each task in the system presents clear purposes | Missions, levels |
| Time restriction<br>There is a time limit for the students to perform the tasks of their responsibility | Time pressure |
| Freedom to fail<br>The system allows learners to have more than one attempt in each mission, giving them freedom to take risks and fail | Missions, feedback |
| Unlocking content<br>The system offers the students access to blocked content through actions that grant them permission | Levels, missions |
| Achievements<br>The system provides visible forms of rewards and status | Badges, points |
| Classification/increasing levels<br>The system displays, by means of classification or increasing levels, the progression of the students | Levels, progression |
| Immediate feedback<br>The system gives immediate feedback after each mission is fulfilled | Badges collection, points, verbal and non-verbal feedback |
| Clear challenges<br>with rising complexity<br>The system offers are objective and clear, and their level of complexity increases according to the learners' progression | Missions |
| Customization of the activities and levels of difficulty adapted to the students | Missions |

| | |
|---|---|
| The system offers adapted content according to the students' difficulties and skills | |
| Progress indicator<br>The system offers a visible indicator as long as the students fulfill the missions | Points system, collection board |

b. The tools

The prototype was tested in the paper and digital version, as follows:

- Paper-version prototype: use of paper and pencils, cell phone with apps (Poster Maker[24], Kahoot[25], Criador Painel Quadrinhos[26]), and notebook with PowerPoint and online games;
- Digital-version prototype: programmed version deployed to be used in computers.

c. Motivation

Intrinsic and extrinsic rewards will be used:

- Intrinsic motivation: *sense of progress, sense of competence, sense of choice,* and *sense of satisfaction;*
- Extrinsic motivation: *points, badges,* and *bonus.*

d. Measurement of success

As postulated by F. Alves (2014), this action may provide measures of success for the use of the gamified tool. Therefore, it was established that prototype success would be measured by the learners' accomplishment of challenges/activities and the conditions of achievements and downfalls, as shown in Appendix XV, p. 546-547.

## 4.3. Iterative Prototyping

### *4.3.1. Methods*

*Phase Goals*

In this phase, a variety of techniques was used in order to prototype, test, and evaluate the gamified resource.

[24] https://play.google.com/store/apps/details?id=com.a7studio.postermaker&hl=pt_BR
[25] https://kahoot.com/
[26] https://play.google.com/store/apps/details?id=air.bahraniapps.comicspanelcreator&hl=pt_BR

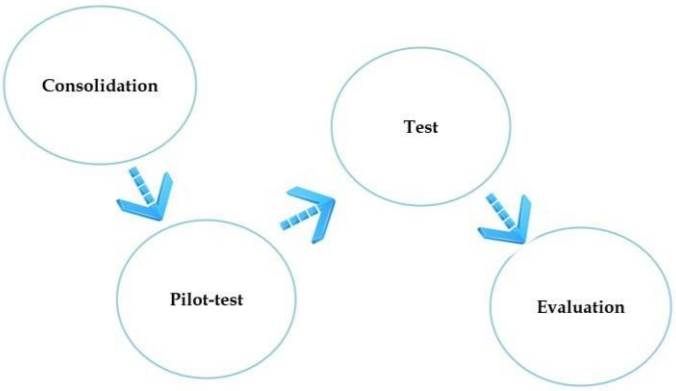
*Procedures*

The iteration of prototypes was developed, as presented below:

a) Paper-version Prototype

Figure 34 illustrates the process of the first prototyping:

**Figure 34** - Paper-version Prototyping




Source: Elaborated by the authors

- Consolidation: The researcher was engaged in participant observation, and thus participated actively in all process of consolidation, evaluation of the design, and creation of the concrete prototype. This entire stage was recorded in the research diary;
- Pilot-test: In order to test the functionality of the resource – structure, game elements, and narrative - we developed a pilot experience with a student with dyslexia, whose reading experience was similar to those of the project participants. This activity was developed in two sessions and recorded in video, and the participant provided informed consent to participate. This experience provided various contributions to the main testing;
- Instruments validation: A validation of the scale-based questionnaire and the open-questionnaires that would be applied after the tests was conducted. The tools were assessed by three different teachers in Special Education and one student with dyslexia from Centro de Educação Ronaldo Miranda - Ceron. The judges had to evaluate the contents of each item of the instruments, according to the criteria given, from grade 0 to 4, considering '0' if the item does not meet the criteria at all, and '4' if the item completely meets the criteria (see how these documents were presented to evaluators in appendixes XVI e XVII). They were also advised that they could make written contributions to each item. The assessors' contributions were useful

to provide additions to the tools. All the participants provided informed consent (Appendix XVIII).

- Test: It was developed in two different meetings - session of Case 01 and session of Case 02. The teacher and researcher conducted the implementation as a "shared teaching", which means that they worked together to help students experience the gamified reading. The tests for the paper-version prototype were developed in parts: *pre-reading*, conducted by the researcher, in which we helped the learners make hypotheses about the narrative and activate background knowledge about the narrative theme; *reading*, steered by the teacher and the researcher, in which the prototype was used (This part was developed as follows: the teacher read each narrative chapter, the researcher conducted the missions, timed the challenges, applied the feedback cards, operationalized badges and points' cards, and provided all the explanations about the missions, apps, and tools used in testing, and the teacher was responsible for providing verbal feedback and orientation at the end of each challenge); *pos-reading*, also named evaluation, as follows.
- Evaluation: It used two different types of instruments to gather information: 1. Scale-based questionnaire: Students were asked to indicate their level of agreement with statements on a five-point Likert scale, going from 'strongly agree' to 'strongly disagree', in order to measure their perceptions about learning, motivation, and engagement (see Appendix XIX); 2. Open-questionnaires: Teachers and learners were asked to evaluate the gamified prototype by responding to questionnaires. For students, a two-main question instrument, designed to assess usability, possibilities of learning, structure/content of the resource, was applied. Teachers were asked to evaluate by assigning numbers between 0 and 4 to each item of the structural, content, pedagogic, and value/attitude domains, in addition to writing comments about the prototype in a final question (see the instruments in Appendix XIX). Learners' verbalizations were audio recorded and the teachers' answers were written on paper.

*Iteration*

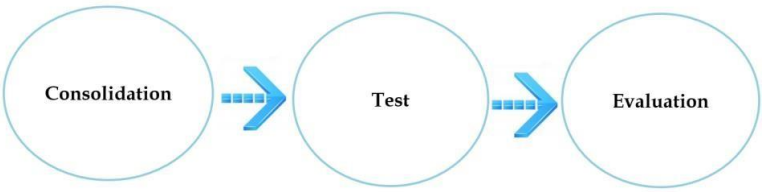
This process refers to the repetition that designing and creating something involves. As pinpointed by Brown (2017), this kind of process has an iterative nature, so it uses trial and error to produce the best solutions (Watson, 2015). Therefore, considering the data provided in the paper-version testing, i.e. the participants' feedback, some aspects related to the mission contents and the gamified tool design were redefined, according to the students' necessities/abilities. This iterative action allowed the redefinition of the paper-version prototype

resulting in the creation of a digital version, which was tested and also evaluated by the participants.

b) Digital-version Prototype

Figure 35 illustrates the process of the second prototyping:

**Figure 35** - Digital-version Prototyping




Source: Elaborated by the authors

- Consolidation: A scholarship holder with programming language specialization was invited to create the digital version for this process of creation. We organized meetings in order to define together the gamified tool aspects. In the first meeting, we discussed the main structure and content and decided to maintain the map adventure, the main character avatar, the badges, and the other game elements. The second meeting provided the opportunity to discuss the missions, time of execution, and programming. After three weeks, the developer presented us the first digital version, from which we promoted various increments and modifications. This version was submitted to the supervisors' evaluation, who suggested changes in challenges and also in another aspects, such as font size and type. In the following sessions, text, functioning, and structure reviews were promoted, as well as additions such as missions with adaptive difficulties and feedback notes, named "hints", after each challenge fail;
- Testing: It was developed in two different meetings − session of Case 01 and session of Case 02. Tests for the digital-version prototype were developed in parts: *pre-reading,* conducted by the researcher, in which the learners received help to formulate hypotheses about the narrative and activate background knowledge about the narrative theme; *reading,* conducted through learners' reading, teacher guidance, and feedback; and
- Evaluation (*post-reading)*: The teachers and students were asked to answer the same instruments used in the paper-version prototype. Additionally, an open-ended question interview was included with the purpose to evaluate the game elements (see interview's guides in Appendix XX). This last instrument was validated by the supervisor and applied to both students and teachers by giving sentences related to the game elements/game structure

about which participants should talk. The interviews were audio recorded and subsequently transcribed.

The entire process of prototyping was recorded in the research diary. Also, the tests were video recorded, and the scenes were transcribed and described in the analysis process.

Data Analysis

As presented, the tests were video recorded since, in the opinion of Loizos (2008), “sempre que algum conjunto de ações humanas é complexo e difícil de ser descrito compreensivamente por um único observador,”[27] (p. 149) it is necessary to record them. Understanding that the development of pedagogical activities carries itself aspects that are difficult to be described only by the researcher's observation, video recording was essential to allow us to review the material, searching for details as often as needed. Yet, videos become rich sources of language expression and "permite registrar, até mesmo, acontecimentos fugazes e não-repetíveis que muito provavelmente escapariam a uma observação direta”[28] (Sadalla & Larocca, 2004, p. 423).

In view of this, in the process of analysis of the videos the Content Analysis Technique (Bardin, 2009), conducted in three steps, was used, according to Figure 23. The entire process followed the same procedures of analysis applied in Phase 02. Nonetheless, in this analysis, critical events were counted as units of analysis.

The findings of this phase were also presented to the supervisors for review; changes were made after this evaluation.

### *4.3.2. Results*

#### 4.3.2.1. Results of Paper-version Prototyping

(i) Consolidation

The storytelling was embodied as a book, as presented in Figure 36. In its creation, Microsoft Word was used as a tool.

[27] “whenever any set of human actions is complex and difficult to be comprehensively described by a single observer, it is necessary to record them.” (free translation)

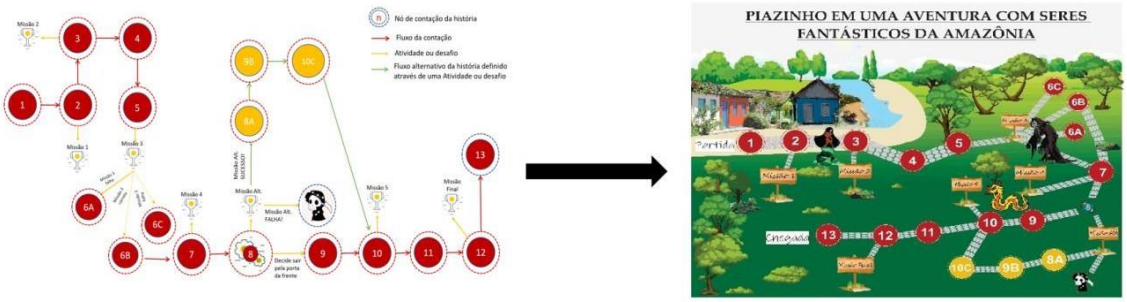
[28] “video allows recording even fleeting and non-repeatable events that would most likely escape from direct observation.” (free translation)

**Figure 36**- Storytelling Book


Source: Elaborated by the authors

The adventure map was based on the planned narrative journey, as seen in figure 37:

**Figure 37**- Adventure Map




Source: Elaborated by the authors

The main character avatar, badges, award, and collection map were produced in CorelDRAW, as shown in Figures 38, 39, 40, and 41:

**Figure 38**- Piazinho

Piazinho was designed based on the characteristics described in the storytelling. This element was created to be used to signal level advance on the adventure map.

Source: Elaborated by the authors

**Figure 39** – Badges


It was established that learners should receive materialized conquest elements, such as badges and awards.

**Figure 40**- Award


Source: Elaborated by the authors

**Figure 41**- Collection Board


A collection board was created in order to motive students to see their conquests throughout the use of the tool.

Source: Elaborated by the authors

The elements *challenges cards* and *feedback cards* were created using PowerPoint, as shown in Figures 42 and 43:

**Figure 42** – Challenge Cards


**Figure 43** – Feedback Cards


Source: Elaborated by the authors

All of these tools were printed in paper in order to be used in the first testing session.

(ii) Pilot-test

This pilot-experiment represented an important procedure to test the following:

- Tool's adequacy and feasibility – The paper-version components were checked, and the importance of a three-step reading process, observation of tool's rules, challenge completion, answers' accuracy, level of difficulty, time/pressure and way of progression, missions' comprehensibility, pre-reading as a needed step in the reading process, and use of apps and other resources in challenges were evaluated;
- Reading gamified activity management – The ways of telling the narrative, student performance regarding concentration in listening to a storyteller, time needed to execution, testing of missions' applicability, observation of time pressure x student performance, and evaluation of types of feedback in order to keep the learners' interest and engagement were tested;
- Gathering of information about the perspective of a student with dyslexia on the game-based process – The learners' opinions on time given to complete the missions, their level of difficulty, and other aspects of the gamified tool were collected.

The test was conducted by developing a reading process comprising three main phases:
- Pre-reading: activities involving prediction about reading and activation of previous knowledge
- Reading: effective reading of the storytelling
- Post-reading: evaluation of the gamified tool

- Category Pre-reading

This category presents units of analysis for the process of pre-reading, in which verbalizations of two critical events identifying two main reading strategies are presented. These events are reading prediction and activation of prior knowledge, as seen in Table 39. Context units (critical events) can be found in Appendix XXI:

**Table 39** - Analysis grid of Category Pre-reading of the Pilot-study

| SUBCATEGORIES | INDICATORS |
|---|---|
| **Reading Prediction** | 1. analysis of the story title |
| | 2. prediction of story's theme |
| | 3. type of text |
| **Activation of prior knowledge** | 1. remembering fantastic beings |
| | 2. content guess |

The transcription of data revealed that a pre-reading activity fulfilled its function in providing reading prediction, since the student could make anticipations about theme and content, and showing the students' encyclopedic knowledge about legendary beings of the Amazon.

- Category Reading

This category presents indicators of critical events that emerged in the process of reading, i.e. when using the prototype in the pilot-study, as shown in Table 40. Critical events (context units) can be accessed in Appendix XXII:

**Table 40** - Analysis grid of Category Reading of Pilot-study

| SUBCATEGORIES | INDICATORS |
|---|---|
| **Actions of challenge 1** | 1. reading of chapters 1 and 2 |
| | 2. explanation and completion of the first challenge |
| | 3. challenge 1 feedback |
| | 4. challenge 1 second try |
| | 5. challenge 1 final feedback |
| | 6. challenge 1 student assessment |
| **Actions of challenge 2** | 1. reading of chapter 3 |
| | 2. explanation and completion of the second challenge |
| | 3. challenge 2 feedback |
| **Actions of challenge 3** | 1. reading of chapters 4 and 5 |
| | 2. explanation and completion of the third challenge |
| | 3. challenge 3 feedback |
| | 4. reading of chapter 6b |
| | 5. challenge 3 student assessment |
| **Actions of challenge 4** | 1. reading of chapter 7 |
| | 2. explanation and completion of the fourth challenge |
| | 3. challenge 4 feedback |
| | 4. challenge 4 student assessment |
| | 1. reading of chapter 8 |

| | |
|---|---|
| **Actions of complementary challenge** | 2. explanation and completion of the complementary challenge |
| | 3. complementary challenge feedback |
| | 4. reading of chapter 8a-10c |
| **Actions of challenge 5** | 1. reading of chapters 9-10 |
| | 2. explanation and completion of the fifth challenge |
| | 3. challenge 5 feedback |
| **Actions of challenge 6** | 1. reading of chapters 11-12 |
| | 2. explanation and completion of the challenge 6 |
| | 3. challenge 6 feedback |
| **Actions of completion** | 1. reading of chapters 13 |
| | 2. activity of closing |

This stage of the pilot-test mainly contributed to a comprehension of feedback as a fundamental component of teachers as facilitators of learning. Teachers may provide information and guidance aiming to help learners understand and/or restructure information. Therefore, the pilot-test provided important findings about feedback management in order to keep learners with dyslexia interested and engaged and, consequently, improve their performance in the gamified experience. In summary, situated, informative, and explicit feedback may be a key element for engagement, motivation, and learning.

- Category Post-reading

The post-reading activity allowed us to know the students' perceptions on the gamified tool, such as assessment of potential learning, and motivation and other aspects of the tool. The frequencies of occurrences indicate a favorable evaluation, as shown in Table 41 below:

**Table 41** -Analysis grid of Category Post-reading of the Pilot-study

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Gamified tool advantages** | 1. learning | *aprender novas coisas* | 3 |
| | 2. motivation | *sim motivou* | 2 |
| | 3. use of game elements | *de ir ganhando pontos achei bacana* | 2 |
| | | ***total*** | 8 |
| **Gamified tool disadvantages** | 1. absence of negative aspect | *não tem ponto negativo .....eu não botaria ponto negativo* | 1 |
| | 2. using difficulties | *Nada* | 3 |
| | | ***total*** | 4 |
| **Abilities and knowledge favored** | 1. reasoning | *habilidades e conhecimentos de raciocínio* | 3 |
| | 2. attention | *Também* | 1 |
| | 3. reading | *sim (contribui para a leitura)* | 1 |
| | | ***total*** | 5 |
| **Storytelling way** | 1. teacher as the storyteller | *porque a pessoa vai contar a história e acho que é melhor assim do jeito que tá.... é mais próximo* | 3 |
| | | ***total*** | 3 |
| **Feelings of using the tool** | 1. enjoyment | *o prazer de saber a história... e de como ia terminar* | 1 |
| | | ***total*** | 1 |
| **Impressions about the tool** | 1.impressions about the activities | *eram boas* | 1 |
| | 2. tool's structure | *achei criativo e bacana* | 1 |
| | 3. pictures | *sim (gostou das ilustrações)* | 1 |
| | | ***total*** | 3 |
| **Perception about the game elements** | 1. adventure story | *aventura e estória* | 2 |
| | 2. levels | *assemelho a fases... dificuldade diferentes* | 1 |
| | 3. points | *ir ganhando os pontos... enquanto tu vais acertando as missões e ter o troféu* | 1 |
| | 4. badges | *pra saber se tá indo bem ou não* | 1 |
| | 5. rewards | *são justos* | 3 |
| | 6. level of difficulty | *tem umas que são difíceis e outras são mais fáceis* | 4 |
| | 7. complementary challenge | *acho que ela precisa tá aí pra ter um ponto extra e pra ter mais um objetivo* | 4 |
| | 8. narrative journey | *de fazer o percurso sabendo a história e (saber) como terminar da maneira certa* | 1 |
| | 9. avatar | *sim...bastante* | 1 |
| | 10. missing elements | *Nada* | 1 |
| | 11. adventure map | *sim (ajudou a visualizar a história)* | 2 |
| | | ***total*** | 21 |
| **Perception of a paper-version prototype** | 1. tools used in paper-version | *Muito bacana* | 2 |
| | 2. importance of paper tools | *pra não viver de tecnologia pra gente viver mais o mundo real... tocar nós objetos e mover eles* | 2 |
| | | ***total*** | 4 |

The pilot-test provided information about the students' perspectives on storytelling functionality and contributions. Appendix XXIV shows the times of evaluation, indicating the learners' opinions about *amount of time* and *missions' level of difficult* (as seen in critical event 1, action 6, lines 1-10). These types of information contributed to our perception of the relationship between time x level of difficulty, and also time pressure, in a gamified experience.

Post-reading combined with the application of an evaluation open-questionnaire (as shown in Table 41) enabled collecting beneficial information on the *tool's advantages* to foster learning (reasoning, attention, and reading), motivation, and enjoyment, and on the *tool's structure* and *significance of the game elements.*

These findings are relevant given their contribution to the adequacy of the time limit for the activities, preservation of the gamified structure and, above all, deep comprehension about the storytelling potential as a supportive tool to the reading activities of the volunteer-students with dyslexia in this research.

(III) Validation of Evaluation Instruments

The main goal of this validation was assessing the instruments' content and, consequently, verifying their operability, reliability, and validity.

For purposes of exclusion or selection of the instruments' items, an exclusion criterion of a score below 50% was defined, i.e. each item could have a maximum of four points. Therefore, any item with a lower value of two points would be eliminated. As the items were not scored below the stipulated average, all the questions proposed still integrate the instruments. Despite the non-exclusion of items, some modifications were made based on the judges' suggestions.

- Validation Performed by Teachers

The contributions of the judges were significant for the redefinition of a few questions, such as "detailed specification" in items 12 and 13, "addition of missing word", and "inclusion of a question about motivation" in the teachers' open-questionnaire. One of the judges made some suggestions about changes in vocabularies for items 1, 9, 10,11, 13, and 15 of the students' scale-based questionnaire. Therefore, words such as *fortemente, êxtase, feedback, suscitou, motriz* and *imenso* should be replaced in order to improve learners' comprehension. Chart 1 presents the results of the students' scale-based questionnaire validation:

**Chart 1** - Student's Scale-based Questionnaire Validation

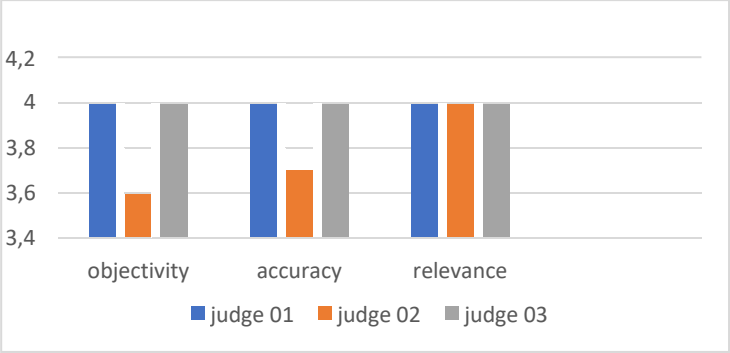



Chart 2 presents the results of the validation of the students' open-questionnaire:

**Chart 2** - Student's Open-questionnaire Validation

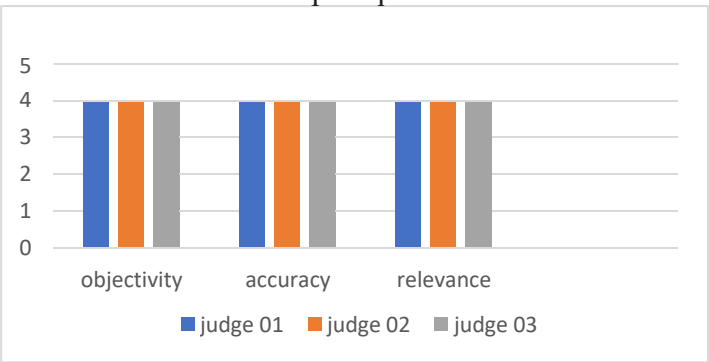
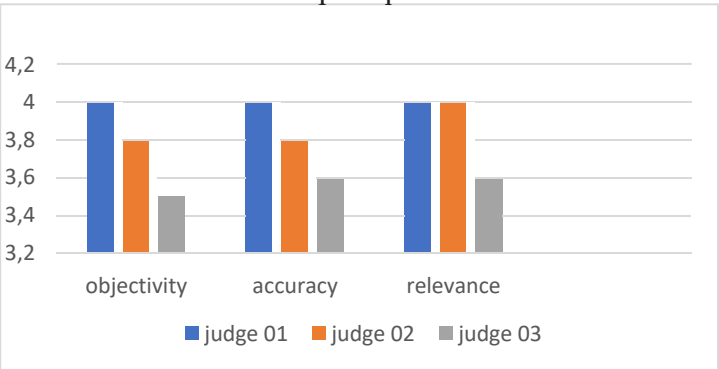



Chart 3 shows the results obtained for the validation of the teachers' open-questionnaire:

**Chart 3** - Teachers' Open-questionnaire Validation




- Validation Performed by Students

Student assessment consisted in judging the learners' scale-based questionnaire and the open-questionnaire. The task was applied to one student of Ceron under supervision of a teacher. In order to understand

what kind of tool those instruments would be evaluating, the gamified storytelling was introduced to the student and validation was then performed. This validation activity lasted almost two hours.

The pupil was very shy and had some difficulties in understanding the items. Thus, reading was assisted by a teacher. Along the validation, learners could suggest changes to some vocabulary, such as *êxtase, motriz, descodificação, contextualizar, utilização, narrativa, feedback* and *segmentar,* as well as text font. Moreover, the student suggested game mechanisms like avatar customization and use of coins as a reward.

Content validity refers to the degree an assessment tool is relevant and to sampling of the "contents of the test to a particular domain" (Cohen et al., 2005, p. 131). In this work, it represented a fundamental procedure to guarantee a better comprehension of the evaluation tools' content by the participants. This activity contributed to:

- *Operationality*: verification of vocabulary accessibility and questions directness; the suggestions proposed by the evaluators made it possible to choose the most appropriate terms/expressions;
- *Reliability:* it was possible to verify if content was comprehensible to the participants in order to guarantee similar results;
- *Validity*: it was found that the instruments could provide the necessary data, since the evaluators were able to relate the content to the use of the gamified tool.

The validation resulted in changes in a few items' content. These modifications occurred in the choice of new words to facilitate the participants' comprehension of the questions proposed. There was no change in the number of items, but some of them were repositioned to provide an appropriate content identification within each scale-based questionnaire purpose, as follows: a) items 7 and 11-14 of the motivation and engagement scale-based questionnaire were transferred to the perceived learning scale-based questionnaire; and b) item 4 of the perceived learning scale-based questionnaire was eliminated.

(IV) Test

This test was performed in three phases:

- Pre-reading: with activities of prediction about reading and activation of previous knowledge
- Reading: process of storytelling reading and challenge performance
- Post-reading: application of open-questionnaires and scale-based questionnaires

The findings are presented below:

- Category Pre-reading

The process of pre-reading presented indicators of strategies of prediction, such as *reading prediction* and *activation of encyclopedic competence*, as shown in Table 42. The context units (critical events) can be found in Appendixes XXIV (Case 01) and XXV (Case 02):

**Table 42 -** Analysis grid of Category Pre-reading of the Paper- version Test

| SUBCATEGORIES | INDICATORS Case 01 | INDICATORS Case 02 |
|---|---|---|
| **Reading Prediction** | 1. analysis of the story title | 1. analysis of the story title |
| | 2. prediction of story's theme | 2. prediction of story's theme |
| | 3. type, vocabulary and structure text | 3. type and structure text |
| **Activation of prior knowledge** | 1. remembering fantastic beings | 1. remembering fantastic beings |
| | 2. guessing the story content | 2. guessing the story content |
| | 3. orientation of storytelling's language | ------ |
| | 4. questioning students | ------ |

- Category of Reading

Each critical event determined in the analysis is associated with challenges fulfilled throughout the test of the gamified tool. These challenges are the core of the process since they allow the unlocking of levels and reading progression. Therefore, the indicators identified in the analysis represent the motivation actions for reading continuation. Table 43 presents the subcategories and indicators. Critical events are described in Appendixes XXVI (case 01) and XXVII (case 02):

**Table 43 -** Analysis grid of Category Reading of the Paper-version Test

| SUBCATEGORIES | INDICATORS Case 01 | INDICATORS Case 02 |
|---|---|---|
| **Guidance action on reading journey** | 1. guidance on rules, rewards and reading path | 1. guidance on rules, rewards and reading path |
| **Actions of challenge 1** | 1. reading of chapters 1 and 2 | 1. reading of chapters 1 and 2 |
| | 2. compliance of the first challenge 1 | 2. completion of the first challenge |
| | 3. teachers' feedback | 3. teachers' guidance feedback |
| | ---- | 4. resumption of first challenge |
| | ---- | 4. rewarding feedback |
| **Actions of challenge 2** | 1. reading of chapter 3 | 1. reading of chapter 3 |
| | 2. compliance of the second challenge | 2. completion of the second challenge |
| | 3. teachers' feedback | 3. teachers' feedback |
| **Actions of challenge 3** | 1. reading of chapters 4 and 5 | 1. reading of chapters 4 and 5 |
| | 2. compliance of the third challenge | 2. completion of the third challenge |
| | 3. teachers' feedback | 3. teachers' feedback |
| | 4. reading of chapter 6B | 4. reading of chapter 6C |
| | ---- | 5. resumption of second challenge (second chance allowed) |
| | ---- | 5. teachers' guidance feedback |
| | ---- | 6. reading of chapter 6A |
| | ---- | 7. resumption of second challenge (third chance allowed) |
| | ---- | 8. rewarding feedback |
| | ---- | 10. reading of chapter 6B |
| **Actions of challenge 4** | 1. reading of chapter 7 | 1. reading of chapter 7 |
| | 2. compliance of the fourth challenge | 2. completion of the fourth challenge |
| | 3. teachers' feedback | 3. teachers' feedback |
| **Actions of complementary challenge** | ------ | 1. guidance on an alternative reading path |
| | 1. reading of chapter 8 | 2. reading of chapter 8 |
| | 2. compliance of the complementary challenge | 3. completion of the complementary challenge |
| | 3. teachers' feedback | 4. teachers' feedback |
| **Reading journey recontextualization** | 1. orientation of alternative reading journey | 1. reading of extra chapters 8A, 9B and 10C |
| | 2. reading of extra chapters 8A, 9B and 10C | 2. returning to the reading main path |
| | 3. returning to the reading main path | ---- |
| **Actions of challenge 5** | 1. reading of chapter 10 | 1. reading of chapter 10 |
| | 2. compliance of the fifth challenge | 2. completion of the fifth challenge |
| | 3. teachers' feedback | 3. teachers' feedback |
| **Actions of challenge 6** | 1. explanation about the final challenge | 1. reading of chapter 11 |
| | 2. compliance about the final challenge | 2. completion about the final challenge |
| | 3. teachers' feedback | 3. teachers' feedback |
| **Actions of completion** | 1. reading of chapter 12 | 1. reading of chapter 12 |
| | 2. final rewarding feedback | 2. final rewarding feedback |

(V) Evaluation (Category Post-reading)

To obtain the students' and teachers' perspectives on testing of the gamified tool, scale-based questionnaires and open-questionnaires were applied. The results are presented below.

a. Students' Evaluation Findings

In the analysis of the scale-based questionnaires (see this instrument in Appendix XXVIII), the values were assigned to each level of agreement according to Table 44:

**Table 44** - Value in Order of Agreement of the Variables

| INCREASING VALUE OF AGREEMENT | | | | |
|---|---|---|---|---|
| strongly disagree | disagree | neutral | agree | strongly disagree |
| 1 | 2 | 3 | 4 | 5 |

Data from Case 01 and Case 02 were tabulated by using simple statistics, with the agreement value multiplied by the number of votes received, and also the agreement's median.

Table 45 summarizes the results of the motivation and engagement scale-based questionnaire:

**Table 45** - Paper-version Prototyping Evaluation – Analysis of Data and Average of Perceived Motivation and Engagement according to the Students' Answers

| | **Level of agreement** | | | | | |
|---|---|---|---|---|---|---|
| Statement | strongly disagree | disagree | neutral | agree | strongly disagree | median |
| Influenced by the desire to be rewarded | | | | 4 | 5 | 4,5 |
| Motivated due to missions and progression | | | | 4 | 5 | 4,5 |
| Appreciation of the clear goals | | | | 8 | | 4 |
| Motivated by storytelling | | | | 4 | 5 | 4,5 |
| Motivated by time and pression | | | | 8 | | |
| Appreciation of challenges | | | | | 10 | 54 |
| Sense of focus and concentration | | | | 4 | 5 | 4,5 |
| Feeling of enthusiasm using the gamified tool | | | | 4 | 5 | 4,5 |
| Engaged by getting feedback and guiding | | | | | 10 | 5 |
| Motivated by expectation to learn | | | | | 10 | 5 |
| Had fun | | | | 4 | 5 | 4,5 |
| Feeling of satisfaction in completing the reading journey | | | | 4 | 5 | 4,5 |

As shown in Table 45, the results are satisfactory. The variable of

motivation and engagement scale-based questionnaire are, on average, from 4 to 5; therefore, these results are perceptibly positive and represent the students' agreement with statements about the contributions of the gamified storytelling to the affective domain.

Table 46 presents the results of the students' perceived learning scale-based questionnaire:

**Table 46** - Paper-version Prototyping Evaluation – Analysis of Data and Average of Perceived Learning according to the Students' Answers

| | **Level of agreement** | | | | | |
|---|---|---|---|---|---|---|
| Statement | strongly disagree | disagree | neutra | agree | strongly disagree | median |
| Learning satisfaction | | | | 4 | 5 | 4,5 |
| Use of skills to fulfill challenges | | | | | 10 | 5 |
| Increased skills | | | | 4 | 5 | 4,5 |
| Persistence on using the tool in order to know how well s/he could do the challenges | | | | | 10 | 5 |
| Recognize reading and writing difficulties | | | | 4 | 5 | 4,5 |
| Better comprehension of the own reading difficulties | | | | 4 | 5 | 4,5 |
| Expansion of knowledge about punctuation | | | | | 10 | 5 |
| Amelioration of decoding | | | | | 10 | 5 |
| Make inferences | | | | | 10 | 5 |
| Make word contextualization | | | | 4 | 5 | 4,5 |
| Connect parts of the text | | | 3 | | 5 | 4 |
| Amelioration of reading comprehension | | | | 4 | 5 | 4,5 |
| Amelioration of word comprehension skill | | | | 8 | | 4 |
| Improvement of skill of summarize texts | | | | 8 | | 4 |

The findings in Table 46 reveal an average from 3.5 to 5, demonstrating more agreement with the statements. The student in Case 01 could not give opinion about two statements: 'Connect parts of the text' and 'Use of adjectives in description text'; hence, she selected the neutral value. Most values express agreement, i.e. a positive evaluation about the contribution of the gamified storytelling to learning.

Students were also asked to complete an open-questionnaire (transcriptions of learners' answers are on appendixes XXIX – for case 01, and XXX - for case 02). Table 47 summarizes the results obtained for both cases:

**Table 47** - Paper-version Prototyping – Analysis grid of the Evaluation Open-questionnaire

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Abilities and knowledge favored** | 1. memory | *MEMÓRIA (C1)* | 1 |
| | | ---- | - |
| | 2. reading | ---- | - |
| | | *de leitura (C2)* | 1 |
| | 4. punctuation | *acho que usar melhor a pontuação (C1)* | 3 |
| | | ---- | - |
| | | ***total*** | 5 |
| **Feelings of using the tool** | 1. enjoyment | *alegria (C1)* | 1 |
| | | ---- | - |
| | | ---- | - |
| | 2. happiness | *fiquei feliz (C2)* | 1 |
| | | ***total*** | 2 |
| **Perception of game elements** | 1. challenges | *legais (C1)* | 4 |
| | | *vou dar bom (C2)* | 3 |
| | 2. feedback | *excelente (C1)* | 2 |
| | | *excelente (C2)* | 1 |
| | 3. rewards (badges and points) | *gosto dos pontos (C1)* | 6 |
| | | *é bom... mas depende quando é divertido (C2)* | 6 |
| | 4. level of difficulty | *acho que algumas... missões mais difíceis (C1)* | 5 |
| | | *difícil* | 5 |
| | 5. complementary challenge | *achei legal (C1)* | 4 |
| | | *excelente (C2)* | 1 |
| | 6. narrative journey | *bom... eu gostei* | 3 |
| | | *excelente (C2)* | 1 |
| | | ***total*** | 41 |
| **Perception of a paper-version prototype** | 1. tools used in paper-version | *ah: acho que tá bom assim... eu gostei(C1)* | 1 |
| | | *excelente (C2)* | 1 |
| | 2. weakness | *acho que nada (C1)* | 2 |
| | | *os desafios* | 2 |
| | 3. strenght | *TUDO (C1)* | 2 |
| | | *história (C2)* | 2 |
| | 4. difficulties | *só um pouquinho.... naquela do quadrinho... eu demorei a pensar* | 2 |
| | | *só.....só no desafio* | 1 |
| | 5. material quality | *deu pra ver sim (C1)* | 1 |
| | | *deu pra ver tudo (C2)* | 2 |
| | 6. missing game strategies | *mais missões pra aumenta a coleção (C1)* | 2 |
| | | *fase de treinamento (C2)* | 1 |
| | 7. missing story elements | ---- | - |
| | | *faltou mais:: lendas (C2)* | 7 |
| | | ***total*** | 26 |

Although students had difficulties expressing their opinions in each question, the verbalizations' frequency demonstrates a positive evaluation for the gamified prototype. The findings reveal a contribution to the cognitive domain and also to the affective domain, and also provide information about the learners' perceptions and feelings about their gamified experience.

a. Teachers' Evaluation Findings

The findings in Table 48 show that the items contemplate the evaluated criteria, with an average between 3.5 and 4. The median of the two last items in Table 44 represents the teachers' opinion that prototype content does not favor any bias, stereotypes or violence, hence they reveal favorable results.

**Table 48** - Paper-version Prototyping – Teachers' evaluation Results

| **DOMAINS** | Scores | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | **Me.** |
| **STRUCTURAL** | | | | | |
| Easier use of the prototype | | | | 8 | 4 |
| Prototype surface | | | | 8 | 4 |
| Suitability | | | | 8 | 4 |
| Organization and structure | | | | 8 | 4 |
| **CONTENT** | | | | | |
| Target-students suitability | | | | 8 | 4 |
| Activities pertinence according to students' difficulties | | | | 8 | 4 |
| Story accuracy | | | | 8 | 4 |
| **PEDAGOGICAL** | | | | | |
| Learning potential | | | | 8 | 4 |
| Clarity of activities | | | 3 | 4 | 3.5 |
| Vocabulary | | | 3 | 4 | 3,5 |
| Innovation | | | | 8 | 4 |
| **VALUES AND ATTITUDES** | | | | | |
| Environment protection valorization | | | | 8 | 4 |
| Stereotype and prejudice favoring | 0 | | | | 0 |
| Violence encouragement | 0 | | | | 0 |

As can be seen in Table 48, the gamified prototype was evaluated positively by both teachers (see Appendix XXXI). In their own words, the reading experience contributed to cognitive aspects, such as memory, attention, focus, and grammar:

Case 01: *a atividade desenvolvida com a aluna foi tão interessante ao ponto de prender a atenção da mesma por todo o desenvolvimento da proposição pedagógica (T1)*
Case 02: *a atividade é muito interessante, pois trabalha diversos aspectos que colaboram para o desenvolvimento e aprendizagem do aluno: atenção, concentração, memória, aspectos gramaticais.*

These results provided feedback on what worked properly in the gamified experience, contributing with information to the next step of prototyping. The application of this instrument was relevant as well, since it also provided a few ideas to improve some aspects of use, as summarized in Table 49:

**Table 49** - Paper-version Prototyping – Teachers' contributions

| Contributions | Verbalization |
|---|---|
| **Need of textual revision** | *há apenas ressalva para a revisão de mais ou menos três palavras do texto (T1)* |
| **Content feedback** | *sugiro que seja feito um feedback sobre as lendas e personagens, para que o aluno possa se familiarizar e se concentrar mais na leitura... (T2)* |
| **Constant reiteration of tasks** | *também é importante repetir uma ou mais vezes os desafios e perguntas propostas (T2)* |
| **Reduction of the challenge texts** | *alguns desafios e leitura são um pouco extensos (T2)* |

Teachers' verbalizations strictly refer to the use of the prototype; hence their ideas could help in the enhancement of the reading gamified experience in the implementation of the digital version, as presented in the following subsections.

#### 4.3.2.2 Results of Digital-version Prototyping

##### (I) Consolidation

This new prototyping resulted in a digital gamified storytelling, which can be downloaded and locally accessed with a computer. Figure 44 presents the first page of this prototype. This digital product can be checked as Appendix XXXII[1].

**Figure 44** - First Page of the Digital Gamified Storytelling


Source: Elaborated by the authors

[1] The digital product can be checked by clicking on the link: https://drive.google.com/drive/folders/1TTKD8OCssmzeh1oW3b6lKiwZKTrxgp36?usp=sharing

(II) Test

As in the paper-version prototyping, this testing phase was conducted in three reading steps, as shown below:

- Pre-reading: development of strategies of prediction on the story's theme and triggering of previous knowledge;
- Reading: storytelling reading and challenge performance;
- Post-reading: comprehension task by asking the students to summarize information of the story.

The results are presented below.

- Category Pre-reading

Table 50 presents the indicators of the strategies used to help with text comprehension. These strategies are summarized in *reading prediction* and *activation of background knowledge*. The context units (critical events) can be found in Appendixes XXXIII (Case 01) and XXXIV (Case 02):

**Table 50** - Analysis grid of Category Pre-reading of the Digital-version Test

| SUBCATEGORIES | INDICATORS Case 01 | INDICATORS Case 02 |
|---|---|---|
| **Reading Prediction** | 1. analysis of the story title | 1. analysis of the story title |
| | 2. type, vocabulary and structure text | 2. type, vocabulary and structure text |
| **Activation of prior knowledge** | 1. remembering fantastic beings | 1. remembering fantastic beings |
| | 2. pre-reading conclusion and reading stage orientation | 2. questioning students |

Considering the pre-reading possible strategies, Table 50 summarizes the results for fulfilment of tasks that helped increasing the students' interest in the text.

- Category Reading

Table 51 shows how the indicators reflect the presence of actions related to each challenge developed in the reading process. The critical events can be found in Appendixes XXXV (Case 01) and XXXVI (Case 02):

**Table 51** - Analysis grid of Category Reading of the Digital-version Test

| SUBCATEGORIES | INDICATORS Case 01 | INDICATORS Case 02 |
|---|---|---|
| **Actions of challenge 1** | 1. reading of chapters 1 and 2 | 1. reading of chapters 1 and 2 |
| | 2. challenge 1 first try | 2. challenge 1 first try |
| | 3. challenge 1 first try feedback | 3. challenge 1 first try feedback |
| | 4. challenge 1 second try | 4. challenge 1 second try |
| | 5. challenge 1 second try feedback | 5. challenge 1 third try |
| | ---- | 6. challenge 1 final feedback |
| **Actions of challenge 2** | 1. reading of chapter 3 | 1. reading of chapter 3 |
| | 2. completion of the second challenge | 2. challenge 2 first try |
| | 3. challenge 2 feedback | 3. challenge 2 first try feedback |
| | ---- | 4. challenge 2 second try |
| | ---- | 5. challenge 2 second try feedback |
| | ---- | 6. challenge 2 third try |
| | ---- | 7. challenge 2 third try feedback |
| **Actions of challenge 3** | 1. reading of chapters 4 and 5 | 1. reading of chapters 4 and 5 |
| | 2. completion of the challenge 3 | 2. completion of the challenge 3 |
| | 3. challenge 3 feedback | 3. challenge 3 feedback |
| **Actions of challenge 4** | 1. reading of chapters 6B and 7 | 1. reading of chapters 6B and 7 |
| | 2. completion of the challenge 4 | 2. completion of the challenge 4 |
| | 3. challenge 4 first try feedback | 3. challenge 4 first try feedback |
| | 4. challenge 4 second try | 4. challenge 4 second try |
| | 5. challenge 4 second try feedback | 5. challenge 4 second try feedback |
| | 1. reading of chapter 8 | 1. reading of chapter 8 |
| | 2. completion of the complementary challenge | 2. completion of the complementary challenge |
| | 3. complementary challenge feedback | 3. complementary challenge first try feedback |
| | 4. reading of extra chapters 8A, 9B and 10C | 4. complementary challenge second try |
| | ---- | 5. complementary challenge second try feedback |
| | ---- | 6. reading of extra chapters 8A, 9B and 10C |
| **Actions of challenge 5** | 1. reading of chapters 8, 9 and10 | 1. reading of chapters 8, 9 and10 |
| | 2. completion of the challenge 5 | 2. completion of the challenge 5 |
| | 3. challenge 5 feedback | 3. challenge 5 feedback |
| **Actions of challenge 6** | 1. reading of chapters 11 and 12 | 1. reading of chapters 11 and 12 |
| | 2. completion of the challenge 6 | 2. completion of the challenge 6 |
| | 3. challenge 6 feedback | 3. challenge 6 feedback |
| **Actions of completion of reading journey** | 1. reading of chapter 13 | 1. reading of chapter 13 |
| | 2. final rewarding feedback | 2. final rewarding feedback |

These findings may be deemed relevant since they pinpoint actions of a process involving a complex interaction of deriving meaning between the participants (teachers and students) and the digital gamified tool. The indicators identified demonstrated the completion of the proposed activity aimed at an estimated process of *reading fulfill a mission get feedback.*

- Evaluation (Category Post-reading)

  a. Students' Evaluation Findings

In the analysis of the scale-based questionnaires (Appendix XXXVII), simple statistics was also applied to define the average of the two values by summing the two numbers and dividing by two, as seen in Table 52:

**Table 52** - Digital-version Prototyping Evaluation – Analysis of Data and Average of Motivation and Engagement Scale-based Questionnaire according to Students' answers

| | **Level of agreement** | | | | | |
|---|---|---|---|---|---|---|
| Statement | strongly disagree | disagree | neutral | agree | strongly disagree | median |
| Influenced by the desire to be rewarded | | | | 8 | | 4 |
| Motivated due to missions and progression | | | | 4 | 5 | 4,5 |
| Appreciation of the clear goals | | | | 8 | | 4 |
| Motivated by storytelling | | | | 8 | | 4 |
| Motivated by time and pression | | 2 | | | 5 | 3,5 |
| Appreciation of the challenges | | | | | 10 | 5 |
| Sense of focus and concentration | | | | 4 | 5 | 4,5 |
| Feeling of enthusiasm using the gamified tool | | | | 4 | 5 | 4,5 |
| Engaged by getting feedback and guiding | | | | | 10 | 5 |
| Motivation by expectation to learning | | | | | 10 | 5 |
| Had fun | | | | 4 | 5 | 4,5 |
| Feeling of satisfaction in completing the reading journey | | | | 8 | | 4 |

Table 52 evinces a positive contribution of the digital gamified prototype to the affective domain. However, the statement on *motivation by time and pressure* seemed to be least helpful in providing motivation. This finding may also be deemed important because it reveals that **time pressure** can work as a frustrating or fostering game element, according to the user's engagement.

In Table 53, the results of the students' perceived learning scale-based questionnaire are presented:

**Table 53 -** Digital-version Prototyping Evaluation – Analysis of Data and Average of Perceived Learning Scale-based Questionnaire according to Students' answer

| | **Level of agreement** | | | | | |
|---|---|---|---|---|---|---|
| Statement | strongly disagree | disagree | neutral | agree | strongly disagree | median |
| Learning satisfaction | | | | | 10 | 5 |
| Use of skills to fulfill challenges | | | | | 10 | 5 |
| Increased skills | | | | 8 | | 4 |
| Persistence on using the tool in order to know how well s/he could do the challenges | | | | 4 | 5 | 4,5 |
| Recognizing reading and writing difficulties | | | | 4 | 5 | 4,5 |
| Better comprehension of my reading difficulties | | | | | 10 | 5 |
| Expansion of knowledge about punctuation | | | | 8 | | 4 |
| Amelioration of decoding | | | | 4 | 5 | 4,5 |
| Make inferences | | | | | 10 | 5 |
| Make word contextualization | | | | 4 | 5 | 4,5 |
| Connect parts of the text | | | | | 8 | 4 |
| Amelioration of reading comprehension | | | 3 | 4 | | 3,5 |
| Amelioration of word comprehension skill | | | | 4 | 5 | 4,5 |
| Improvement of skill of summarize texts | | | | 4 | 5 | 4,5 |

The results specify the students' positive level of agreement with the statements, varying from 'agree' to 'strongly agree', which highlights how successful the contribution of the digital gamified storytelling was to reading learning. The option for *neutral* on *amelioration of reading comprehension* represents a "non-opinion" about that statement, which implies that the experience was not efficient to comprehension for one participant.

The median of the most of agreement values given by the students in Tables 52 and 53 indicates that they were satisfied or very satisfied with the gamified tool aspects and their contributions to both the cognitive and affective domains. The median of values were ascribed to statements: (i) *motivation by time and pressure* (Table 52), which revealed that one of the students was not pleased and the other was satisfied with the contribution of the time element to motivation and engagement; and (ii) *amelioration of reading comprehension* (Table 53), which indicates that one of the learners expressed absence of impression and the other demonstrated satisfaction.

In order to evaluate the digital version of the gamified tool, the learners again answered an open-questionnaire (Appendixes XXXVIII – Case 01, and XXXIX – Case 02). Table 54 summarizes the results of both cases:

**Table 54** - Analysis grid of the Evaluation Open-questionnaire

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Abilities and knowledge favored** | 1. summary | *o resumo (C1)* | 1 |
| | | ---- | - |
| | 2. comprehension | *eu gostei de compreender(C1)* | 1 |
| | | *compreensão auditiva (C2)* | 2 |
| | 4. punctuation | *a pontuação (C1)* | 1 |
| | | *uso da:s aspas (C2)* | 5 |
| | 5. introduction | *o/a introdução (C1)* | 1 |
| | 6. attention/memory | ---- | - |
| | | *atenção também (C2)* | 3 |
| | 1.vocabulary | ---- | - |
| | | *vo-ca-bu-lário né? (C2)* | 5 |
| | | ***total*** | 19 |
| **Feelings of using the tool** | 1. enjoyment | *alegria (C1)* | 5 |
| | | *gostei muito (C2)* | 2 |
| | 2. happiness | ---- | - |
| | | *feliz (C2)* | 1 |
| | | ***total*** | 8 |
| **Perception of game elements** | 1. challenges | *eu gostei muito (C1)* | 1 |
| | | *os desafios foram bons também (C2)* | 3 |
| | 2. feedback | *ah... importante (C1)* | 1 |
| | | *achei bom (C2)* | 1 |
| | 3. rewards (badges and points) | *me incentivaram (C1)* | 1 |
| | | *sim... excelente (C2)* | 3 |
| | 4. level of difficulty | *não muito difíceis (C1)* | 1 |
| | | *um pouco (C2)* | 3 |
| | 5. complementary challenge | *e/ foi muito legal... eu gostei (C1)* | 1 |
| | | *achei importante...mais desafio (C2)* | 3 |
| | 6. narrative journey | *foi bom... bombom... bom (C1)* | 1 |
| | | *bom (C2)* | 2 |
| | | ***total*** | 21 |
| **Perception of the digital-version prototype** | 1. the tool | ---- | - |
| | | *que teve bastante melhoração (C2)* | 8 |
| | 2. weakness | *não achei.. (C1)* | 1 |
| | | *música lá... da:: iara... que me incomodou mais (C2)* | 10 |
| | 3. strenght | *de quando divide... acho que o jogo fica mais legal (C1)* | 8 |
| | | *também ... a narração (C2)* | 3 |
| | 4. difficulties | *aqueles que tinham que completar as palavras (C1)* | 5 |
| | | *leitura (C2)* | 5 |
| | 5. quality | *tava tudo bonito (C1)* | 1 |
| | | *tava muito bom... dava pra ver tudo (C2)* | 2 |
| | 6. missing game strategies | *acho que não (C1)* | 3 |
| | | *acho que não... gostei... excelente (C2)* | 1 |
| | | ***total*** | 47 |

When the students answered the evaluation open-questionnaire, they were asked what their perceptions about the experience with the prototype were considering their perceptions of game elements/strategies and the use of the tool. As can be seen in Table 54, the distribution of frequencies of verbalizations for each subcategory reveals concepts of positive evaluation. The most cited

verbalizations concerned *perception of the digital-version prototype* and *perception of game elements*, and these provide a better understanding about the learners' perspectives on the tool itself. In addition, occurrences of *feelings and abilities* and *knowledge favored* indicate perceptions in the cognitive and affective domains.

Table 55 summarizes students' verbalizations regarding the interview with open-ended questions (see appendix XL – Case 01, and XLI- Case 02):

**Table 55** -Digital-version Prototyping – Analysis grid of Open-ended Question Interviews with Students

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Motivation and engagement** | 1. storytelling is great | *achei muito legal (S1)* | 2 |
| | | eu *gostei da narrativa (S2)* | 5 |
| | 2. missions are the core of fun | *eu achei legais as missões (S1)* | 7 |
| | | *sem as missões não ia ser divertido* | 4 |
| | 3. missions motive and engage | ------ | - |
| | | *eu acho legais esses jogos de fazer missões (S1)* | 10 |
| | 4. achievement stimulate and engage | ------ | - |
| | | *animei... mas pra mim e mais pra jogar do que pelo prêmio (S2)* | 3 |
| | 5.time is pressure but important | ------ | - |
| | | *o tempo é necessário sem ele não teria motivo (S2)* | 12 |
| | 6. time provokes anxiety | *eu ficava um pouco agoniada por causa do tempo (S1)* | 9 |
| | | *o tempo me faz sentir tanto frustrado quanto nervoso... fico um pouco empolgado (S2)* | 2 |
| | 7. map of adventure is motivating | ------ | - |
| | | *gostei… motiva (S2)* | 2 |
| | 8. map of adventure is a reading guiding | *mostra a localização dos níveis... e importante (S1)* | 3 |
| | | ------ | - |
| | 9. feedback is motivating | *e dada uma nova motivação para continuar (S2)* | 5 |
| | | *ele me inspira e me motiva pra continuar (S2)* | 2 |
| | 10. gamified experience provided enjoyment, engagement and fun | *eu gostei… foi divertido (S1)* | 4 |
| | | *eu gostei da experiencia que eu tive (S2)* | 6 |
| | 11. level/progression help in motivation | *quantos mais níveis a gente passa mais motivado a gente se sente para passar o final do jogo (S1)* | 5 |
| | | *isso me deixa motivado (S2)* | 3 |
| | 12. rewarding is motivating | *quando a gente ganha uma medalha ou um troféu isso incentiva cada vez mais a continuarmos jogando e ganhar mais troféus e medalhas (S1)* | 3 |
| | | ------ | - |
| | 13. rewarding is important | ------ | - |
| | | *eu gostei... é importante (S2)* | 2 |
| | 14. elements that provided more enjoyment | *o mapa e a história pois a gente lê a história, e quando terminamos as missões, tem mais um pouco da história para o jogo (S1)* | 1 |
| | | ------ | - |
| | | *as missões e a história... pois para continuar a história, e preciso fazer as* | 1 |

| | | | |
|---|---|---|---|
| | 15. elements that provided more fun | *missões, que desbloqueiam os níveis onde estão os pedaços da história (S1)* | |
| | | ------ | - |
| | 16. use of effort and persistence | ------ | - |
| | | *para ser sério e não desistir facilmente (S2)* | 2 |
| | | ***total*** | 93 |
| **Learning outcomes** | 1. recognition of difficulties with missions | *dificuldades de entendimento (S1)* | 6 |
| | | ------ | - |
| | 2. recognition of punctuation difficulties | *percebi que eu tenho dificuldade com pontuação de vírgula (S1)* | 3 |
| | | *na atividade eu tive mais dificuldade sobre pontuação (S2)* | 1 |
| | 3. comprehension and reading fluency | *agora eu leio mais devagar e com atenção* | 2 |
| | | *acho que pra compreender (S2)* | 1 |
| | 4. learning of new words | ------ | - |
| | | *me ajudou a aprender palavras novas (S2)* | 2 |
| | 5. recall legend | ------ | - |
| | | *me ajudou a conhecer mais a lenda (S2)* | 1 |
| | 6. elements that provided learning | ------ | - |
| | | *as missões contribuíram para a aprendizagem de palavras novas e pontuação(S2)* | 18 |
| | | ***total*** | 34 |

The results clearly show that students' perceptions reveal the contributions of the gamified reading experience to the affective and learning domains, as seen in Table 55. As a result, most of the frequencies (n=93) show contributions to motivation, engagement, fun, and enjoyment.

b. Teachers' Evaluation Findings

As can be seen in Table 56, both teachers reported positive opinions about the four domains in the evaluation (see answers in Appendix XLII).

**Table 56** - Digital-version Prototyping – Teachers' evaluation Results

| **DOMAINS** | Scores | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | **Me.** |
| **STRUCTURAL** | | | | | |
| Easier use of the prototype | | | | 8 | 4 |
| Prototype surface | | | | 8 | 4 |
| Suitability | | | | 8 | 4 |
| Organization and structure | | | | 8 | 4 |
| **CONTENT** | | | | | |
| Target-students suitability | | | | 8 | 4 |
| Activities pertinence according to students' difficulties | | | | 8 | 4 |
| Story accuracy | | | | 8 | 4 |
| **PEDAGOGICAL** | | | | | |
| Learning potential | | | 3 | 4 | 3,5 |
| Clarity of activities | | | | 8 | 4 |
| Vocabulary | | | | 8 | 4 |
| Innovation | | | | 8 | 4 |
| **VALUES AND ATTITUDES** | | | | | |
| Environment protection valorization | | | | 8 | 4 |
| Stereotype and prejudice favoring | 0 | | | | 0 |
| Violence encouragement | 0 | | | | 0 |

As summarized in Table 56, the respondents agreed, with an extremely positive score of -4, for the majorities of the domains. Only the item "learning potential" of the *pedagogical domain* presents a median of 3.5. Items about favoring of stereotypes and prejudices, and violence encouragement were also positively assessed, since a score of 0 means that teachers perceived an absence of these aspects.

According to the educators, a few ideas could still improve the digital version:

> Case 01: *no desafio 6 deveriam constar dicas anteriores como antecipação da atividade (T1)*
> Case 02: *sugere-se que ao retornar ao vídeo do boitatá (desafio 2) não retomar o vídeo completo ... pois muitas informações ... confundem e tiram o foco do aluno* and *retirar o fundo musical pois incomoda* (T2)

These provided positive criticism and enabled the modification of the final digital version in order to get the best solutions for a better performance in future pedagogical implementation.

The results of the open-ended question interview are summarized in Table 57, as follows (see interview's transcription in Appendixes XLIII and XLIV)

**Table 57** - Digital-version Prototyping – Analysis grid of Open-ended Question Interviews with Teachers

| SUB-CATEGORIES | INDICATORS | UNIT CONTEXT | Fr. |
|---|---|---|---|
| **Contributions to motivation and engagement** | 1. the game condition is fun and motivating | *é muito bom o instrumento da gamificação pois o aluno se sente motivado a ganhar os objetivos e a ser premiado (T1)* | 6 |
| | | *quando vem com uma proposta diferenciada de game... existe toda uma logística para trazer esse aluno para dentro dessa narrativa* | 8 |
| | 2. rewarding is motivating | *devido as premiações o aluno fica mais motivado para aprender (T1)* | 1 |
| | | *e perceber que houve o medo... mas ele venceu (T2)* | 3 |
| | 3. need of competition | *ele se sente mais motivado .... quando tem o adversário (T1)* | 5 |
| | | ----- | - |
| | 4. missions are motivating | *pois quando o aluno se sente desafiado como eu falei no início... ele vai se sentir motivado a cumprir para conseguir a premiação (T1)* | 2 |
| | | *deixam o aluno com mais interesse (T2)* | 12 |
| | 5. level progression engages the learner | *os níveis são importantes para ele se sentir desafiado e também se sentir interessado e motivado... (sentir) de que é capaz (T1)* | 6 |
| | | *o nível acaba motivando e compromissando o aluno (T2)* | 5 |
| | 6. badges are motivating for teachers and learners | *vemos na tela cheia os badges que também vão motivar o professor e o aluno (T1)* | 3 |
| | | *ele se sentiu muito motivado (T2)* | 5 |

| | | | |
|---|---|---|---|
| | 7. badges provide enjoyment and self-stem | ----- | - |
| | | *traz também essa questão do ego e da autoestima (T2)* | 4 |
| | 8. feedback motives and engages | *ainda que seja o feedback negativo ele vai impulsionar o aluno para conseguir um feedback positivo (T1)* | 3 |
| | | *o momento de ele perceber que ele tem mais uma chance e que não foi ali que ele acabou tudo (T2)* | 5 |
| | 9. time pressure is challenging | *o tempo é o principal desafio e principal motivação (T1)* | 15 |
| | | *é uma pressão muito grande mas que faz parte... o aluno precisa lidar com esse desafio para que ele consiga fazer essa compreensão e que trabalhe mais rápido essa lógica (T2)* | 3 |
| | 10. time causes tension for both teacher and student | ---- | - |
| | | *com o tempo há uma pressão maior não só no aluno... e se o professor não conseguir também se controlar ele pode até atrapalhar querendo dar elementos para que ele (o aluno) chegue mais rápido (T2)* | 7 |
| | 11.teachers' feedback and guiding provide engagement | ---- | - |
| | | *enquanto professor há o papel interventivo de estar puxando ele para dentro dessa narrativa (T2)* | 2 |
| | | ***total*** | 81 |
| **Contributions to learning outcomes** | 1. the story contributed to cultural revival | *foi importante para resgatar a nossa cultura (T1)* | 2 |
| | | ---- | - |
| | 2. the game condition contributed to decoding and comprehension | *tá ligado diretamente a compreensão (T1)* | 5 |
| | | *até o final do jogo ele já pronunciava (as palavras) sem nenhuma dificuldade fonética (T2)* | 10 |
| | 3. sound and image animation contributed to comprehension | *então juntamente com as letras vem as imagens e vem os sons... e isso tudo ele vai juntando na cabeça dele para culminar na construção do sentido da palavra (T1)* | 2 |
| | | *o próprio som que também vai trazendo (o aluno) para compreender o mundo que está acontecendo ali (T2)* | 5 |
| | 4. recognition/recall of reading difficulties (or not?) | *o jogo ajudou a aluna a admitir suas fraquezas e suas dificuldades na leitura: 'eu realmente não sei lidar com isso...não sei lidar com pontuação' (T1)* | 7 |
| | | *a percepção ficou muito mais visível ao professor ... eu acho que não é o jogo em si que vão percepção pro aluno (T2)* | 8 |
| | 5. teachers' guiding and feedback provide better comprehension | ---- | - |
| | | *o próprio mediador que é o professor... num momento de não compreensão de estar mostrando para ele (o aluno) alguma coisa que está passando despercebida e ele conseguir se localizar melhor na narrativa mesmo (T2)* | 12 |
| | 6. the game condition contributed to vocabulary | ---- | - |
| | | *houve uma melhora e ampliação de vocabulário (T2)* | 3 |
| | 7. the game condition contributed to memory | ---- | - |
| | | *memorias que são necessárias para que ele busque as informações para dar continuidade a uma outra aula (T2)* | 3 |
| | | ***total*** | 57 |

As seen in Table 57, these findings highlight that most frequencies (81 utterances) concern the contributions of game elements and game condition to motivation, engagement, fun, enjoyment, and interest. Furthermore, a lower number of occurrences (57 verbalizations) expressed significant opinions about the game condition and particular elements such as image and sound animation, and the contributions of teachers' guidance and feedback to learning outcomes.

Considering the participants' feedback, the prototype underwent a few modifications, such as the inclusion of a saving progress function with the aim to allow the students to use the same journey player at different times. Moreover, a multiplayer feature was included, by which more than on learner can play in the same environment, but not at the same time, as shown in Figure 45:

**Figure 45** - Multiplayer Feature


Source: Elaborated by the authors

These features meet the teachers' suggestions about the necessity to provide a way to complete the reading journey through various assistance sessions, as well to record the reading progress of more students in the same story setting.

## 4.4 Discussion

The main purpose of this work was to investigate and develop a process for the prototyping of a gamified tool to support reading and learning of Brazilian students with dyslexia. A non-linear process involving four phases was followed and led to the development, testing, and evaluation of the gamified storytelling. Several points of this entire work are highlighted in this discussion.

### *4.4.1 Empathizing: Learning about Students with Dyslexia*

The first phase of this research project, according to the Design Thinking approach (Brown & Wyatt, 2010), was dedicated to the exploration of the

learners' thoughts, feelings, motivations, needs, and difficulties and provided information for designing a tool that actually worked for the participants. It was not possible to explore all the students' schooling experiences; however, we were close and chose to learn mainly about their difficulties with dyslexia and their interactions in the school context.

This first stage involved observation and an immersion in the SRM context in order to have a deeper understanding of the issues, students' needs, and challenges of individuals with dyslexia at school. This process of exploration and immersion provided important insights that could allow us to define for whom we would design a gamified solution.

Data triangulation showed relevant findings about the *students' dyslexic characteristics* and *dyslexia in Special Education*.

A. Student's Characteristics

As shown in Table 8 (p. 78), *reported* data communicated important past information about students, such as their dyslexia history, highlighting the process of dyslexia identification and its early indicators, as well as their schooling experiences, which allowed us to understand if there was a precocious identification and, consequently, a needed prompt to proper intervention (Alves, 2014). As seen in Table 8, the dyslexia of the participants in this research was identified at pre-school age for both, which possibly enabled an early intervention.

The reported types of difficulties in the interviews provided interestingly insights on the problems faced by the students. Tables 9-11 (p. 79-80), for example, summarize findings that reveal past, current, and absent difficulties from the perspective of the legal guardians. This demonstrates that learners overcome their difficulties with time when appropriate and systematic interventions are implemented (Shaywitz et al., 2008). However, the participants in our project still kept a range of dyslexic difficulties, which were divided into different domains (reading, writing, and memory and cognition), also identified in the teachers' interviews. Tables 15-17 (p. 84-85) more specifically present which kind of dyslexic difficulties are still presented by the students. Therefore, as students 01 and 02 are teenagers with some years of schooling and support at the SRM, which represents a crucial role in their cognitive development, their reading accuracy and decoding probably improved in connection with educational assistance. As claimed by Rizzato (2015), dyslexia is a long-life learning disorder that persists, and there are degrees of expression of this specific learning difficulty in adolescent and adult individuals.

*Evinced data* validated the existence of the dyslexic difficulties pinpointed in the interviews for both cases. These data showed six subcategories with indicators of dyslexic difficulties for both cases, shown in the mapping

literacy activities listed in Table 19 (p. 87). These were important findings because the students could demonstrate what is still hard in reading or writing activities. Also, the results in Tables 20-22 (p. 88-90) are in agreement with the signs of dyslexia mentioned in the literature (IDA, 2002; Riddick, 1996; Rodrigues & Ciasca, 2016; Teles, 2004).

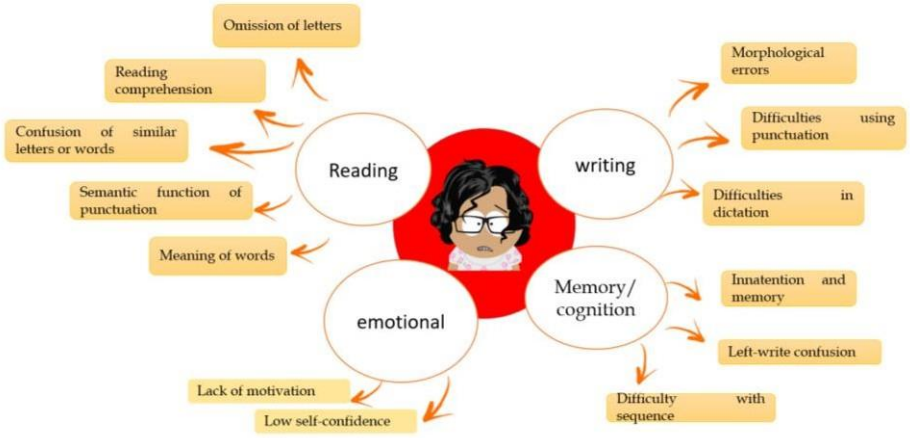
Moreover, these findings also reveal that student 01 acquired good decoding skills, but presents many difficulties in comprehension. According to IDA (2017), by getting good and proper instruction, some individuals with dyslexia are able to decode and spell, but may experience difficulties later on, when they are required to be engaged in more complex activities. Thus, even presenting reading fluency and spelling ability, it is important to take into consideration the difficulties that both students face when reading.

These results helped create a new perspective about dyslexia signs in adolescence by providing perceived and manifested difficulties, indicating that next steps of the research should be focused on how both learners differ in the nature of their literacy problems and how to apply adapted levels of difficulties in the gamified solution.

One type of problem reported in the interviews was named emotional problems. This type seems important given that dyslexia affects the students' life inside and outside the school. The data reveal controversial information about student 02 because the legal guardian perceived an individual motivated to learn and who is self-confident. On the other hand, the teacher perceived a demotivated person with low self-confidence, as seen in Tables 12 (p. 81) and 18 (p. 86). In the face of these two pieces of information, the perception about how learner 02 feels about performing literacy activities seems to be different according to the context. Regarding student 01, both informants highlighted her emotional constraints when performing academic reading. This type of finding is important given the need to understand that dyslexia can cause loss of confidence, feelings of inferiority, and frustration. With respect to this, the emotional side seems to be one of the most missed areas in dyslexia; for this reason, parents and teachers may offer continuous and consistent encouragement and support in order to help students with the emotional side of dyslexia (Ryan, 2018).

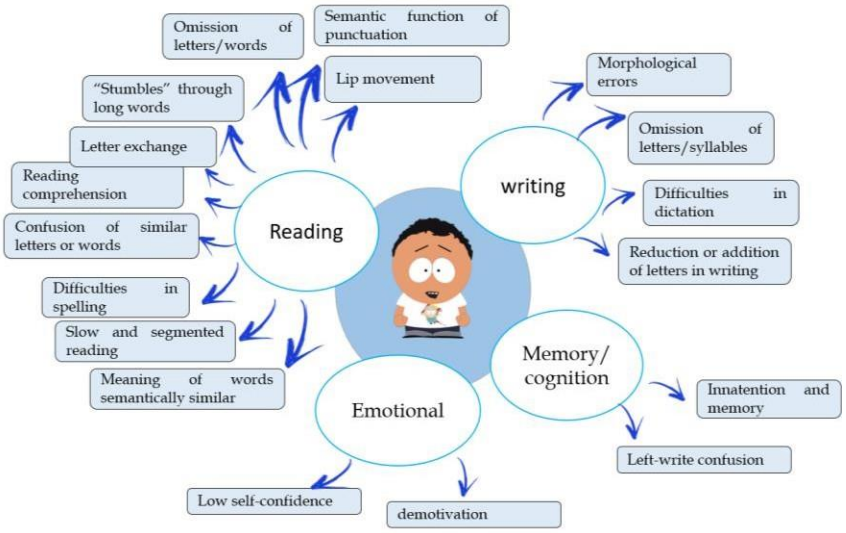
Overall, the *evinced* and *reported data* allowed an overview of the learners' difficulties, as presented in Figures 46 and 47:

**Figure 46** - Student 01 Literacy and Cognitive Difficulties




Source: Elaborated by the authors

**Figure 47** - Student 02 Literacy and Cognitive Difficulties




Source: Elaborated by the authors

In summary, although they are both literate students, with some reading experience, the literacy difficulties of student 02 are more perceptible than those of learner 01. This noticeable difference perhaps indicates that students have different degree of dyslexia, as pinpointed in the DSM-5 (APA, 2014).

Data on *awareness-raising activities* provided a better definition of the student-participants profile, given their own perceptions. Overall, the results summarize how students view/perceive/feel dyslexia. According to the purposes of these activities, it was shown that:

(i) Perception about their practice in reading

Perceptions about own reading ability and fears and interests in reading is important to learning because it affects students' motivation

and academic achievement (Majer, 2018); thus, that is a point that deserves consideration. The students' performance in educational activities might be affected by how learners feel about reading learning. Looking at Table 23 (p. 91), it is possible to easily identify that students 01 and 02 express a positive self-perception of their reading skills.

This seems to show that students believe in their own ability unless they are asked to read aloud. But this fear of failure may not be related to the learners' skills, but to lack of confidence, since students with dyslexia frequently have problems with demotivation, self-esteem, and self-confidence (Carvalhais, 2010; Majer, 2018), which may affect how other people, e.g. teachers and parents, perceive the students' reading ability.

Helping the students with this fear of failure when reading aloud may be considered in order to enable them to better cope with their difficulties. Thus, we can take advantage of the students' interests in reading in the learning process for the purpose of designing the gamified tool in the next steps.

(ii) Perception about own dyslexic difficulties

The students' perceived difficulties may not reflect all their real difficulties, but give us their perceptions about progress in learning. In order to get a clear picture of how they see their difficulties, it was simply asked of them to *Tell us about your dyslexic difficulties.*

Learners appeared to be comfortable with the question and understood its importance for this research. When talking about their difficulties due to dyslexia they pointed out difficulties in the past and in the present, as presented in Table 24 (p. 92). By comparison, they show how they improved with educational support. Some parts of their answers mentioned "eu *tive* dificuldades na leitura e na escrita" or "antes, eu tinha dificuldades…". In order to clarify the current difficulties, students usually used expression as "até hoje eu ainda tenho …" or "hoje eu já consigo mas demoro" or "estou começando a aprender ais". These kinds of utterances emphasize the pupils' comprehension of how dyslexia manifests itself in different ways at different stages of life when the students receive appropriate academic support (Riddick, 1996).

In addition, it is important to highlight that descriptions of past and present-day difficulties show problems with spelling, writing, decoding, and reading comprehension, in addition to cognitive work, such as focus and concentration, as learner 01 mentioned more than once. This information shows that deficits in reading and writing commonly occur together, as stated in the DSM-5 (APA, 2014) and discussed in the literature (Rodrigues & Ciasca, 2016).

Furthermore, both participants were asked about their comprehension of the label dyslexia. Their answers associate the literacy disorder, including writing, as seen in the verbalization of student 02. This specific finding indicates the relevance of teachers and parents talking about dyslexia as a reading impairment in order to promote the students' awareness and positive feelings (Riddick, 1996).

Table 24 (p. 92) also summarizes the findings regarding *how students cope with their difficulties.* They were also asked to talk about specific strategies they used to ask for help when dealing with their reading and writing difficulties. Both learners gave similar answers concerning asking for help in class: "eu peço ajuda ao professor, colegas, e até à professora da Sala de Recursos". As to dealing with reading and writing problems, they mention utterances as "ler lentamente", "evitar escrever palavras longas", "eu leio devagar para tentar entender todo o texto", "evito ler em voz alta", and even ask "para fazer as atividades em casa". These findings explicitly show that both learners, as teenagers with some reading experience, are clear about their difficulties and that they resort to strategies in order to deal with them.

(iii) Impressions on educational support

The results in Table 25 (p. 94) show interesting content about how participants perceive educational support in their learning experiences. It was considered relevant to listen to the learners' voice with the aim to understand *what they had to say about school*.

A closer look at the participants' verbalizations pointed to the figure of teachers highlighting their lack of knowledge about the learners' condition and the absence of specific support targeting these pupils. This figure reveals that some teachers are more supportive on one side while others are more impatient/stressful or even harassing. The specialized teacher in the setting of the SRM appears warmer and more supportive in learning. This is not entirely surprising given the difficult of teachers to deal with this disorder (Rodrigues & Ciasca, 2016) in mainstream classes. Although Special Education teachers are prepared and paid to help these learners, it is time the rest of the teachers also learn how to support and embrace pupils with dyslexia, as claimed by Ianhez and Nico (2002) and Riddick (1996).

Learners also made considerations about common activities not being useful for their learning such as "testes são díficeis e não ajudam", "eu não gusto de ler em voz alta na sala de aula… eu fico nervoso". These sentences show that creating appropriate teaching for students with dyslexia is as important as any other treatment (Demonet et al., 2004). Moreover, people with specific reading and writing difficulties may be

engaged in school by multi-sensory activities (Silva, 2004). Additionally, different teaching strategies and methods for the inclusion of these students and learning improvement were not mentioned. This finding suggests that there is a lack of adjustments that should be proposed by a collaborative group of general and special education teachers (IDA, 2017).

Another relevant point is related to the relationship with non-dyslexic students. Both learners made reference to the lack of knowledge about their disorder and support, as well as presence of animosity, when talking about their peers. Casserly (2012) postulated about the role of peers in the students' lives because their actions are influenced by those that are closer and the verbal persuasions they get from their peers. The verbalizations of student 02, for instance, express also that the animosity and negative labeling come from his peers, which probably contributes to his self-impression. Majer (2018) highlighted that students with dyslexia provide a negative self-evaluation of their competence compared to the perceived abilities of their peers. Thus, in order to avoid negative effects on children and teenagers with literacy impairments it is necessary to explore how students with dyslexia relate to their peers and teachers at school, so that they cannot be undermined and neglected.

Besides teachers and peers, parents' support may also have an impact on students' learning. The parents' role is not only to support learning, but also to the motivation and confidence of the adolescent. The learners' experiences with their parents are pointed as supportive and guiding, thus they seem to perceive their parents as encouraging figures. This seems to indicate the relevance of parents working closely with teachers with the aim to provide better interventions for learning improvement (Riddick, 1996).

Finally, students also talked about their self-perception of their learning behavior at school. As seen in Table 25 (p. 94), the findings expressed a part of a self-image about their engagement in academic activities. Students present different perceptions that explain how they behave in a regular class, at the SRM and at home doing homework. These are interesting findings because they seem to indicate a relationship between self-perception, self-esteem (Majer, 2018), commitment to learning, and teachers'/parents' perceptions.

(iv) Feelings and Thoughts

The category of feelings is highlighted given the importance of knowing the students' sentiment, specifically because reading and writing are the center of the academic activities in this phase of schooling. The findings in Table 26 (p. 96) reveal significant information about the feelings they experience in the educational setting.

The indicators identified in the analysis process show how the SRM is a comfortable and inclusive learning space to both students, and how they feel sad about the lack of official inclusion of individuals with dyslexia in pedagogical specialized assistance. Since emotions can be affected by teacher-student and peers-student relationships, learners were asked how they feel about these school figures. According to their answers, it was not possible to observe a caring relationship with educators; however, they did not refer to negative feelings. As for the peer-student relationship, the girl participant referred to classmates as "amigos", which seems to represent positive feelings. On the other hand, student 02 expressed stress related to the feeling of being different from the others or being bullied by some classmates. "eles me chamam de preguiçoso e tartaruga", he said (as shown in Table 25, p. 94).

Feelings about schooling activities reveal important findings on how both students feel uncomfortable with tests and exercises. This underlines the importance of creating diversified teaching and learning strategies according to the needs of students with dyslexia (IDA, 2017). This is associated with their difficulties with academic tasks; thus, when asked how they feel about their difficulties due to dyslexia, the learners described feelings such as *dissatisfaction*, *anxiety* and *stress* caused by their difficulties. Those feelings may lead to avoidance of situations in which the learner feels incapable of reading.

Understanding the students' feelings represents an important part of inclusive teaching at school, especially when students with literacy impairments are adolescents. According to Eissa (2010), in adolescence students may experience more frustrations or stress because reading is the center of their academic activities in this phase, and they do not feel comfortable participating in activities in which they are required to read or write.

This important task of understanding students' emotions is the responsibility of teachers and parents (Weissman, 2014). Both of them may work together to help students learn what is or not dyslexia and understand that they can learn differently from the other classmates. Teachers also must know dyslexia and their characteristics in order to give the learners' proper aid to become successful at the school activities. In addition, parents can provide assistance at home with homework. This

kind of collaborative work may provide appropriate support, and hopefully help diminish the students' frustrations, discontent, stress, and anxiety.

(v) Expectations about School support

The findings in this category express three interesting aspects: i) *inclusion* – students highlight expectations of inclusion of learning tools, such as computers, into regular classes and also into SRM assistance. Additionally, learner 01 emphasized she expected inclusion of students with dyslexia in the one-hour sessions at the SRM; (ii) *time* – both learners highlight the need for more time *in class* or extending time for tasks at home; and iii) *attention* –the need for teachers' and peers' attention was emphasized.

These three identified aspects are evidence of the need for accommodations, as pointed by Shaywitz et al. (2008). According to these authors, assistive technologies, like computers and other tools such as software, may be used as a compensation for handwriting or fluency difficulties. In addition, there is scientific evidence of needed extra time on tests/tasks, specifically as the students' progress to major school. The need for attention seems to highlight again the impact of teachers' and peers' perception on students' lives (Casserly, 2012) and how they need/want special attention to their specificities.

(vi) Motivation to get involved in reading/writing practices Motivation

is a central aspect in this research given that it is a key concept in gamification, as postulated by Kapp (2013). Likewise, this concept is important to individuals with dyslexia (Carvalhais, 2010) because it represents an important factor in determining the learning success of students with disabilities (Dev, 1997).

Tables 28 and 29 (p. 97 - 98) indicate that the student-participants demonstrated a small significant difference concerning *motivation to comply with activities,* since student 02 manifested to be more connected and interested in activities. As for the domain *motivation for achievements,* the scores express low motivation for student 02 as he does not feel self-encouraged to perform the reading activities or challenged by the school tasks. Finally, in the domain *engagement to learn*, both learners agree they feel excited, dedicated, and self-confident in their own learning at school.

These findings demonstrate that pupils think positively about themselves as learners and perceive themselves as motivated to achieve good learning results. On the other hand, the scores express that the

students are not highly satisfied with what the school offers as activities and how it challenges them for literacy activities. In this respect, as claimed by Dev (1997), tasks must be evaluated in order to increase the learners' intrinsic motivation. Consequently, evaluations help bring more effective pedagogical interventions to students with learning difficulties aiming to develop a desirable level of learning.

B. Dyslexia in Special Education

Students with Specific Learning Difficulties, such as dyslexia, present educational needs. They need appropriate pedagogical interventions in regular classes and/or the support of a specialized teacher in Special Education. The use of interviews and documentary analysis in this research project allowed for a better comprehension of how learners with learning difficulties are assistedin the Brazilian Education system, as shown below.

(i) Brazilian Specialized Education

The educational law, Lei de Diretrizes e Bases (LDB - 9.394/96), governs the Brazilian educational system and ensures access to quality education for all Brazilians from a pluralistic perspective, thus providing access to the public with special needs. This law defines Special Education as part of the pedagogical proposal of mainstream schools. As a state duty, it may be offered from early childhood throughout the entire schooling life of a student.

This legislation establishes the duties of the Brazilian educational system by highlighting guidelines on specific curricula, methods, teaching strategies/resources to support students with special needs, school adaptations, educators with proper instruction, training for labor market and social equity; additionally, it provides specific policies of inclusion for learners with high skills, as summarized in Table 33 (p. 105)

Moreover, Decree no. 7611/201, as seen in Table 34 (p. 107), defines Special Education as a set of activities and accessibility resources arranged institutionally and continuously organized. It disposes specific important guidelines for: a.) Special Education as an integral part of regular education, with development of pedagogical resources/tools for the promotion of inclusive education and assuring the students' continuous education across all schooling levels; b.) the complementary or supplementary offer of Specialized Education Assistance and other special education services; and c.) the creation of an inclusive system aiming to guarantee access to the educational regular system to people with disabilities/special needs.

In summary, this document analysis provided a comprehension about the current legislation of Special Education as part of regular and obligatory schooling in Brazil, whose guidelines are founded in the Brazilian Federal Constitution. Based on inclusive education perspectives, this Special Education policy establishes assurance of an inclusive educational system without discrimination across all schooling levels and is based on the equality of opportunities and the non-exclusion of any student with disabilities.

(ii) Target public of the specialized education

The Lei de Diretrizes e Bases (LDB - 9.394/96), in its article no. 4, addresses aspects related to Inclusive Education, mainly highlighting the target public of Special Education – students with disabilities (physical, mental, visual, auditory, sensorial or intellectual disability), high skills (gifted), and pervasive developmental disorder, as seen in Table 33 (p. 105). Students with Specific Learning Difficulties – e.g. dyslexia, dyscalculia or dysortographia – are excluded, as pointed by Martins and Tonini (2011).

Decree no. 7611/201 also provides the same guidelines, as summarized in Table 34 (p. 107). Despite this inclusive perspective, there is no reference to students with specific learning difficulties and other disorders, as verbalized by teacher-participants in Table 30 (p. 99). Although the parents of individuals with dyslexia look for support from schools, these students are not legally supported. In light of this, it is hard to find or identify these types of individuals at public schools. The students participating in this study are part of only three cases enrolled in Special Education Attendance at Crie in the city of Belém-Pará.

The presence of these students at the SRM is associated with the type of educator practices. The findings in Table 30 reveal two different practices: *Regular attendance of students with dyslexia* and *Practice of advisory to students with dyslexia.* According to teacher 01, a kind of "assessoramento" is offered, by which she offers advisory assistance over tests to learner 01. On the other hand, teacher 02 offers weekly individual assistance sessions to student 02. Even though this learner is not officially part of the SRM demand, educator 02 advocates the inclusion of all students with disabilities and learning difficulties, based on educational inclusive education perspectives (Oliveira, 2007), as seen in Table 30.

(iii) SRM in practice

In the perspective of inclusive education, decree no. 7.611/2011defines specialized educational services as a set of activities

developed in SRM located in the same school where the learner is attending regular classes. SRM are classified as spaces equipped with diverse pedagogic tools, furniture, and equipment aimed at the necessities of the students or Specialized Educational Centers (as shown in Table 32, p. 103). According to teachers, equipment is provided by the Federal Government and private institutions, and materials are also collaboratively produced with the students. Concerning the materials, teacher 02 highlights that they are still children-oriented materials. Therefore, there is a need for more appropriate pedagogical resources for adolescent learners, as seen in Table 32.

Both the SRM researched at the two schools are organized to offer weekly attendance sessions to students with dyslexia and also support to mainstream class teachers. As presented in Table 30 (p. 99), SRM also have teachers' assistants, undergraduate students whose work is to mediate the students with disabilities-teacher and student-student relationships, in addition to monitoring the process of learning of these special needs' pupils. All the support work developed is supervised by the specialized teacher at the SRM.

The SRM, in practice, according to D. Alves (2006, p. 12), "responde aos objetivos de uma prática educacional inclusiva que organiza serviços para o atendimento educacional especializado, disponibiliza recursos e promove atividades para desenvolver o potencial de todos os alunos, a sua participação e aprendizagem".[29] Thus, it is a space of an inclusive school where complementary support is offered to explore students' skills and competences. It is multifunctional by virtue of its wide capacity to support all type of disabilities using a variety of pedagogical resource/tools, such as tv, computer, assistive technologies, games, toys, and so on (Table 32, p. 103). Obviously, teachers and students also have difficulties in practice due to malfunctioning of tools and electronic/digital devices, no access to the internet, and lack of dialogue between specialized teachers and mainstream teachers in regard to sharing resources.

Therefore, as a place of specialized assistance, the SRM may continuously offer creative and diversified activities by means of adapted resources and materials, aiming to stimulate the learning of math, communication, and reading/writing (Santos et al., 2016), and also provides a welcome time according to the learners' individual needs and difficulties (as summarized in Table 32).

[29] "It responds to the objectives of an inclusive educational practice that organizes services for specialized educational assistance, provides resources, and promotes activities to develop the students' potential, participation and learning." (free translation)

(iv) Specialized educator work at the SRM

Specialized educators are set to take part in various actions at the SRM. As the findings revealed, the pedagogical work is organized by means of teaching planning. As seen in Table 35 (p. 108), according to their practice, teacher 01 creates a general planning to embrace all the SRM activities and students and teacher 02 develops an individual plan for each student, including the one with dyslexia, as summarized in Table 36 (p. 110).

This act of planning may be part of the whole process of teaching with the aim to improve students' learning efficiently. It means that teachers consider the students' learning, establishing learning goals and learning strategies/resources. The presence of *expected outcomes* in Table 36 shows what kind of learning is expected. It is a critical aspect that can be used to modify or improve teaching strategies/techniques over a schooling period.

Planning embraces the organization of actions based on a need analysis and diagnostic evaluation in order to collect information to clarify the students' needs, as mentioned by teacher 02 in Table 31 (p. 101). This provides individual planning according to the learners' profile and a variety of teaching strategies, including educational games, with the aim to develop learners' capabilities. This range of learning strategies and materials also encompasses activities developed with students with dyslexic difficulties, as revealed in Tables 31 and 32 (p. 101 e 103)

The actions of these two teacher-participants at the SRM ensure specialized educational assistance to students with dyslexia, supporting them and meeting their needs. This practice motivates a discussion about the need for correcting the existence of inaccuracies in defining inclusive education parameters. Therefore, a wide (re)debate about the Brazilian special education legislation, aiming to include students with SLD and other disorders as part of the special education's demand, can help with a desirable schooling inclusion of a large variety of special needs (Lombardi et al., 2016). Finally, inclusion is a citizenship and human developmental weapon. Therefore, if it is properly applied it guarantees consequent social inclusion.

### *4.4.2 Ideation Experience*

Ideation is a stage of DT in which designers, following data collection for exploration and inspiration, make sense of what they heard and saw in the field in order to generate insights to create opportunities for designing a solution (Brown & Wyatt, 1010). In view of this definition, the process of ideation represented an opportunity to be creative and imaginative toward the generation of ideas to design and create a gamified tool, in addition to applying knowledge (Carroll et

al., 2010), which meant to transform the knowledge developed about the students with dyslexia and their needs into a potential gamified solution.

Murakami and Júnior Leite (2014) and Cavalcanti (2014) have revealed the importance of this stage as a time of team effort toward the conception and prototype design of a virtual learning environment and serious game, respectively. Likewise, this research was focused on a collaborative work with the researcher, students, and teachers in cocreation meetings. As described in Section 4.2, the cocreation sessions provided relevant information about the learners' profile and their interests in game and game elements and, consequently, defined the learners' profile as *explorers* and *achievers* (F. Alves, 2014). They also provided information about the type of actions to be provoked by the application of decisive game features. Moreover, they evoked the pupils' previous knowledge about narrative elements (time, place, characters, scenario…) and game features.

This phase of ideation was crucial by representing a transitional stage from exploration and learning of context and participant characterization to the prototyping of the gamified storytelling. This time for designing was about focusing on the learners, generating ideas, and determining the right features of the tool, such as the gamification framework, type of tool, and narrative journey structure, as presented in Section 4.2.

The process of creation also represented a time to practice ideation as an important key to expand ideas. As an educational research in the Special Education context, the emphasis on this creative process demonstrates the confidence that students with dyslexia could be part of creating a solution to support reading by giving suggestions/ideas. Even though the process of getting ideas was hard given the learners' timidity and difficulties in sharing suggestions, this phase highlighted the relevance of challenging students with learning difficulties to participate in creative work, and also restates the significance of a student-centered pedagogy (Scheer et al, 2012).

### *4.4.3 The Gamified Reading Experience*

#### 4.4.3.1 Benefits of the Pre-reading Strategy

As an interactive activity, the process of reading creates meaning through the reader-text interaction (Leffa, 1999; Nunes, 2000). Therefore, this process involved strategies by which learners were prepared to get engaged in reading.

First, a pre-reading activity was developed, i.e. the first important stage in the reading activity. Its aim lied on previewing or surveying text information, focusing the students' attention and interest in a text, activating background knowledge, and introducing text vocabulary or structure.

The analysis of critical events of the pilot-test and the main test shows that benefits of this previous survey, as summarized in Tables 39 (p. 127), 42 (p. 133) and 50 (p. 140).

a. **Reading prediction** – This is a very important strategy because it helped the students making connections between what the text was leading to and what the learners already knew (Koch & Elias, 2011). Prediction motivated by title analysis, as seen in critical event 1, action 1, lines 1-19, Appendix XXI; critical event 1, action 1, lines 1-16, Appendix XXIV; critical event 1, action 1, lines 1-29, Appendix XXV; critical event 1, action 1, lines 1-31, Appendix XXXIII; critical event 1, action 1, lines 5-24, Appendix XXXIV) helped with the theme anticipations; presentation of vocabulary, text type and structure (critical event 1, action 3, lines 1-8, Appendix XXIV; critical event 1, action 3, lines 1-4, Appendix XXV; critical event 1, action 2, lines 1-4, Appendix XXXIII; critical event 1, action 2, lines 1-7, Appendix XXIV supplied learners with text processing through type of text identification and linguistic and background knowledge (Koch & Elias, 2011).

b. **Activation of prior knowledge** – Good readers may apply their prior knowledge to reading. Regarding the use of images of fantastic beings, this was a relevant resource to help determine the previous knowledge of students about the region and the Amazon folklore, aiming to anticipate meanings. The indicators of previous knowledge activation, such as remembering fantastic beings, guessing the story content and questioning students, as seen in Appendices XXI (critical event 2, actions 1 and 2); XXIV (critical event 2, actions 1, 2 and 3), XXV (critical event 2, actions 1 and 2), appendix XXXIII (critical event 2, action 1), and appendix XXXIV (critical event 2, action 1) provide a connection between the students' prior knowledge and the new text in order to ensure reading comprehension (Koch & Elias, 2011).

In addition, these critical events evince that pre-reading has fulfilledits purpose of increasing learners' interest and confidence in the engagement in a gamified reading, and also creating conditions for text comprehension by connecting encyclopedic knowledge with new information.

#### 4.4.3.2 The Game-based Reading Process

The incorporation of game elements/strategies into storytelling provided an opportunity to help students with dyslexia. The potential of these elements appeared to be able to help in learners' motivation for learning and engagement in the reading activity. Additionally, applying these game mechanisms to a supportive tool seemed to help students find fun in the reading activity, as demonstrated by their enjoyment of the experience. In this research project, it is believed that gamification in practice served as an intervention for the cognitive and affective domain (Muntean, 2011).

Testing and assessment of the paper- and digital-version of the gamified tool provided key findings about the game's designed elements, as discussed below. For the purpose of giving answers to the research questions − *How do game elements/strategies influence students' engagement and motivation?* and *How do game elements/strategies influence students' learning?* −, game design elements are discussed, focusing on their influence on motivation, engagement, and learning outcomes.

*a) Motivational and Engagement Effects*

Considering that gamification is about engaging users to an emotional level and motivate them to reach defined goals (Simões et al., 2015), this gamified tool incorporates a set of game mechanisms and rules that define the game setting of this reading tool and help with two psychological outcomes – motivation and engagement (Saputra, 2015). Elements as *challenges, feedback, goals, fantasy, adventure map, unlocking levels/progress, and time/pressure* and *points/badges* seemed to have a major influence on the degree of students' engagement and motivation, as well as enjoyment.

- Challenges and Feedback

This gamified tool was focused on some conflicts represented by challenges. These types of game elements help users understand what to do in a gamified experience (Zichermman & Cunninghan, 2011). These missions are represented by literacy activities that had to be solved against the tool itself, with the teachers' help (as seen in Appendix XV, p. 542-543). There were seven challenges adapted to the reading skills of both participants. Paper-version prototyping allowed the first test to determine which missions would be challenging to the students.

The use of missions at the center of this gamified tool was implemented to provide the feeling of excitement and accomplishment to the students. As seen in Tables 40 (p. 127), 43 (p. 134), and 51 (p. 141), the indicators provided information about the actions around the seven missions. These actions reveal the fundamental goals of the reading process.

In this experience, it was verified if the relationship between challenges and skills ensures engagement in a gamified experience. Therefore, this psychological effect was revealed with participation and interest in the process. Participant observation revealed evidence of engagement and loops of engagement in the two type of prototypes.

In the paper-version test, learners were interested in participating in the experience by unlocking the chapters (levels) and fulfilling the missions. Figure 48 illustrate these challenges:

**Figure 48-** Challenges Presentation of the Paper-version Prototype


Source: Elaborated by the authors

The challenges were planned so that they would not be easy nor impossible to complete by learners. However, it was observed in the process that the need of resources, such as pencil, paper, and editing apps to take notes and give answers, demonstrated the learners' problems with writing. It revealed difficulties with: a) punctuation (critical event 1, action 3, lines 1-28, Appendix XXII; critical event 2, action 3, lines 8-28, Appendix XXVI; and critical event 1, action 3, lines 1-28, Appendix XXVII); b) word contextualization (critical event 4, action 2, lines 6-30, Appendix XXVII); c) omissions (critical event 8, action 2, lines 75-93, Appendix XXVII); and d) difficulties with the use of adjectives (critical event 6, action 4, lines 12-31, Appendix XXII)

When working on some missions, the pupils showed more concentration and *anxiety*, probably resulting from a higher challenge and less skills (Hamari et al., 2014), and also *frustration*, as learner 02 and the student of the pilot-test seemed to demonstrate when they failed the challenges (critical event 4, action 3, lines 1-3, Appendix XXVII; and critical event 1, action 5, line 1-4, Appendix XXII, respectively). In missions where a balanced level of difficult and skills was required, more happiness and pleasure were observed (Alexiou & Schippers, 2018) when they felt they were able to comply with the mission (as seen in critical event 2, action 3, lines 1-3, Appendix XXII; critical event 2, action 3, lines 33-35, Appendix XXVI, and critical event 3 action 3, lines 8 -18, Appendix XXVII)

One important point to make is that accomplishment of challenges and its relationship with re-engagement when students fail is related to teachers' guidance. This was an extremely important observation in this work, that providing continuous and concomitant feedback and guidance helped with the learners' engagement levels (Csikszentmihalyi, 1988; Sweetser & Wyeth, 2005). Since the assessment of all the tools and resources, including time, was made by the teacher and researcher, it was possible to provide longer explanations and teaching support throughout the reading experience. Thus, every time the participants made literacy mistakes due to their dyslexic difficulties, the educator's guidance did not allow them to feel lost or disoriented. This observation led to a conclusion about the importance of the role of educators as facilitators, aiming to sustain pupils' skill improvement (Ianhez & Nico, 2002; Ridick, 1996).

The process of iteration provided challenges and changes in order to adjust the missions and the level of the students' skills. Thus, the digital version presented a method of adapting the difficulty level of the challenges and excluded any writing task. The digital version presents missions, as shown in Figure 49:

**Figure 49** - Gamified Tool Missions


Source: Elaborated by the authors

Each mission has different adaptative levels. Thus, the students had more than one try to fulfill a mission: 3 tries for missions 1-4, and 2 tries from the complementary mission – mission 6. The adaptative aspect lies on the levels of difficulty. Thus, if the learners fail on the first attempt, negative feedback provides adjustment for the second and third tries by presenting aid hints/resources to make the mission easier to the apprentice. An example of this is presented in Figure 50:

**Figure 50–** Adaptative Challenges – Mission 1


Source: Elaborated by the authors

The digital-version test provided evidence that adaptative challenges focusing only on reading skills increased student involvement. The critical events of testing still revealed that students keep trying to overcome challenges. Table 51 (p. 141) summarizes, in indicators of *Actions of challenge 01*, a good example of how learners were engaged

in surpassing the levels by solving the missions through various tries. Emotions and feelings, as well as amusement, were also demonstrated by learners when surpassing a level (critical event 1, action 5, lines 58-60, Appendix XXXV; critical event 1, action 6, lines 1-4, Appendix XXXVI). Therefore, emotional and cognitive engagement (Alexiou & Schippers, 2018) referring respectively to concentration in challenges and demonstration of feelings and emotions such as happiness, enjoyment (critical event 7, action 3, lines 1-4, Appendix XXXV; critical event 3, action 3, lines 1-3, Appendix XXXVI), frustration, anxiety (critical event 1, action 4, line 2, Appendix XXII; critical event 2, action 2, lines 10-12, Appendix XXXV; critical event 7, action 2, lines 9-10, Appendix XXXVI) or satisfaction (critical event 2, action 3, lines 2-3, Appendix XXII; critical event 3, action 3, lines 1-4, Appendix XXXV; critical event 4, action 5, lines 1-4, Appendix XXXVI) indicate the students' involvement in the gamified reading experience.

In summary, besides the emotions identified, dimensions of flow such as concentration on tasks, clear understanding of goals, challenging actions, and sense of control when overcoming missions (Simões et al., 2015) were verified in this gamified experience.

When invited to be engaged in missions in order to unlock chapters, students also demonstrated intrinsic interest in knowing more about Piazinho's story. The perception of their own skills to fulfill the missions increased their intrinsic motivation (Hamari et al., 2014) to keep participating in the experience. Thus, the presence of a game element such as a challenge influences intrinsic motivation, i.e. personal enjoyment and interest in taking part of an activity (Lie, 2011). This is the strongest type of motivation that sustains engagement in a process and is associated with learning.

As revealed by the findings, this demonstration of being capable to fulfill challenges offered by a tool, planned and designed specifically according to the students' needs/interests and difficulties, made the experience meaningful.

Gamification involves people at an emotional level. Posing challenges with defined goals is a way to keep people emotionally immersed and engaged to reach significative aims (Burke, 2015). Furthermore, this author refers to the encouragement of individuals participating in a gamified activity.

Encouragement was provided collaboratively by teachers and the research object throughout the reading experience. This continuous action highlights the relevance of *feedback* in gamification. This game element can assume an effective role keeping the cognitive engagement of students (Alexiou & Schippers, 2018) and is a dimension of

engagement flow (Diana et al., 2014). Therefore, *feedback* was a central game strategy in this work.

The pilot-test mainly demonstrated the importance of feedback in the whole activity. It was an opportunity to verify how to conduct feedback, in order to stimulate the students' engagement. Thus, the use of feedback cards (see Figure 41, p. 125) and their contribution to return information about learners' status in the activity, which other kind of information to give to pupils, and comprehension of what kind of situational information to provide to students for a better understanding of the gamified tool were considered. Paper III presents interesting contributions about feedback as an element of immersion in gamified learning. Additionally, paper IV makes contributions about gamification design elements to reading learning in the pilot-experience.

Reflections about the pilot-test deeply contributed to the perception of failure as part of learning. Thus, tests with students 01 and 02 also valued the teachers' feedback. As shown in critical events, the different types of educator feedback represent *encouragement* (critical event 4, action 3, lines 1-5, Appendix XXII; critical event 1, action 3, lines 1-2, Appendix XXXV; critical event 4, action 8, lines 4-5, Appendix XXXVI), *instructions and guidance* (critical event 7, action 2, lines 1-11, Appendix XXII; critical event 5, action 2, lines 13-16, Appendix XXVI; critical event 4, action 7, lines 38-39, Appendix XXXVI), *task correction* (critical event 1, action 3, lines 3-6, Appendix XXVII; critical event 1, action 4, lines 23-32, Appendix XXXV; critical event 1, action 3, lines 1-7, Appendix XXVI), *information about students' performance with the purpose of motivating pupils to keep engaged in the activity* (critical event 5, action 3, lines 1-3, Appendix XXII; critical event 3, action 3, lines 1-20, Appendix XXVII; critical event 1, action 5, lines 1-6, Appendix XXXV), and *use of badges and points as rewarding feedback* (critical event 3, action 3, lines 1-8, Appendix XXII; critical event 4, action 10, lines 1-2, Appendix XXXVI; critical event 3, action 3, lines 1-5, Appendix XXXV).

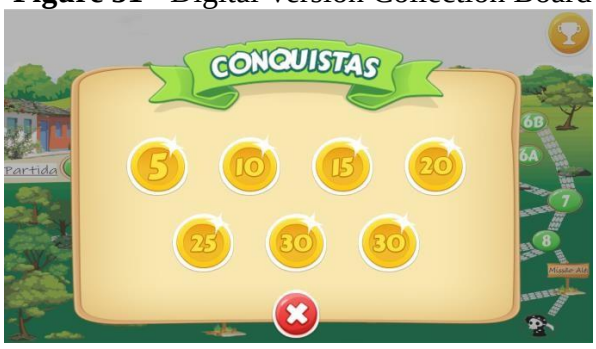
In the paper-version test the feedback seemed to have both negative and positive effects. Learner 2 seemed sad every time he did not comply with a mission and received negative feedback about his performance. This type of feedback is not harmful; it can also be effective as positive feedback if it is immediate and useful (Kim et al., 2018). In this experience, after negative feedback about a performance, the teacher played a fundamental role in providing corrections and guidance aimed at learner re-engagement in the process. By getting help and learning about new opportunities to complete the challenges, it was possible for

the student to maintain his enjoyment and, consequently, intrinsic motivation and interest in retaking the challenges, as we can see in Table 43 (p. 134). As to student 01, she got less negative feedback since she demonstrated more skills to solve the tasks, but her teacher also did great work giving feedback for correction and guidance over the missions (see Table 43).

The digital test was much more effective in *rewarding and encouragement feedback* because of the feedback system developed. Thus, when learners failed or succeeded, the system provided immediate negative or positive feedback, respectively. Appendix XXXV (critical event 1, action 3, lines 1-6) and Appendix XXXVI (critical event 2, action 3, lines 1-4) are examples that show that even when feedback was negative it helped lead students to recover from mistakes by facilitating new tries. This represents an important aspect of the gamified tool given the students' need for receiving "feedback on progress towards completing the tasks" (Sweetser & Wyeth, 2005, p. 04). Aside from the system feedback, the educator's feedback and guidance in this test were also fundamental to the students' progress in the experience. Teacher 04 did excellent work by calmly reading the challenges and giving corrective feedback after any fail. In Appendix XXXVI (critical event 4, action 2, lines 24-30) there is an example of this type of feedback. The educators demonstrated the importance of useful feedback to facilitate learners' re-engagement after failing to meet their goals. As seen in testing, the teachers also showed their engagement in the reading process. Even though it was not the focus of this work to examine the relationship between teachers and students' engagement, it seemed that expression of interest and a positive attitude towards the pupils' learning progress reflected very positively on student motivation and (re)engagement.

Another important instrument of feedback was the collection board, as shown in Figure 41 (paper-version prototype, p. 125) and Figure 51 (digital-version prototype):

**Figure 51** - Digital-version Collection Board




Source: Elaborated by the authors

This instrument allows the students to know their progress. According to Sweetser and Wyeth (2005) and Zichermman and Cunningham (2011), users may know their status or score in the game. In this study, the use of this collection board helped keep the students motivated to keep reading and unlocking levels. Motivation was observed in Appendix XXII (critical event 5, action 3, lines 6-8), Appendix XXVI (critical event 9, action 3, lines 21-30) and Appendix XXXVI (critical event 5, action 3, lines 4-5)

Finally, feedback as a game element contributed to better engagement and motivation. The system and teaching-feedback loops provided in the paper and digital-version prototypes were purposeful and meaningful (given during and after each challenge). Returning information to students and informing them about their errors or guiding them through the contents throughout the reading journey helped with the gamification movement and students' motivation to keep engaged in the activity.

- Goals and Rewards

Clear goals are fundamental in a gamified solution because they allow individual engagement insofar as learners understand the tasks and how to complete them (Busarello et al., 2014). In this gamified tool there are several goals, each one associated with a challenge. Goals were presented as learning objectives and challenges, as shown in Figure 52:

**Figure 52** - Challenge Goals


Source: Elaborated by the authors

These subgoals entertained students and motivated them to complete the tasks in order to reach the main objective, i.e. the end of the gamified

narrative. Each goal achievement got positive feedback, notifying learners' progress along the journey. Examples of Appendix XXII (critical event 6, action 2, lines 11-18), Appendix XXVI (critical event 5, action 2, lines 1-16), and Appendix XXXVI (critical event 4, action 2, lines 3-11) show how teachers provide explanations and contextualization when presenting each subgoal before the challenges. These actions clearly helped with student comprehension.

The experience also shows that learners were more engaged towards achieving each particular aim given the incentives they could get in the end of a mission. *Badges* and *points* were applied to this tool as rewards, as seen in Figure 39 (paper-version prototype, p. 125) and in figure 53 (digital-version prototype), as follow:

**Figure 53** - Digital-version Prototype: Badges and Points


Source: Elaborated by the authors

This system of points is described in Appendix XV, p. 546-547) and they seemed to be an absolute requirement in the gamified solution (as claimed by Zichermman & Cunninghan, 2011) as they are deemed as one of the main elements to motivate users.

As shown in the critical events of the paper- and digital-version tests, these rewards representing quantity of goal achievements also allowed emotional engagement, as seen in Appendix XXII (critical event 2, action 3, lines 1-6), Appendix XXVII (critical event 3 action 3, lines 1-9), and Appendix XXXV (critical event 3, action 3, lines 1-5) provided extrinsic motives that helped with learners' motivation to progress in the reading journey. These motives can be described as the necessity of *collecting* by getting badges in the end of a challenge and the *recognition for achievement*.

Kim et al. (2018) and Werbach and Hunter (2012) postulated that gamification rewards, such as points and badges, can also have a negative effect on users. However, in this experience, some examples of teachers talking to students about the value of these rewards as reflection of their achievements were observed, as seen in Appendix XXVII (critical event

4, action 9, lines 21-24), and Appendix XXXVI (critical event 1, action 6, lines 1-4).

As the subgoals were gradually achieved, students were collecting badges and points indicating mastery. Therefore, in agreement with Alexiou and Schippers (2018), this gamified process with a reward system represented a fundamental element to maintain students' engagement and motivation by representing to them their efforts, reading progress, and good performance.

- Time Pressure

According to Busarello et al. *(*2014), this element allows to establish clear and challenging goals to users. In this gamified reading experience, this element was added to all the missions.

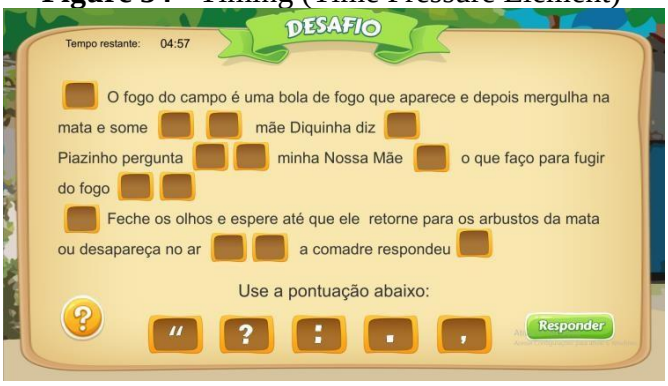
The pilot-test provided evidence about the time given to each mission and how it influences task accomplishment. We were interested in testing the ability of the students with dyslexia to reach the goals in the given amount of time. Thus, Appendix XXII shows examples of explanations about time in the pilot-experiment, as seen in critical event 1, action 2, lines 13-16, and the students' evaluation of time pressure as a difficult element, as observed in critical event 1, action 6, lines 1-9. In addition, Appendix XXVII (critical event 8, action 3, lines 10-14), and Appendix XXXVI (critical event 6, action 2, lines 136-140) exemplify verbal interactions about amount of time and its importance to complete the challenges.

Regarding the pilot-test and paper-version test with students 01 and 02, time was managed by the researcher. In some challenges the initial amount of time was expanded according to the students' needs, mainly learner 02, throughout the journey. This learner felt the time pressure time more strongly. Appendix XXVII (critical event 9, action 3, lines 1-9) provides an example of the student showing his interest in time limit and demonstrating his feelings regarding this pressure. As to student 01 and the pilot-experiment student, a more conscious perception of the relationship between time pressure and decision-making, based on skill level, was observed. The findings in Appendix XXII (critical event 4, action 4, lines 1-6), Appendix XXVI (critical events 8, action 3), and Appendix XXXV (examples of critical event 3, actions 2-3) show that they were able to accomplish most of the tasks according to the amount of time given.

In the digital version, time pressure was perceived in both learners' test (critical event 2, action 2, lines 11-12, Appendix XXXV; and critical event 4, action 2, line 91-94, Appendix XXXVI, as examples),

specifically, because a timing progress is displayed when a challenge begins, as exemplified in figure 54:

**Figure 54** - Timing (Time Pressure Element)




Source: Elaborated by the authors

As learners in this version could visualize the time, this element become more effective in engaging them emotionally by providing the pressure and stress of a game. This pressure seemed also exhausting when participants were not able to complete a task, as demonstrated in time critical events 1, action 4, lines 59-60 (Appendix XXXV) and critical events 4, action 3, lines 1-7 (Appendix XXXVI). Hence, the timed-goal activities were challenging and led to a high level of energy and effort to comply with the missions, and also personal satisfaction when the subgoals were achieved.

- Unlocking Levels and Progress

In a gamified solution, levels indicate progress. This leveling-up serves as a "marker for users to know where they stand in a gaming experience over time" (Zichemman & Cunninghan, 2011, p. 45). Levels are illustrated by the adventure map in Figure 28. Each level represents a chapter of the story, so once learners complete one level, they can access the next, thus highlighting progressive disclosure.

In the paper-version tests (both the pilot-test and the test with students 01 and 02), the concept of adventure map lay on a concrete game board. It guided learners through the reading path, showing levels and conducting Piazinho along the journey, as seen in Figure 55:

**Figure 55** - Paper-version test: using adventure map

Source: Elaborated by the authors

Critical event 5, action 4, lines 1-4 (Appendix XXII), critical event 1, action 2, lines 14 (Appendix XXVI) and critical event 4, action 6, lines 1-3 (Appendix XXVII) illustrate how students used the map adventure. Participants were motivated by curiosity in conquering levels and demonstrated they felt rewarded by each unlocking-level step.

The digital version also presented the adventure map as the starting point of the reading activity. As in the paper-version test, this mechanism provided strict guidance so that participants could see their current level when they finished a challenge or chapter. For instance, Appendix XXXV (critical event 7, action 2, lines 1-5) and Appendix XXXVI (critical event 7, action 1, line 1) and show how this game mechanism of content unlocking helped keep learners motivated to be engaged in the reading. Also, the use of the map adventure provided a sense of control and clear goals, which are two dimensions of flow engagement (Csikszentmihalyi, 1990).

- Fantasy

This game feature evokes images of objects or situations that are not extrinsically present. This can stimulate learners and make the experience more emotional (Busarello et al., 2014). In order to motivate and engage participants in reading, this gamified tool was founded on a story about a fictional character named Piazinho.

This narrative added fun experiences to the tool so that students could explore an adventure with mythical figures of the Amazon region in Brazil and discover other aspects regarding that culture, according to unlocking levels and progress. Both the paper and digital versions show how pupils experienced the story, characters, and fantastic situations that never happened in their real lives. The progress in reading showed how pupils were interested in making new discoveries about Piazinho’s story.

*b) Game Mechanism Effects on Cognitive Learning*

According to Kapp (2013), gamification is not about adding points, badges, and levels to an e-learning program, but fundamentally rethinking learning design. In this respect, the goal of this gamified tool is to use game mechanisms to evoke the intrinsic motivation and engagement of students with dyslexia in order to capture their interest in the reading activity, and consequently in learning.

Rather than defining which type of learning outcomes would result from an experience like that, this work focused on the skills and knowledge that learners with dyslexia were able to show/use. Therefore, it focused on the observation of which individual or group of gamification mechanisms could make a contribution to learning.

- Correlation Between Time Pressure and Performance

Applying a timer to an activity creates a cognitive pressure on the students. In this study, the fact of being timed did not cause a positive effect on pupils' performance. It was observed that timed missions represented a relevant mechanism of the tool concerning emotional engagement and motivation. Nonetheless, as discussed previously, the time limit was extended by teachers in the paper-version test, according to the situational needs of student 02 to accomplish a mission, as seen in critical event 9, action 2, line 123 (Appendix XXVII).

As in the digital-version prototype, tasks were timed by the system; hence, the correlation between time and performance was clearly stressed. Students' performance was impacted by time since they used adaptative challenge tries to complete the task, and the teachers provided support and encouragement, as seen in Appendix XXXV (critical event 1, action 3, lines 1-18) and Appendix XXXVI (critical event 4, action 3, lines 1-8).

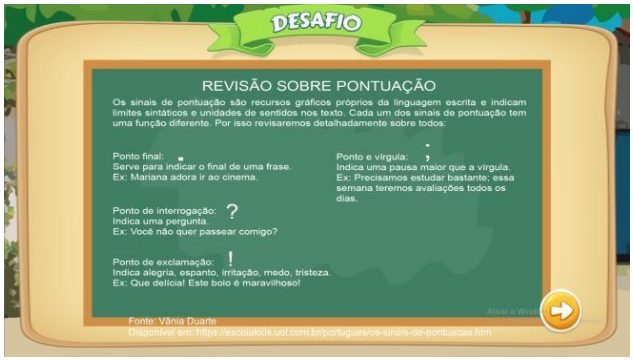
This finding provides a better understanding of the learners' needs for more time to comprehend the tasks' goals and which skills and knowledges should be applied to each mission. This study demonstrated that learners with dyslexia need adaptative time to clearly understand what is required as knowledge and skills to be used in a task, thus avoiding loss of self-confidence. Better performance is clearly associated with awareness about what is required to progress in a gamified experience (Schmitz et al., 2012).

- Challenge of Progressive Disclosure

As seen in Appendix XV (p. 542-543; 546-547), challenges are about curriculum concepts. Therefore, these missions were given to improve the students' skills and knowledge about each specific concept.

The paper-version prototype experience first revealed the students' difficulties with written word organization in sentences, use of connecting words, punctuation, and also with reading difficulties such as word contextualization. These difficulties were recorded in the field notes (see p. 459-460; 470, Appendix XII). Therefore, the missions were changed to be more adequate to the students' skills and knowledges in the digital-version prototype. Changes excluded any writing task and maintained the ones focused on reading aspects. Additionally, a review of the necessary concepts was included in order to recall content, as seen in Figure 56:

**Figure 56** - Digital-version Prototype: Review on Grammar Punctuation




Source: Elaborated by the authors

As seen, this process of iteration allows us to provide a closer balance between the students' skills and challenges (Csikszentmihalyi, 1990). As previously explained, an adaptative challenge was also provided, aiming to help learners comply with the missions and progress in the reading journey.

The observation of both paper- and digital-prototype tests showed a decrease in students' difficulties and increase in skills after challenge changes in the process of iteration, as seen in the comparison of learners' performance in challenge 5 and the complementary mission of both the paper and digital tests (as seen in critical events 6 and 8, actions 2, Appendix XXVI; and critical events 5 and 6, actions 2, Appendix XXXV), for example.

Even though learners still had some difficulties in completing the tasks, they exploited the adaptative tries offered by the system and maintained continuous engagement in the progressive disclosure of the story chapters. Therefore, challenges and level progress seem to be important game mechanisms to guide students towards mastery of a skill. In this process, the support provided by the educators, through calm mediation with clear explanations, was a vital aspect that contributed to a better understanding of each mission. Concerning the role of the educators, Ding et al. (2017) highlighted the fundamental support of teachers in gamified activities.

- Feedback and Rewards

Feedback had a vital role to learning outcomes in this gamified experience. According to Ryan and Deci (2000a), this element can strengthen a sense of competence in learners. Therefore, system feedback and teacher guidance and reinforcement help students to recover from errors. Gains of knowledge in case of use of feedback are associated with learning with failure.

Observation of situational information given by the tool, and also by the educators, after the challenges provided important results: 1. Learning with failure by persisting with challenges: three actions of retaking missions in Appendix XXVII, critical event 4, mission 3, and in Appendix XXXV, critical event 1, mission 1); 2. Demonstration of own difficulties with specific concepts, e.g. word contextualization, semantic function of punctuation and syntax (Appendix XXII, critical event 1, actions 2 and 4; Appendix XXVI, critical event 6, action 2, lines 72-81; Appendix XXVII, critical event 4, action 5 and lines 1-18; Appendix XXXV, critical event 1, action 2, lines 38-46); 3. Better understanding of grammar topics such as punctuation (Appendix XXII, critical event 4, action 3, lines 85-96; Appendix XXVI, critical event 2, action 3, lines 28-40; Appendix XXXVI, critical event 01, action 3, lines 1-16); 4. Negotiation on comprehension of word/sentence meaning focusing on non-verbal and verbal texts, as in Appendix XXII (critical event 2, action 3, lines 1-4), Appendix XXXVI (critical event 4, action 2, lines 75-80), and Appendix XXXV, critical event 4, action 2, lines 15- 18). The pilot-test also presents the potential to help with comprehension of folklore as a body of knowledge (as observed in Appendix XXII, critical event 4, action 2, lines 1-75) as well.

Use of verbal positive feedback in both paper- and digital-version tests boosted the learners' sense of progress and learning. Thus, verbal

guidance and support by teachers, as well as verbal system reinforcement, have clearly helped improve the learners' performance.

Moreover, the application of badges and points as rewards is a way of measuring the pupils' performance (Busarello et al., 2014). Badges, according to a study conducted by Balci et al. (2018), can improve learners' performance. In this experience, the collection of badges encouraged learners with dyslexia to correct and complete the tasks, to become interested learners, and to make more efforts to progress by level, earn more recognition, and learn with Piazinho's adventure.

The data from the observation suggest that the application of game design elements had a significant influence on the students' learning reading process. However, specific concept-earning outcomes cannot be substantiated, and a more rigorous study is still needed in order to trace the contributions of the gamification mechanism to learning outcomes.

#### *4.4.4* Participants' Perspectives

At the end of both the paper and digital versions of the main tests, students and educators were also able to provide impressions about the gamified experience. Key findings extracted from the open-questionnaire, scale-based questionnaires and open-ended question interviews pinpoint to meaningful contributions to motivation and engagement and to learning outcomes.

- *Perceived Motivation and Engagement*

The results of the scale-based questionnaire, open- questionnaire and open-ended questions (Tables 45, p. 135; 47, p. 137; 52, p. 142; 54 and 55, p. 144-145) seem to suggest that learners agreed with the game mechanisms embedded to the tool: (i) use of extrinsic motives, badges and points, are important to the tool and stimulated and encouraged them to participate in the activity; (ii) missions, as the core of fun, as well level progression and clear goals provided a feeling of enjoyment and motivation to be engaged in the task itself; (iii) the influence of the fantastic story, reading journey, and feedback on a better engagement and enjoyment of the experience. The findings also expressing the story and missions were the elements that most contributed to fun and enjoyment (as also mentioned in the pilot-test, Table 41, p. 129).

These findings are in agreement with those of other studies. Saputra (2015) concluded that the incorporation of seven game elements − story/theme, clear goals, levels, points, rewards, feedback,

and achievements/badges − into an application improved interest and enjoyment, according to the feedback provided by the students with dyslexia. Further to this, learners with dyslexia expressed a positive opinion about their interest and motivation after testing a gamified application.

On the other hand, the element time pressure was deemed by the students as a stressful element in the digital-version test. However, its effects on student 01 were more stressful than on learner 02. So, in her opinion, instead of motivating the student, it provoked anxiety. As for learner 02, time pressure caused anxiety, but also excitement; therefore, it is important and necessary. Even though this perception is important in gamification, time pressure represented the worst part of a gamified activity presented in Cheong et al. (2013).

Regarding the perceptions, Table 56 (p. 146) summarizes results that allow us to reflect about interest, participation, and enjoyment of the activity. Some characteristics of intrinsic motivation were mentioned by educators, e.g. students' commitment to be successful in the reading journey.

The creation of a gamified scenario created the need for mastery or competence and for being effective in the activity. Hence, to complete missions and get rewards, as part of intrinsic motivation (Alexiou & Schippers, 2018), was a process in which students engaged and reengaged. By evaluating challenges, badges/points, level/progression, and time pressure, educators perceived how these game elements seemed ideal to keep the students motivated and interested in investing the necessary efforts to complete the tasks (Ryan & Deci, 2000a), culminating in cognitive learning. In addition, use of an outcome-based feedback system, teachers' verbal feedback, as well non-verbal feedback such as badges/points, provided information about the fundamental role of these mechanisms.

Verbalization also provided evidence of how teachers' evaluative feedback benefit students' performance by informing them how to perform the missions and how to improve skills and knowledge (Chan & Lam, 2008). In addition, feedback also contributed to engagement, as claimed by Csikszentmihalyi (1990). Even the negative feedback, as argued by teacher 03, boosted the students' engagement in the learning process, aiming a positive feedback.

It was important to hear about fun from the considerations by teachers 03 and 04. According to them, the *game condition* of the prototype provided potential for motivation and fun. So, thinking about the learning of students, *fun*, as stated by F. Alves (2014), is a hard thing to create; however, it is the key to motivation. The teachers

highlighted that this gamified narrative, as a differentiated reading activity, has the potential to foster engagement and interest, given their perceptions of the pupils' excitement to achieve the goals and face the challenges.

Furthermore, teacher 01 mentioned an interesting limitation of this gamified tool: the absence of mechanisms of competition/collaboration. This perception seems to be associated with the need for social relatedness (Ryan & Deci, 2000b), i.e. the wish to be socially and emotionally connected with others. Hence, social status or a gamified network could satisfy this need of the students.

- *Perceived Learning*

According to students (see tables 41, p. 129; 46-47, p. 136- 137; 53-55, p. 143-145) the interaction with the gamified tool was effective in improve the sense of learning, the relevance to gain knowledge, use/enhance skills, feeling of progress through missions, recall legends and topics as punctuation, and perception of amelioration of subjects as synthesis, word contextualization, comprehension/reading fluency, make inferences and reading decoding.

More specifically, larger number of frequencies indicated specifics skills and knowledges, as memory, attention, logic, vocabulary, summary, reading, comprehension or punctuation was verbalized after digital-version test (as presented in tables 41; 53-55). Furthermore, as presented in table 55, learner 02 perceived the individual contribution of game elements to learning. Table 58 summarizes his verbalizations:

**Table 58 -** Perceived Contributions of Game Elements to Learning

| Learner verbalizations | Game elements |
|---|---|
| *ajudou a saber da narrativa* | Level/progression |
| *tem que mostrar as habilidades nas missões* | Challenges |
| *o tempo é bom e é ruim... tanto para aprendizado e quanto para pensar ou para relembrar o que você estudou* | Time pressure |
| *representam o aprendizado... a conquista e também o desenvolvimento* | Badges/points |
| *me ajuda a repensar a resposta* | Feedback |

Additionally, other studies, like those by Dimora and Niemiec (2015), do not highlight the individual contribution of game mechanisms to the learning of students with dyslexia. Their conclusions are restricted to summarize that the pupils' feedback on a gamified application, designed

and developed to support young students with dyslexia, can help with learning at school.

Likewise, the learners' assessment and educators' opinions also revealed contributions of the gamified tool to gains in learning and knowledge. As learners, they mentioned contributions in reading comprehension, cultural revivals, recall of some difficulties, memory, and vocabulary, as summarized in Table 57 (p. 147). A great number of utterances highlight the input of multiples languages, such as sound, animation, and illustrations, which also contribute to meaning construction in reading. Moreover, considerations about the teachers' feedback and guidance suggest the important role of educators in giving direct and effective feedback to students (Kim et al., 2018), specifically when mediating activities to students with reading impairment.

- *Perception on Gamified Prototypes*

The findings in Tables 41 (p. 129), 48 (p. 138), and 56 (p. 146) indicate the students' opinion about the prototypes' structures and content. Although it is not the aim of this study to compare the paper and digital versions, the pupils' verbalizations contributed to the tool's amelioration. Positive feedback about the tools used and material quality and strengths revealed what worked, but references to difficulties with challenges and missing game strategies facilitate our comprehension about what could be redefined. Perceptions of the paper version revealed the relevance of using of concrete material for *touching* and *moving* them (Table 41), and the digital version demonstrated enhancement, as summarized in Table 56, concerning *missing game strategies* and *the tool* itself. Obviously, difficulties with the missions still occurred, and new weaknesses that were changed in the final version were mentioned.

Moreover, in the pilot-test, the student was able to mention a pleasing impression about the tool's structure and also about the functionality of the game elements (as shown in Table 41), which provide a better comprehension about the reason for designing these elements (Busarello et al., 2014; Werbach & Hunter, 2012).

These results are based on Design Thinking assumptions (Brown & Wyatt, 2010; Scheer et al., 2015), denoting the relevance of hearing students with dyslexia, in order to involve them and redefine the tool in a process of learning. To consider their feedback nurtures their interest and participation as our source of inspiration in the whole interactive process of creating this gamified tool.

The teachers' opinions on the learning experience emphasize that the gamified tool is appropriate to students with dyslexia. The findings in Tables 48 (p. 138) and 56 (p. 146) express that the two teachers who participated in the paper-version test, and the two who participated in the digital version experience, expressed surprisingly similar positive scores.

This strongly positive feedback indicates the merit of the effective use of the gamified tool concerning: (i) *structural domain*, which means that the prototypes are structurally easy to handle, have a well elaborated surface, and present representative and adequate illustrations of the narrative; (ii) *content* domain, which indicates balance between level x skills/difficulties and thematic accuracy; (iii) *pedagogical domain* regarding good learning potential, adequate vocabulary, clear activities, and a very innovative solution; and finally, (iv) *values and attitudes domains*, which means the tool content is according to Brazilian Curricular Bases by instigating environment protection and preserving pleasing values about regional culture.

Additionally, teachers' feedback in the paper test, as *textual review and shortening of texts and missions* presented in Table 49 (p. 139), contributed to the tools' redefinitions over the iteration process. Similarly, in the digital test, the suggestion of *removing background sound* was accepted as a change for the prototype final version. These redefinitions lie on the comprehension of tests as a "time to get feedback and redefine the solution" (Scheer et al., 2011). Other propositions, such as feedback about legends, iteration of tasks (paper-test evaluation), task anticipation, and video adjustment (digital-test evaluation) contributed to the teachers' guidance along the experience.

### *4.4.5 Overall Considerations*

Generally speaking, it was observed that the set of game mechanisms articulated for building this gamified tool influenced intrinsic motivation and engagement to facilitate the learning of students with dyslexia.

Regarding *engagement*, as in Saputra (2015) study, two indicators – participation and interest – were observed to define if students were engaged in the reading journey. Therefore, both the paper and digital versions provided gains in engagement. Our observations suggest that the gamified reading effectively engaged students in the activity by showing the learners' concentration and interest (cognitive engagement), but also enjoyment, stress, and anxiety (emotional engagement), which were activated by the game elements as discussed above.

As claimed by Kapp (2013), the concept of flow was used as a guidepost to encourage flow engagement in this gamified tool. It was embedded with

conditions to generate the state of flow by applying game mechanisms. Thus, we tried to create a balance between challenges and the learners' skills when we defined adaptative missions in the digital-version prototype, as well as clear goals and immediate feedback. Nonetheless, the test revealed that the combination of game elements, such as time pressure and challenges, resulted in an increased level of anxiety and, consequently, additional difficulties to the students. Thus, we concluded that the current challenge level is difficult to reach, thus some of the challenges seemed more difficulty, specially to student 02. Fortunately, teachers were supportive in helping students achieve a feeling of competence. More specific measurements of flow are required in future studies in order to verify if flow is a state achievable with the use of gamification for students with dyslexia.

Considering the results about the students' motivation in Tables 28 (p. 97) and 29 (p. 98), in which their perceptions about self-motivation to reach goals is positive, this experience showed that gamification, as an active strategy, was effective in supporting the reading activity for students with dyslexia.

The use of the gamified activity with outside motivators, such as the use of a map adventure, unlocking levels, missions, badges and points, certainly made the experience more enticing. As the aim of this kind of experience is to drive intrinsic motivation, these elements, mainly collection of badges and points, were extrinsic mediators to motivate students to engage in playing with the missions and earn rewards.

In both the paper- and digital-version tests, we observed authentic motivation of students with energy and persistence on missions and reading journey. As these students with dyslexia have some constraints with motivation, this work is aligned with the existing literature on the use of gamification to support student motivation and engagement (Dymora & Niemiec, 2019; Gooch et al, 2015, 2016; Saputra 2015).

Extrinsic motivation is easy to be perceived in a gamified experience. The students were rewarded with points, badges, and teachers' support. However, intrinsic motivation is harder to measure and spot. As an essential part of the self-determination theory (Ryan & Deci, 2000b), this type of motivation is based on basic psychological needs of autonomy, competence and relatedness, as discussed in, chapter 2, subsubsection 2.4.5.2. We considered as examples of intrinsic motivation the demonstration of enjoyment, accomplishments of tasks related to *the autonomy* (control of decisions made to reach goals), sense of competence/progress stated by levels progress in the reading journey, associated with *competence* (the need to progress and become better in the experience), and pleasure in interacting with the teacher of Special education. This is connected with *relatedness* (the need to gain meaningful teaching support over the gamified experience).

Regarding the educators' support, it is relevant to highlight the role of the pedagogical use of gamification, as studied by Gooch et al. (2016). In this work, when teachers became really engaged in the gamified experience, they positively influenced the learners' engagement as well. Therefore, the role of teachers as mediators in the learning process is also fundamental in the use of gamified resources.

Discussion about engagement, enjoyment, and intrinsic motivation are essential in this type of work, given that when learners are intrinsically motivated, they are inclined to learn (Alexiou & Schippers, 2018). The learning of the participants was associated with the use of skills and knowledge, awareness of difficulties in reading and writing, evoking of curiosity, completion of tasks, and feeling of progression. We also tried to focus on the students' reading journey by promoting sense of control of learners, aiming to make this gamified experience more suitable.

Considering the use of challenging tasks, a fantastic story, clear goals, rewards, and collecting game mechanisms, this experience worked as situated learning. Rewards seemed to be important to motivation and engagement; however, they became representative of progression and learning. Feedback, as a critical element to learning (Kapp, 2013), was central in this gamified activity given its role as a process of providing learners with ways to maximize their potential.

Concerning learning, other authors, such as Hamari et al. (2016), in an investigation about game-based learning, concluded that challenge in game had a positive effect in learning. Tolentino and Roleda (2017) argued that use of gamification has significant effects on learners' achievements in physics. More specifically, Gooch et al. (2015, 2016) claimed that the pedagogical use of gamification provides improved educational outcomes.

In summary, this process of gamified application provided an interesting learning scenario to the teacher-student with dyslexia interaction through reading and creation of meanings. The use of multiple semiosis – written language, movement, and static imagens, as well as animation, sounds – clearly contributed to making students emotionally engaged and motivated to complete this immersive experience journey.

# 5

# CONCLUSION

## 5.1 Conclusions and Implications of the Study

This thesis, structured on a case study approach, was inspired by the Design Thinking (DT) methodology: four phases were conducted leading to the prototyping, testing, and evaluation of a gamified storytelling tool.

Phase 01, named immersion and exploration, provided information about the students, and also about the Multifunctional Resource Room (SRM) as an educational space of attendance at school. This process of analysis also contributed to the redefinition of the initial challenge of this investigation regarding the use of DT as methodological inspiration to develop a gamified storytelling.

The process of ideation developed over phase 03 generated a narrative based on Amazon legends entitled *Piazinho em uma ventura com seres fantásticos da Amazônia,* a gamification design framework founded upon six actions: definition of learning objectives, determination of skills, behavior and knowledges expected, description of learners' profile based on information collected in phase 01, design of game principles and elements, structure of the narrative journey, inclusion of game mechanisms to promote entertainment, and deployment of the tool.

The instruments developed in phase 03 were applied in the iterative prototyping of phase 04 to create, test, and evaluate, first a paper-version, and subsequently a digital-version of the same gamified storytelling. This iterative process allowed redefinition of the game mechanisms, such as challenges and time pressure, inclusion of feedback aspects, and also slight modifications in story content and structure, according to the participants' needs. New modifications were provided in the final non-tested digital version, including capability to save information on game progress and exclusion of background sounds. The study performed allowed meeting the initial objectives:

- To map and characterize students with dyslexia

  Information about learners, such as thoughts, feelings, motivations to read/write, expectations about school support, needs and evinced and self-perceived difficulties were vital to understand the dyslexia characteristics of the two

adolescents and to learn about the students for whom the gamified tool would be designed.

- To explore the special education context in supporting students with dyslexia

  Interviews with open-ended questions and documentary analysis allowed a profound comprehension of why learners with learning difficulties are not assisted under the Brazilian Special Education program according to the Brazilian official educational law and Special Education decree. Moreover, it provided a better understanding of SRM functioning during daily attendance per teachers' observations.

- To ideate, prototype, and test a gamified tool, and evaluate the indicators of motivation, engagement, and reading learning of students with dyslexia

  This study complied with the process of design and prototyping of a gamified solution embedded with game mechanisms according to the students' skills and difficulties. Moreover, tests were provided, recorded, and analyzed, aiming to identify indicators of emotional and cognitive engagement, increased intrinsic motivation demonstrated by enjoyment and immersion, and demonstration of use of skills and knowledge over the gamified experience. The results of the process of analysis of critical events revealed the benefit of reading steps, such as pre-reading and post-reading, and the contributions of this gamified reading.

- To obtain teachers' and learners' perspectives on the gamified reading experience

  The participants' perceptions were collected by means of scale-based questionnaires, open-questionnaires, and open-ended question interviews. The data provided information about perceived motivation, engagement, and learning, and also about both paper and digital prototypes. This information allowed the comprehension of how participants perceived the effects of use of gamification as a supportive tool in reading.

This research lies on the theoretical principles of reading activities in cognitive and socio-discursive perspectives, specific learning difficulties such as dyslexia, and gamification to prototype a supportive storytelling as a model for gamified reading. The methodological journey led to several key findings, as follows:

- Dyslexic difficulties in the reading, writing, and memory and cognition domains allowed a better comprehension of the degrees of expression of dyslexia (Rizzato, 2015) of both participants. This understanding helped in

the design and creation of a gamified solution according to the learners' literacy problems and levels of difficulties;

- The learners' perceptions on reading skills, their own literacy difficulties, feelings and thoughts, need for educational adjustments, and motivation to participate in reading and writing activities revealed how their performance and interest on reading/writing are affected at school;
- Triangulation of data revealed that, in practice, SRM do not comply with the objectives of inclusive education, since students with dyslexia or other learning disabilities are not part of the target public for Special Education assistance. This represents a fundamental piece of information to justify a total lack of interest of teachers in regular classes about this learning disability, difficulties in the identification of dyslexia in the first years of school and, consequently, a scarcity of learners with a correct diagnostic and educational accommodations;
- A pilot-test revealed its own importance in designing a solution, which contributed to the tool's management, improvement in challenges and comprehension of the educators' participation, and guidance over the use of the prototype;
- The game-based reading experience with both paper and digital prototypes provided indicators of the effects of game mechanisms, e.g. *challenges, feedback, goals, fantasy, adventure map, unlocking levels/progress,* and *time/pressure* and *points/badges,* towards a more intrinsic motivation (interest) and engagement (committed participation) by learners;
- The process of iteration enabled revisiting the prototype and learning about the importance of participant feedback and experimentation;
- Mutual influence of time pressure-performance, challenges-progressive disclosure and feedback-rewarding were more effective on cognitive learning, which implies the use/demonstration of skills and knowledges during testing of both paper and digital versions;
- Teachers' engagement in the gamified reading revealed the fundamental role of feedback and guidance in this type of experience;
- According to the students, the gamified experience provided enjoyment, engagement, fun, even though the element time pressure represented stress and anxiety;
- The teachers' perceptions revealed the characteristics of intrinsic motivation and the contributions of game elements such as challenges, badges/points, level/progression and time pressure to learners' motivation and engagement, as well as the benefits of feedback as a motivating element. Additionally, the tool's game condition potential for fun and amusement was mentioned;
- The educators' and students' opinions about the effectiveness of the gamified experience were also positive. The findings are significant, given the importance of obtaining feedback from students as well as teachers on this

kind of learning experience. Their contributions suggest that applying gamification to reading activities is a serious strategy to promote learning through enjoyment, motivation, and learning.

- The participants' perspectives on both paper and digital prototypes highlighted the importance of students and teachers' feedback in the process of design and creation according to the DT approach. Moreover, the educators expressed positive opinions about the merit of the gamified tool regarding the content, structure, pedagogical, and values and attitudes domains.

Overall, the actions designed for the gamified storytelling were accomplished.

- 1st Action (DEFINE): The learning goals of demonstrating motivation and engagement and recalling knowledge and cognitive skills were observed in evinced indicators in tests, as well in the participants' evaluations;
- 2nd Action (DETERMINE): The skills, knowledge, and behaviors posed were mostly used and recalled in testing, according to the results. Embedded features of rewarding, feedback, clear goals, challenges, progressive disclosure, and fantastic story gave learners opportunities for the recognition and self-*expression* of emotions, literacy skills, and difficulties, as well the *exploration* of the reading journey and challenges;
- 3rd Action (DESCRIBE): The description of learners' profile was effectively developed during phase 01, which allowed building a tool according to their necessities/difficulties/skills;
- 4th Action (DEVISE): The design principles were applied to the prototypes, according to the initial journey structure;
- 5th Action (DON'T FORGET THE FUN): Fun is hard to create in learning (Alves, 2014), so it was a purpose of this work to apply game mechanisms such as collection of badges/points, progress display, creation of missions, and constant feedback to make the tool enjoyable and successful. A final question about this action was: *Was it fun*? The whole process was not only to concentrate on providing entertainment to students, but also on providing support as a reading tool. Surely, the gamified experience provided fun while stimulating learners, according to the test indicators and the participants' evaluations. Nonetheless, it was not a goal of this research project to measure how much fun was provided or how much fun was needed in this type of educational application;
- 6th Action (DEPLOY): According to the plan, a paper version and a digital version of the prototype were deployed in this design cycle. The success of these prototypes was measured by learner engagement, achievements, and progress during the entire reading journey, as well by the participants' evaluations, as presented in results.

In summary, the whole research journey revealed that this work represents more than embedding a solution with game mechanisms with the aim to entertain. It is totally about helping learners with reading impairment feel more deeply interested and engaged in reading learning. Rather than perceive the gamified solution as a product, it is fundamental to comprehend it as a supportive tool for pupils in public schools who need more appropriate accommodations such as pedagogical resources.

### 5.2 Limitations of the Study

Some methodological limitations of this study are noted below.

The first limitation involves *issues with participant selection.* As described in this thesis, there were limitations in the recruitment of students with dyslexia in public schools in the region of Belém. At the time when this research was planned, it was expected to identify a larger available sample population at the same school to explore solely one SRM context. However, since the lack of early diagnosis, school-family dialogue, centers for dyslexic students, and legal pedagogical assistance in Special Education provide a scarcity of attested learners with this Specific Learning Difficulties, this study was conducted with only two students and their educators. This limitation enabled the exploration of solely two SRM, which resulted in extensive descriptions of the pedagogical spaces and teacher practices. Even though the small number of participants in this research represents the need to rethink the identification and remediation of dyslexia in schools, it does not allow for a generalization of results to a larger population. On the positive side, this sample size enabled a close relationship with the participants, a more open data collection process, and better comprehension of the meanings of those specific samples.

The second limitation is the *absence of previous studies.* Prior research data are fundamental for a study by providing the theoretical bases to the theme under investigation; however, past studies on the effects of gamification in learning for students with dyslexia are still limited. The studies found in the literature are more focused on the contributions of enjoyment, engagement, and motivation (Saputra, 2015), best teaching practices using a gamified platform (Gooch et al., 2016), and early identification of dyslexia (Rello et al., 2012), with one of them addressing the use of gamification as a supportive learning tool for dyslexic learners (Dimora & Niemec, 2019). Also, all of them involved children with dyslexia. However, this scarcity hinders more specific comparisons with the results of this study about the effects of gamification on motivation, engagement, and learning among teenage students with dyslexia.

Third, it is worth mentioning the *techniques used to collect data.* After completing the data interpretation, we noticed that the manner in which information was collected inhibited a more extensive analysis. In phase 01, the inclusion of questions/exercises about social-emotional topics, dysortography, and dyscalculia could have contributed to a deeper understanding of the students' difficulties and needs. In the iterative phase 03, the use of the gamified tool in different sessions, with limited time, could have provided optimal usage. Therefore, in future research projects these specific methods will be revised.

Finally, some limitations of the research project were associated with *access* in the research field. This work was intended to analyze documentation regarding the regulation of Multifunctional Resource Rooms in order to understand the objectives and strategies imposed to these spaces by the Brazilian Special Education laws; nonetheless, access to this kind of documents was denied by the CRIE. Additionally, the *time dedicated to the research project* also influenced the process of investigation. Limits of one hour per session per week required too much time to complete phase 01, for instance. Future studies may consider a shorter period of time for data collection.

### 5.3 Contributions to the Field

The use of gamification in education has grown in the past years. Many research projects have been investigating the usage of game mechanisms as an educational approach to motivate students to engage in the learning process. As a 'young' field of study, the ongoing and completed studies are still contributing to the foundation of general concepts and principles and, consequently, to the theorization of gamified learning. This particular study represents a contribution to this goal.

The exploration in phase 01 contributed to demonstrate the lack of appropriate assistance provided to students with dyslexia in Brazilian public schools, even though researchers and associations have been drawing attention to the need for proper pedagogical interventions (IDA, 2017; Shaywitz et al., 2008;). This research contributions lie on the necessity to talk about this SLD at school.

The characterization of the dyslexic difficulties of the two teenagers participating in this study also revealed how learners with dyslexia who have been receiving support from special educators since childhood can develop reading skills and overcome most of their difficulties with word identification in reading. This type of results emphasizes the fundamental role of teaching support at school, as well as the necessity for collaborative work between special educators and mainstream classes teachers.

This thesis can also present a contribution to the literature of DT as an educational approach. With a starting point on the understanding of learners' needs and difficulties in their schooling context, it focuses on empathy for creating solutions (Dam & Siang, 2018). Therefore, the design and development of this gamified tool allowed us to make pedagogical sense of DT in the context of inclusive education.

A further contribution of this study to an understanding of gamification was to provide a method to make a reading activity more interesting. The application of game mechanisms to solutions/tools showed to be supportive to this target population with reading impairment. The purposeful application of feedback, challenges, points and badges, time pressure, clear goals and level/progression, according to the results, added a layer of learners' interest, which showed the advantages of gamification as one active methodology to make learning of reading more attractive to students with dyslexia. As a digital approach, the use of this gamified tool also contributed with findings to the literature that considered

more than the psychological outcomes, e.g. engagement, enjoyment and motivation, but also the use of technology to enhance learning (use of skills and knowledges).

As to the game elements applied to the narrative, the analysis of feedback from the participants promoted output focusing on the importance of the effectiveness of this element in gamification and, mainly, in education. As a key instrument in learning (Sprouls, 2011), feedback figured in this study as powerful, helpful, motivating, and energizing. Most importantly, this research showed the importance of teachers' feedback and guidance provided to students with reading impairment in overcoming challenges. Thus, the study represents a relevant contribution to the literature on the role of feedback and guidance.

However, perhaps the major contribution of this thesis is the gamified tool itself. It is the first prototype of a gamified narrative of Amazon legends that is relevant for cultural reasons. This exploration of digital books may represent an example of the development of gamified reading to praise our regional legends and, mainly, support the learning of students with SLDs such as dyslexia, but also of learners with other types of conditions such as autism spectrum disorder. This tool is freely available to schools and can be the first of a set of gamified digital narratives in Multifunctional Resource Rooms.

### 5.4 Future Work

Some adaptations and more usability tests have been left to be conducted in future studies (i.e. validation tests with new special education teachers are very time consuming and require sessions on tool presentation and testing). Future work should focus more on the profound analysis potential of the tool itself and the specific game mechanisms in reading learning, besides different methods of collecting and analyzing the data.

This thesis mainly focused on how gamification could contribute to affective outcomes such as enjoyment, engagement, and motivation, and to cognitive learning as well, leaving the potential negative effects of gamification (Toda et al., 2018), e.g. exploration of types of fun (F. Alves, 2014) and impacts on socializing by competition and collaboration, outside the scope of this work. Therefore, in future research projects, some of the following ideas could be tested:

(i) Further analyses should be conducted in order to provide more comprehensive information about the negative effects that the use of game mechanics may have on learners with dyslexia. This work would, for instance, aid in the understanding of which specific game elements influence disengagement, demotivation, or other negative impacts on learning;

(ii) Fun is considered to be a key aspect in gamification (F. Alves, 2014; Werbach & Hunter, 2012), so it would be important to conduct a study focusing more on creating and exploring the concept of fun in this type of gamified experience;

(iii) Socialization is also important in gamification. However, due to the difficulties in recruiting students with dyslexia at the same school, this

experience focused solely on individual experiences. Further studies should invest on recruiting learners with dyslexia from private and federal schools, aiming to create team work. This type of group work would allow verifying promotion of amusement from competition and collaboration, as well as determining the negative aspects of this type of dynamics. Moreover, a higher number of interacting participants would supply us with more data to describe the contributions of gamification to the learning of adolescents with reading impairment.

Other types of process of ideation and design could be also managed, e.g. immersion of both teachers and students in a more rapid DT environment. Teachers could guide learners through specific reading/writing topics of higher difficulty for them to generate ideas and, consequently, paper-gamified prototypes. This type of immersive process could provide constructivist learning (Scheer et al., 2012).

Forthcoming studies could also promote a comparison of the gamified narrative with a non-gamified version of the story. A central question in this type of research would be addressed as which of the two experiences is more enjoyable to learners with dyslexia. Thus, it would be possible to obtain more comprehensive results about the positive effects of gamified reading in the support of pupils with dyslexia.

Furthermore, this thesis evinced the fundamental role of teachers in guiding students by providing directive guidelines and corrective and supportive feedback. Hence, future work could observe how teachers could appropriate the use of the tool in different ways in the assistance sessions for students with other disabilities. Gooch et al. (2015, 2016) developed an interesting study evaluating this pedagogical appropriation of a gamified platform.

Lastly, this experience was developed in three reading steps, which contributed to the use of skills at the pre-reading, reading, and post-reading stages. Therefore, tests with this gamified tool could be extended to poor readers in regular classes, which could improve their abilities to make inferences, increase active prior knowledges, and enable text prediction (preparation for reading) in order to enrich vocabulary, facilitate word recognition, deal with the meaning of words and sentences (reading), and reflect upon text content (post reading). A study on the use of gamified reading with that target public could also increase the number of participants, as well the extent of application of game dynamics involving collaboration and competition with the aim to promote group enjoyment.

# B

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