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ADHD learners as victims or survivors in L2 learning contexts: a case of application of dynamic assessment to selective attention and reading comprehension ability

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Abstract

With the growing concern for the issues and problems associated with static testing, dynamic assessment (DA) has been recently receiving increased attention as an alternative in educational settings. The present single case study attempted to investigate the potential of interactionist dynamic assessment in developing an Attention Deficit Hyperactivity Disorder (ADHD) L2 learner's reading competence and selective attention. A 13-year-old female EFL learner with the combined type of ADHD voluntarily participated in this study. During the DA sessions, the learner read some short passages and answered the questions through mediations emerging from the interactions between the mediator and the learner. The qualitative analysis of DA protocols led to the development of an inventory of different forms of implicit and explicit mediations. Moreover, the quantitative analysis of the data showed that DA contributed to the learner's reading comprehension and some congruent parameters of selective attention. The results of the present study call for teachers', policymakers', and material developers' increasing attention to the mediations required to assist ADHD L2 learner's independence from the mediator, which demonstrates self-regulation.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD), Dynamic assessment, Reading comprehension, Selective attention

Introduction

Recently, dynamic assessment (DA) has only emerged in the field of L2 as a framework for incorporating teaching and assessment as a single activity in which different types of assistance are offered to demonstrate the learners' abilities while simultaneously fostering their improvement (Poehner et al., 2015, 2017). DA is grounded in Vygotsky's view of the Zone of Proximal Development (ZPD) and Sociocultural Theory (SCT). A key concept in ZPD and Vygotsky's theory of mind is mediation (Lantolf & Poehner, 2004). According to Poehner and Infante (2016), higher-level thinking develops through interaction with others and physical and symbolic artifacts. In particular, DA focuses on the interactive dialogue between a practitioner and students.

As an alternative form of assessment, DA questions the validity of arguing for a disclosure between teaching and assessment and draws attention to a combination of instruction and assessment processes within a single assessment procedure. It is presumed to afford information about future learning potentials rather than student's present performance (Tzuriel, 2000). Traditional assessments measure learners' independent performance, focusing on only the learning product. They often exhibit floor effects particularly in young learners, who do not perform well due to inadequate learning opportunities (Catts et al., 2009). DA targets this issue through teaching the skills evaluated by the test items and evaluation students' progress in response to that instruction. This allows a distinction to be made between students' poor performance due to learning deficits and insufficient prior learning opportunities. Moreover, DA has been shown to contribute to the early recognition of risk of learning disabilities (Cho et al., 2020; Gellert & Elbro, 2018; Petersen et al., 2018).

DA is an evolving method of psychological, psychoeducational assessment, and instructional tool that has gained great attention in the field of psychology as well as in various other domains such as neuropsychology, speech/language, and education (Haywood & Lidz, 2006). DA is also useful in the assessment of individuals suffering from certain clinical psychological problems such as attachment disorders, social/interpersonal deficits, Attention Deficit Hyperactivity Disorder (ADHD), and learning difficulties, and the principles and techniques of DA can be equally applied to individuals with psychological problems (Haywood & Lidz, 2006). One of the most common mental disorders in the classroom associated with learning dysfunctions is ADHD.

ADHD is widely recognized in both society and educational settings. It is not a new occurrence, as medical professionals have reported symptoms related to ADHD since 1700s (Weyandt & DuPaul, 2012). Children with ADHD may display a range of symptoms, including being easily distracted, having difficulty sitting still and concentrating for a long time, acting impulsively, being restless, and talking excessively (Clauss-Ehlers, 2009). While the severity of hyperactivity and restlessness vary among ADHD children, most struggle with maintaining attention, making careless errors, completing assignments on time, constantly fidgeting in their seats, and appearing to daydream or disengage when uninterested in a lesson (Taylor, 2017).

The cognitive components of both bottom-up and top-down processing of auditory and visual processing are impaired in people with ADHD (Cain & Bignell, 2014; Kaldonek-Crnjakovic, 2018). As a result, many ADHD students encounter additional challenges related to reading and language abilities. The delayed development of fronto-cerebellar networks in ADHD individuals also leads to impairments in higher-level executive cognitive functions (Rubia, 2013). Accordingly, ADHD students are likely to struggle with keeping vocabulary, grammar, and pronunciation rules in order to speak with linguistic accuracy in a normal time (Simon, 2000). Hence, L2 learning could be a grueling and slow process for them. Among all language skills, they find mastering listening comprehension particularly challenging because of their working memory impairment (Kormos, 2017). Therefore, multisensory learning has been suggested as a useful approach in teaching a second language to students with learning disabilities because visual aids can contribute to the memorization of lexical and grammatical forms (Kaldonek-Crnjakovic, 2018).

Despite the popularity of dynamic assessment and its extensive use among ADHD individuals in many fields, including first language acquisition, its application is not much common in EFL contexts. Therefore, the present study was conducted to investigate the impact of DA on the reading comprehension and selective attention of ADHD L2 learners.

Attention Deficit Hyperactivity Disorder

As a neurodevelopmental disorder, the term Attention-Deficit Hyperactivity Disorder (ADHD) is identified with a continuing process of inattention associated with a high level of impulsivity and/or hyperactivity (Sroubek et al., 2013). ADHD children are often impatient, unpredictable, and impulsive with poor organizational skills, and usually limited in controlling their own behavior, which might them to resort to verbal outbursts when distressed and with no apparent concern for the outcomes of their actions (Thapar et al., 2013). Children with ADHD act without thinking, are hyperactive, and have trouble focusing. They may realize what is expected from them but have problems following through since they cannot sit motionless, pay attention, or attend to details (Douglas, 2005).

According to the American Psychiatric Association (2013), there are three types of ADHD patients: (a) the predominantly inattentive type finds it difficult to arrange or finish a given task, follow instructions or conversations, and pay attention to details; (b) the predominantly hyperactive-impulsive type talks and fidgets to a large extent, finds it difficult to sit still for a long time, and feels restless and impulsive, which could lead to interjecting others frequently, grabbing things from people, or speaking at unsuitable times; (c) the combined type shows impulsive and hyperactive behaviors and suffers from inattention and distractibility. Irrespective of the type of the disorder, any of the mentioned features could disrupt the process of learning an L2. It is worth noting that in this study, the participant suffered from the combined type of ADHD.

Statistically, ADHD influences about 8% to 10% of school-aged children. Boys are reported to be about three times more likely than girls to be diagnosed with this disorder, though it is not yet proved why (Sousa, 2001). While ADHD itself is not classified as a learning disability, it does hinder the learning process (Rubia, 2013). Recent studies indicate that approximately 5–10% of school-aged children encounter challenges with learning and social functioning as a result of their ADHD condition (Coghill et al., 2017; Polanczyk et al., 2007). This suggests that a great number of students within regular classrooms would benefit from special support from their teachers (Turketi, 2010).

ADHD school-aged children experience several academic and educational challenges (Loe & Feldman, 2007) and behavioral problems that cause school suspension or expulsion (LeFever et al., 2002). For instance, they have some difficulties following directions and sustaining attention over time in the classroom, which can prevent learning and limit their access to academic skills (Stahr et al., 2006). According to Yue et al. (2022), individuals with ADHD are more prone to quitting high school compared to their peers without ADHD. Additionally. ADHD children are less inclined to attend post-secondary education, resulting in limited job opportunities. Individuals with ADHD may suffer from impairments in all aspects of life. ADHD is also linked with poor school performance, low academic achievement, anxiety, low

retention, depression, aggression, and problems with family and social relationships. Numerous studies have also reported deficits in relation to cognitive abilities, memory functions, spatial abilities, executive functions, language skills (Barkley, 2006; Goldstein & Schwebach, 2004), and working memory (Francesmonneris et al., 2013).

Theoretical bases of DA

DA is an approach that combines assessment and instruction to evaluate and enhance the learning potential of learners (Grigorenko, 2009). DA focuses on dialogic interactions between the mediator and the learner(s) and involves cooperative activities during which students perform tasks beyond their current level of ability (Poehner, 2008). Lidz (1991) asserts that the goal of DA is to not only measure but also intervene and modify behaviors by focusing on the learning process. According to Antón and García (2022), "mediation in DA refers to the intervention of the assessor in order to select, amplify, and interpret objects and processes to the learner during the assessment" (p. 172). Verbalization and elaborated feedback have been identified as the most important components of mediation, and low-performing students tend to benefit the most from mediated interventions compared to other groups (Lidz, 1991). It is emphasized that in this study DA was employed mainly as an intervention tool to foster achievement.

DA is also a process-oriented form of assessment engaging mediators and learners in continuous interactions (Jeltova et al., 2007) that provide gradual mediations according to the learners' needs. A decrease in the frequency of mediations needed by a learner over time indicates that the learner is improving and moving from a dependence on other-regulation to self-regulation, which indicates gaining a higher level of independence and self-reliance (Aljaafreh & Lantolf, 1994). In this process, the development of knowledge and cognitive skills depends on sociocultural forms of mediation (Sternberg & Grigorenko, 2002).

The theoretical aspect of DA lies in Vygotsky's ZPD, which emphasizes the role of mediation (Lantolf & Poehner, 2004). In Vygotsky's view (1978), ZPD stands for the difference between an individual's independent performance and their performance in collaboration with others. This explanation emphasizes the difference between inter- and intramental functioning, or performance mediated externally through collaboration with others and performance mediated internally through interaction with the self.

According to Sociocultural Theory (SCT), learners' responsiveness to mediation depends on their already existing level of ability to demonstrate cognitive functions that have not yet fully developed (Poehner, 2007). Based on SCT, individuals are often mediated through available cultural resources, social activities, artifacts, and practices. They are also mediated when working on their own, whereby their cognitive function is mediated through interactions with their surroundings (Vygotsky, 1986). In other words, individuals' abilities are fully developed and appear as new cognitive functions through social interaction. However, it is emphasized that the individual cannot merely rely on externally provided mediation and needs to self-regulate in order to make progress in learning contexts (Poehner, 2007).

Selective attention in ADHD learners

Selective attention has been a major topic in the field of cognitive psychology and is also addressed in the literature on child psychology (Girard et al., 2018). It is viewed as the cognitive process of selectively focusing on one aspect of environment at the expense of ignoring others. Selective attention is critical to the usefulness of processing sensory data and entails the selection and processing of relevant sensory information while excluding irrelevant data from further processing (Anderson, 2015). It has also been associated with some disabilities such as ADHD (Brodeur & Pond, 2001). In fact, in addition to certain cognitive deficits in relation to planning, organizing, working memory, and inhibition (Cortese et al., 2015), ADHD learners often suffer from problems in relation to attention, information processing speed, and focused attention (Barkley, 1990).

Executive functioning deficits and difficulties are also common in ADHD children. Therefore, it is not surprising that these children also exhibit selective attention deficits when compared to others (Murphy et al., 2016). Recent studies report that children with ADHD show poorer selective attention (Gomez et al., 2012), tend to perform under par in classes, and are at risk of school failure (Barkley, 2006). They generally fail to focus their attention efficiently and are more vulnerable to distraction in at least some situations (Kenemans et al., 2005; Van der Stelt et al., 2001). However, the ability to selectively attend to the teacher, maintain that attention throughout a lesson, and inhibit processing distractions in the classroom are crucial for learning any subject (Gomez et al., 2012).

Learning a second language by ADHD children

Foreign language learning is a complex cognitive activity that poses problems to ADHD students because a high percentage of them also struggle with speech-processing problems caused by their central nervous system dysfunction (Klinger et al., 2007). Students with learning disabilities are likely to face some challenges in different language areas, the most important of which, particularly for beginner language learners, pertain to the fields of phonology, morphology, and syntax (Lerner & Kline, 2006). Problems in phonology affect the learner's ability to process the sounds of the language; weaknesses in morphology lead to a poor appreciation of word roots, tenses, inflections, and problems with syntax impair the understanding of grammar and how word order can affect meaning (Leons et al., 2009).

L2 students with ADHD have difficulties with recognizing individual sounds or syllables within words, which particularly affects the development of L2 reading skills, putting ADHD individuals among poor readers. They often exhibit word decoding deficit—difficulty identifying written words (McGrath et al., 2011; Willcutt et al., 2010), which is often due to certain weaknesses in executive functions, making it difficult for learners to use their internal language efficiently enough to involve in the text (Rief, 2005). Recent studies in the field of first language acquisition have reported that ADHD individuals have problems in word reading and reading comprehension as well (Cain & Bignell, 2014). As working memory and cognitive processes play a critical role in reading comprehension (Cain, 2006), ADHD learners with attention deficits have problems with reading comprehension in both first and second language acquisition contexts (Kałdonek-Crnjaković, 2018). Studies have shown that ADHD children who struggle

with reading ability also exhibit problems in executive function skills in areas such as verbal and visual working memory, attention shifting, and response inhibition (Kibby et al., 2021; Lonergan et al., 2019). Furthermore, lack of sufficient vocabulary knowledge or a mismatch between the reader's vocabulary and that of the text can be regarded as the main causes of L2 reading comprehension problems (Graham & Bellert, 2004).

According to Turketi (2010), the development of L2 reading skills for ADHD students whose native language does not involve various reading rules and exceptions may be more challenging and may require a change in students' mind. This argument confirms the research findings demonstrating that, when asked to read aloud in English, ADHD learners are more likely to experience disappointment and confusion than their peers, and their reading performance is much weaker than what their teachers expect (Turketi, 2010). However, Turketi (2010) suggests that, if the input is enriched and presented in interesting ways using various types of oral and visual teaching strategies (oral, visual, etc.), an ADHD student has possibilities to achieve the main objectives of the syllabus in the class.

DA of L2 learning disability

Early recognition of students with reading difficulties is crucial because early intervention can hinder reading problems or decrease their effects (Fien et al., 2015; Partanen & Siegel, 2014). Young learners' reading comprehension is considered to be a moving target that is continually improving as a result of cognitive development and reading instruction (Speece, 2005). Unfortunately, reading problems are difficult to detect early in a student's development because problems exhibit themselves after reading instruction (Petersen et al., 2016; Poulsen, et al., 2017).

The most appropriate method to consider the challenges of early recognition of second language learners at risk for learning disability is dynamic assessment (Caffrey et al., 2008; Grigorenko, 2009). DA has been recently used in clinical conditions to recognize language disabilities (Pena et al., 2014), but has yet to be employed in school settings for early recognition of learning difficulty (Cho et al., 2020). The information achieved through dynamic assessment can help clinicians with choosing the right type of learning interventions while incorporating observations of classroom and home learning (Moore-Brown et al., 2006).

There are some reasons why DA has the potential to recognize at-risk learners, particularly with respect to reading skill, as compared to traditional assessment. First, the at-risk students' performance on static assessments may be influenced by several factors, such as lack of efficient reading instruction, different linguistic or cultural background, and cognitive impairment. Moreover, at-risk students are vulnerable to floor effects on static standardized reading tests because such tests are not sensitive to the development of students with poor performance (Catts et al., 2009). According to Cho et al. (2017), traditional reading tests often do not sample enough easy items. When a student quickly hits the ceiling on the easiest items on a test, there is no way to seek extra information. In contrast, DA can provide information about students' development and their failure, and how much assistance is required to help them to succeed. For instance, Kozulin and Garb (2002) conducted a study on EFL reading comprehension skills among at-risk young adult immigrants. They maintained that the students' abilities could not be fully developed merely on the basis of

their performance on the pretest; rather, it was necessary to determine to what extent they had benefited from the intervention.

In addition, Elleman et al. (2011) investigated the use of DA with children at risk of comprehension difficulties. Here, the DA entailed teaching the children to be "reading detectives" by using textual clues to solve the problems in the story. The results indicated that DA was an efficient means of measuring reading comprehension and identifying intra-individual differences in young children's reading abilities.

In the same vein, Petersen and Gillam (2015) probed the predictive validity of DA in assessing later risk of reading difficulties in bilingual Hispanic children with language impairment. Their findings revealed that DA functioned as an accurate means of predicting later reading difficulties in bilingual children. Finally, Gellert and Elbro (2018) examined the potential of DA in predicting future reading difficulties in bilingual children. Their results indicated that DA can be useful for early recognition of reading difficulties of children at risk.

Nowadays, the population of ADHD students in mainstream schools in Iran is increasing as evidenced by the medical files submitted by their parents (One of the researchers has been actively working with ADHD students for more than 10 years). Unfortunately, all schools have designed the educational system for regular students and are not prepared to meet the learning needs of ADHD students. Therefore, ADHD students are often placed in the same class as regular students and receive the same teaching methods. ADHD students require different learning opportunities, appropriate environment and special schools. There is a dire need for educators who possess both the knowledge and skills to teach students with learning disabilities. EFL teachers need to be trained to provide a high-quality education based on each student's needs because lack of teaching expertise can not only have an adverse impact on ADHD students' academic progress but also create a rather tense and stressful classroom atmosphere (Silver, 2004; Turketi, 2010).

Unfortunately, quite a few studies on dynamic assessment of reading comprehension have focused on predicting the reading ability of children with learning disabilities, particularly in Iran. Hence, the current study was conducted to determine the extent to which DA could contribute to L2 ADHD learner's reading comprehension and selective attention capacity. Therefore, the following questions were formulated:

RQ1 To what extent does the employment of DA affect ADHD L2 learner's reading comprehension?

RQ2 To what extent does the employment of DA affect ADHD L2 learner's selective attention?

RQ3 In what ways might the employment of DA contribute to ADHD L2 learner's reading comprehension?

Method

Participants

This case study was conducted with a single participant with ADHD called Sahel, henceforth, chosen based on a convenience and purposive sampling procedure. Sahel was a

13-year-old seventh grader attending a regular private high school in Tehran. She was also a monolingual speaker of Persian. As an elementary learner, she attended English classes two sessions a week at a language institute affiliated with her school, each lasting 90 min. She had been diagnosed with ADHD at the age of nine, when she started receiving medical treatment. However, despite regular medication and visits to her psychologist, she was very unsuccessful in learning all her school subjects, including English. The participant was predominately inattentive and exhibited impulsive/hyperactive symptoms (combined type). She continued receiving psychopharmacological during and after the study.

Based on the researchers' observations, Sahel was indeed an intelligent student. While being clumsy and moody, she was sometimes very active and at other times almost silent in the class. She was also very poor in math, physics, Arabic, Persian literature, dictation, and writing, and her performance on paper and pencil language tests had been extremely poor. Sahel's most common behaviors in the English class included shifting from one uncompleted task to another, having difficulty sitting still for long periods and following instructions from the teacher, talking excessively about unrelated topics, and having frequent daydreaming episodes. She often forgot to do her homework or bring her assignments to the class and did not like written work. Moreover, she became easily distracted, avoided doing tasks that required prolonged focus and thought, and was quite impulsive and disoriented.

It is emphasized that Sahel was greatly supported by her parents and other family members, and her mother checked on her schoolwork on a daily basis. Prior to the treatment, the researchers received the parents' signed consent as to their child's participation in the study.

Instruments

The Computerized Stroop Test developed by Capovilla et al. (2005) was used to measure the participant's selective attention or the capacity to attend to specific characteristics of a stimulus both as a pre-test and a post-test. In this study, the Persian version of this test was administered in two stages. In the first stage, the participant was asked to choose the color of the circle that was displayed on the screen out of four colors (blue, red, yellow and green) and press the keys covered with colorful labels (V (blue), B (red), N (yellow), M (green)) on the keyboard. In the second stage, the test consisted of 96 colored words—48 colored congruent words (the meaning of the word corresponded to the color in which the word was written) and 48 incongruous colored words (the meaning of the word did not match the color in which the word was written). A total of 96 congruent and incongruent chromatic words were presented randomly and consecutively. The participant was asked to recognize the colors of the words, regardless of their meaning.

In this study, the conceptual framework of reading comprehension was based on the Common European Framework of Reference (CEFR). According to Council of Europe (2023), traditionally reading in L2 contexts was seen as a passive skill. However, developments in linguistics and psychology have changed this perception, highlighting that reading is an active process involving various factors and skills. Both bottom-up and top-down processes are now recognized as playing significant roles in reading

comprehension. According to the classification provided by CEFR (2023), the participant in this study was at the A2 level (elementary level).

A non-dynamic reading comprehension pre-test was also designed and given to Sahel to assess her reading comprehension ability before the treatment. The test included 4 passages from *Teen 2 Teen 1* (Saslow & Ascher, 2015) followed by 20 multiple-choice, short-answer, and true–false questions (five for each passage). In addition, a different post-test was administered in order to measure the potential effects of DA on her reading comprehension. Both the pretest and post-test were at the same level of difficulty. The post-test included 4 passages selected from *Connect 1* (Richards & Barbison, 2009) followed by 20 questions (five for each passage) in the mentioned three formats. It is noted that the mentioned books were routinely used for all the students at the institute. The Flesch reading ease scores of the passages used for the pre- and post-test were 89 and 82, respectively, indicating that they were at the same difficulty level (easy to read).

Furthermore, the researcher took detailed field-notes on the participants' behaviors in the course of DA mediations during the treatment period. The field notes included factual data or comments on the participants' verbal and physical behavior, as well as the researcher's thoughts, feelings, and subjective reflections.

Materials

Project 1 (Hutchinson, 2013) was used as the main textbook. This book consists of 6 units focusing on all skills and subskills. All 6 units were covered in this study.

Design and procedure

The interactionist DA approach and a microgenetic methodology were employed to provide the treatment to the participant; hence, the researchers followed a qualitative approach to collect and analyze the data, while taking Vygotsky's invaluable comment into account as to, "We must not measure the child, we must interpret the child" (1998, p.204).

At the outset of the study, Sahel's mother was thoroughly briefed regarding the purpose of the study. She willingly provided the researchers with the data regarding the participant's medical and educational background, foreign language knowledge, and home life quality. Before beginning the treatment, the mediator-teacher (one of the researchers) had some sessions with Sahel to develop a friendly relationship and establish rapport with her. Then she tried to give the required DA mediations in a stress-free, quiet, and distraction-free atmosphere. All the DA sessions were audio recorded for later analysis. The teacher also used a diary to record every single detail of the experiment. Generally, she tried to reduce distractions, remove the dangerous things (e.g., scissors, metal ruler, mechanical pencils) from the room, and provide frequent breaks.

During the DA sessions, the mediations emerged out of dialogic interactions between the learner and the mediator. The mediational moves ranged from the most implicit to the most explicit. Since the participant might have become bored and quit the class, each DA session lasted for 15–20 min depending on the mood and cooperation of the participant. Before the treatment, a selective attention test and a reading comprehension test were used as pre-tests. The selective attention test was introduced as a computer game, and then the participant was engaged in practice trials. Prior to the administration of the

test, the teacher provided some instruction on the test in Persian, and the participant was allowed to practice the tasks until she became completely familiar with the multiple testing procedures.

Sahel's reading comprehension was also assessed dynamically. She was assessed through reading tasks that were selected from the main textbook and workbook over 13 sessions (7 weeks). The reading tasks were based on 13 short passages followed by 78 questions in multiple choice, true false, and short answer formats. One passage was studied the each session. During the actual process, Sahel read the passages quite rapidly. Then she was led through the dynamic phase of the test, which consisted of a number of questions. If she failed to provide the correct answers to the questions, implicit and explicit mediations were provided.

The mediations began with the most implicit moves (request to look over the answers) and moved toward the most explicit ones (providing the correct response). During each dialogic interaction, the mediator used all or some of the mediational moves to proceed with each DA session. The following episode represents one of Sahel's reading comprehension DA sessions. After reading the passage, she responded to 5 true–false sentences. She gave 2 correct and 3 incorrect answers. A typical interaction between Sahel and the mediator about one of the true/false questions is given below.

Mediator: There is a telephone on the table in the dining room (true/false).
Sahel: True
M: There is a telephone on the table in the dining room?
S: Yes.
M: Read the sentence again.
S: [She read]. I can remember a telephone but I don't know where it is exactly.
M: Go to the text and find and underline a telephone.
S: I can't find a telephone.
The mediator read the whole text aloud. She stopped when she reached the sentence that contained the answer.
M: "Where is the telephone?"
S: I don't know.
M: Read the text aloud.
S: [She read].
M: Where is the telephone?
S: It's in room D.
M: What is room D?
S: Hall.
M: So, is the sentence true or false?
S: True.
M: True?
S: Yes.
M: Go to the text and find and the telephone and the place of the telephone. It's in paragraph one.
M: Where is the telephone?
S: It's on the table.

M: Where is the table?
S: It's in the hall.
M: Read this sentence carefully. [There is a telephone on the table in the dining room]. Is the sentence true or false?
S: Oh! It's false.
M: Good.

The mediation typology that emerged out of the dialogic interactions between the mediator and the learner in the reading DA sessions is summarized in Table 1.

At the end of the intervention sessions, the same selective attention test (Computerized Stroop Test) and a reading comprehension post- test similar to the pre-test were used to check the effect of DA on the participant's selective attention and reading comprehension.

Data analyses

The participant's performance was analyzed in terms of the appropriateness of the language she produced while completing the tasks and the types of prompts she needed. Minimal quantitative analysis was also incorporated into the process in the form of descriptive reports of the learner's performance on the tests and the number of mediations provided by the mediator.

Field notes and audio recordings were analyzed qualitatively to provide information about the given mediations and the student's attention focus, behavior, and interest in the course of the treatment. This allowed the researchers to re-live the classroom by focusing on the learner's reaction to the mediations and learning behavior. All the interactions between the mediator and the student were audio-recorded, transcribed verbatim, and reported in the form of Language-Related Episodes (LREs) in line with Swain's definition (2001).

Results

Quantitative analysis

Reading comprehension

To answer the first question of the study, the participant's reading comprehension scores on both the pre-test and post-test were computed and compared. She was able to answer 12 out of 20 questions correctly (60%) on the pre-test and 16 questions (80%) on the post-test (Table 2). Hence, it was decided that the employment of DA had effectively

Table 1 Mediation typology

1. Request to look over the answers
2. Request to review the pictures
3. Request for verification
4. Repeat the erroneous response with a questioning tone
5. Request to find and underline the keywords in the text
6. Request to read aloud
7. Identify the specific place of the answer in the text
8. Provide the correct response

contributed to the development of the participant's reading comprehension at the end of the study.

The participant's raw scores on the different sections of the pre- and post-test are given in Table 3 in order to portray the changes in her scores on different questions types.

As illustrated in Table 3, Sahel performed better on true–false and short answer questions on the post-test.

Selective attention

In order to answer the second question of the study, the participant's scores of selective attention parameters were obtained using the Computerized Stroop Test both as a pre-test and a post-test (Table 4).

As presented in Table 4, the time experiment item in both the congruent and incongruent parameters decreased on the post-test; however, the error numbers of congruent and incongruent parameters did not change from the pre-test to the post-test. There was a decrease in the no response item in the congruent parameter in the post-test, while there was an increase in the incongruent parameter. The number of true responses in the congruent parameter increased in the post-test, while the reverse happened with respect to the incongruent parameter. There was a decrease in the response time in both the congruent and incongruent parameters on the post-test, whereas the interference number in both the congruent and incongruent parameters on the post-test increased. Finally, the interference time in the congruent and incongruent parameters on the post-test decreased significantly. The results revealed that Sahel had more difficulties with incongruent tasks. It had contributed to the development of some parameters (congruent tasks) of the selective attention test but not to incongruent ones.

Table 2 Sahel's reading comprehension scores on the pre-test and post-test

Participant	Pre-test	Post-test
Sahel	12 = 60%	16 = 80%

Table 3 Sahel's reading comprehension raw scores on the pre-test and post-test

question types	Multiple choice	True–false	Short answer
Pre-test	3	3	6
Post-test	2	6	8

Table 4 Sahel's selective attention scores on the pre-test and post-test

		Time experiment	Error number	No response	True response	Response time	Interference number	Interference time
Pre-test	Congruent	59	2	4	42	1182	−4	55
	Incongruent	60	0	2	46	1237		
Post-test	Congruent	54	2	0	46	1148	2	−15
	Incongruent	57	0	4	44	1133		

Table 5 Regulatory scale

Transitional levels	Mediational moves
Level 1	The learner is not able to notice, or correct the error, even with intervention from the tutor
Level 2	The learner is able to notice the error, but cannot correct it, even with intervention
Level 3	The learner is able to notice and correct an error, but only under other-regulation
Level 4	The learner notices and corrects an error with minimal, or no feedback from the tutor and begins to assume full responsibility for error correction
Level 5	The learner becomes more consistent in using the target structure correctly in all contexts

Table 6 Levels of Explicitness of Mediational Moves

Learner	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10	DA11	DA12	DA13
Sahel	4, 3	4, 3	4	3	3, 3, 4	3, 3	3, 4, 2	4, 4	4, 4, 4	3	3, 3, 3, 4, 4	3, 4	5

Qualitative analysis: reading comprehension

This study employed a microgenetic perspective as the general methodological framework for data analysis because it allows tracking the learners' development over time (Ableeva, 2010). The quality of the mediations required by the learner was analyzed based on the regulatory scale (Table 5) introduced by Aljaafreh and Lantolf (1994).

Aljaafreh and Lantolf (1994) introduced five transitional levels presenting three different developmental stages with levels 1–3 representing other regulation, level 4 partial self-regulation, and level 5 self-regulation. The analysis of the ADHD L2 learner's performance during the DA sessions demonstrated not only improved independent performance but also some changes in the number of mediations she required. All the DA sessions were coded for the emergence of the different mediational moves that comprised the typologies. The coding process required some expertise and familiarity with the learning behavior of the participant. Therefore, the mediator herself coded the outcome of the DA sessions twice under the close supervision of the participant's psychologist over a 30-day interval. The intra-rater reliability, which was computed using the Pearson Product Moment, was equal to 0.92, indicating a high level of consistency.

The learner's performance in each DA session was thoroughly analyzed in comparison to those in other sessions, and the mediation typology was created based on the explicitness of each move by the mediator in the reading comprehension tasks. (Table 6).

As shown in Table 6, Sahel needed the fewest explicit types of mediation to self- correct in DA3, while she required more explicit meditational prompts in DA8 and DA9. She remained at the same level of explicitness in DA1, DA2, and DA12. She was partially dependent on other-regulation in DA3, DA8, and DA9, while she was completely independent on other-regulation in DA13. Table 7 presents the total and average numbers of prompts required by Sahel each session.

As indicated in Table 7, the number of mediations fluctuated in some sessions. Given the average number of mediations, a decrease was observed in DA4, DA8, DA9, and DA10. By considering the interactions that occurred in both DA sessions (DA12 & DA13) and viewing the average number of the prompts that were given to Sahel, a visible decrease in the number of mediations occurred in DA13.Sahel showed improvement

across the last two mediated assessment sessions with regard to the number of mediations. The mediational moves, which had amounted to 13 in DA3, fell to 5 during DA4. It can be claimed that Sahel's independent performance improved as she came closer to the last session of DA. This signifies that as the participant received some degree of explicit mediation in the class over time, she gained some self-regulation and did not rely completely on other-regulation per mediation anymore.

Discussion

The purpose of this single-case study was to examine the contribution of DA to ADHD L2 learner's reading comprehension and selective attention. The findings of the study initially showed the promise of DA in improving ADHD L2 learner's reading comprehension and some parameters of selective attention. However, the analysis of mediator-learner's dialogic interactions revealed some differences in the learner's levels of internalization during the DA sessions. Furthermore, the results indicated that the participant performed better on the true–false and short answer questions, while she had more difficulties with the multiple-choice items.

The results are consistent with those of several studies divulging the contribution of DA to at-risk learners' success in the learning process. For example, Elleman et al. (2011) reported the potential effect of DA on the inference-making skills of children at risk of comprehension difficulties. The findings are also relatively consistent with those of Navarro and Mora (2012), who suggested that DA provided valid information about improving the comprehension process of students with special comprehension and intelligence difficulties. Furthermore, they are also partly in tune with those of Petersen and Gillam (2015), who examined the predictive validity of DA in assessing the risk of reading difficulties in bilingual children. Based on their findings, the dynamic assessment of reading may be a useful approach for the early recognition of bilingual first graders who are at risk of developing reading difficulties.

A thorough analysis of the data demonstrated that the participant performed independently and required fewer mediations in some sessions (e.g., DA12, 13). According to Poehner (2005, p. 209), "a learner who requires fewer interventions or less explicit mediation at time 2 than at time 1 can be said to have developed". To be more specific, the analysis of the participant's performance showed that the participant's process of knowledge acquisition was not linear but rather "zigzagged" in Vygotsky's (1997) terms. She commonly tended to produce more progressive than regressive moves, particularly during the last two sessions. At the end of the study, Sahel became a more autonomous learner, taking more responsibility in her learning procedure. According to Silver (2004), ADHD students in spite of their innate learning disability can succeed in learning a foreign language when the employed instructional strategies and practices address their needs appropriately. It is emphasized once more that ADHD students suffer from attention deficit, lack of motivation, and poor school performance. The participant's progress in this study could be attributed to providing one-on-one instruction and creating a supportive classroom environment, which could have encouraged her to discover and correct the errors. Furthermore, the analysis of reading comprehension question types indicated that multiple-choice items distracted the participant. The reason could be attributed to the fact that ADHD learners often struggle with maintaining attention for

Table 7 Frequency of mediational moves (Sahel)

Mediations	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10	DA11	DA12	DA13
1. Request to look over the answers	2	2	4	1	2	2	3	2	2	1	3	2	1
2. Request to review the pictures	0	2	0	0	2	2	0	0	0	0	4	2	1
3. Request for verification	2	2	2	1	2	1	2	0	0	1	3	1	1
4. Repeat the erroneous response with a questioning tone	0	1	3	0	1	1	0	2	0	0	0	0	0
5. Request to find and underline the keywords in the text	2	1	1	1	2	2	2	0	2	1	0	0	0
6. Request to read aloud	2	0	2	1	3	2	2	0	2	1	3	0	0
7. Identify the specific place of the answer in the text	1	0	1	1	0	0	1	1	0	1	0	0	0
8. Provide the correct response	0	0	0	0	0	0	0	0	0	0	0	0	0
Total number of mediations	9	8	13	5	12	10	10	5	6	5	12	5	3
Average number of mediations	1.12	1	1.62	0.62	1.5	1.25	1.25	0.62	075	0.62	1.5	0.62	0.37

a long time. Multiple choice items typically require sustained attention to read and process the options and select the correct answer. Distractions can make it a challenge for ADHD learners to stay engaged and accurately answer the questions.

The results of the selective attention test indicated that DA had developed the congruent parameters, but this was not the case in the incongruent parameters. The most important reason is that ADHD children suffer from more specific deficits in relation to performing incongruent parameter (Carter et al., 1995), where the ink color of the word is incompatible with its meaning and may require to be inhibited in order to succeed in the parameter (Barkley et al., 1992). However, several external variables may interfere in the evaluation of findings and their application to ADHD learners such as medication, age, sex, and comorbidity, among others (Assef et al., 2007).

Furthermore, the types of the mediation provided by the mediator and the length of the study could have affected the outcome of this study. The researchers believe that any judgment regarding the effects of the types of mediation on the changes in the incongruent parameters demands further study. However, according to Poehner (2007), in some DA programs, the first DA session can be used as a tool to diagnose the learners' abilities and repeated later to track developmental changes over time. Therefore, a longer study of the variables of this study could result in different results.

As mentioned previously, DA was employed in this study as an intervention rather than an assessment tool. However, employing DA for assessment purposes may also offer various benefits such as a more individualized and personalized approach to assessment. It facilitates the recognition of the learner's strengths, weaknesses, and potentials and provides a more comprehensive understanding of their learning needs. It is emphasized that in order for DA to be useful either as an assessment or instructional tool, teachers require some additional training in order to manage the class-time more efficiently (due to the time-consuming nature of this approach), provide the needed mediations, and interpret the findings appropriately.

Conclusion

Given the findings of the present study, it was concluded that DA can contribute to ADHD L2 learner's reading comprehension while it did not improve the participant's performance on reading comprehension multiple-choice items. However, it is emphasized that the number of mediations the participant received in this process varied during the DA sessions. The participant required more mediations in some sessions while she needed little assistance in the last sessions. Additionally, it can be concluded that DA could contribute to ADHD L2 learner's selective attention regarding the congruent parameters.

The findings of this study can provide some useful guidelines for EFL teachers who teach ADHD students at different educational levels and ages as to the different types of mediation that emerged throughout this study. In addition, they may encourage material developers to design specific reading comprehension activities that could greatly benefit ADHD learners. English language teachers and material developers should take ADHD L2 learners' language needs into consideration and avoid a one-size-fits-all approach to language teaching and learning. Moreover, the results of this study indicate that educational policy makers need to provide special educational services or accommodations to

address the learning needs of children at risk in general and ADHD L2 learners in particular. Course developers should also design practical courses for EFL teachers to guide them on how to treat and teach ADHD L2 learners.

As with all case studies, this single-case study was prone to a number of challenges and limitations. In this study, no generalization can be made based on the data. Nevertheless, the case investigated here proved that ADHD L2 learners do not have to be victims of the educational system and, rather, can survive in the process of foreign and second language learning with some degree of success. Future research could be carried out with a larger sample and extend over a longer period of time while focusing on other learning disabilities and cognitive impairments. This study was one of the first few, if any, attempts at investigating the contributions of DA to the process of L2 learning by ADHD learners. If DA is to be employed among ADHD L2 learners, a great number of studies with students at different ages is required. There is also a need for examining the application of DA to other language skills and sub-skills among ADHD L2 learners. Since the participant in this study was female, the replication of the same study with male learners could provide some interesting results. Moreover, it would be enlightening to investigate how ADHD L2 young learners can benefit from DA even in other school subjects in the future.

Abbreviations

DA Dynamic assessment
ADHD Attention-Deficit Hyperactivity Disorder

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Author contributions
All authors contributed to the different stages of the study, including data collection and analysis, and reporting of the content. They read and approved the final manuscript.

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Availability of data and materials
The data are available and can be accessed by other researchers upon request.

Declarations

Ethics approval and consent to participate
The authors followed the official ethical procedures implemented at their instruction for involving human participants.

Consent for participation
The participant volunteered to take part in the current study and filled in and signed a consent form.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

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