Metacognitive Intervention with e-Books to Promote Vocabulary and Story Comprehension Among Children at Risk for Learning Disabilities

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Abstract The purpose of the current chapter is threefold. First, to describe the rationale underlying the use of e-books in literacy development among children at risk for Learning Disabilities (ALD). Several studies demonstrating the e-book's potential for promoting literacy among this population are also reviewed. The second and third parts of the chapter refer to two recent studies indicating that educational e-books designed specifically for young ALD children can enhance their Vocabulary and Story comprehension. The first study focuses on activity with two modes of educational e-books (with and without embedded metacognitive guidance) in the area of Story comprehension. The second investigates the effect of an intervention program, based on the metacognitive approach, aimed at promoting self-regulated leaning with e-books on Vocabulary and Story comprehension. In the concluding part of the chapter, we discuss the implications of current evidence regarding the e-book's use for creating inclusive learning environments.

Keywords Metacognitive intervention · Electronic books · Children at risk for learning disabilities · Vocabulary · Story comprehension

Among the special education population, children at risk for learning disabilities experience a wide variety of difficulties. One of the main ones many face is the acquisition of language and emergent literacy skills such as vocabulary and story comprehension, which are required for successful school learning and integration into modern, technological society (Hutinger et al. 2005; Milburn et al. 2017). Indications of learning disabilities develop before or during childhood and continue into adulthood. In light of this, educators and researchers are looking for new ways

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to reduce the gap between children at risk for learning disabilities and their typically developing peers, thus enabling them to start life on an equivalent level. In this spirit, the current chapter focuses on electronic books (e-books) that support vocabulary acquisition and story comprehension among children at risk for learning disabilities.

As they consider the variety of e-books on the market, educators and researchers evaluate the products' potential to enrich the development of literacy among children with diverse educational needs (Bus et al. this volume; Van Daal et al. this volume). The chapter will be divided into five parts: The first three will focus on the population at risk for learning disabilities, their academic difficulties, and the rationale behind using e-books to help them progress. The fourth part will present two studies: The first focuses on the impact of activity with the same educational e-book in two situations (with/without embedded metacognitive guidance) on promoting vocabulary and story comprehension. The second investigates the effect of an educational program to promote metacognition as preparation for activity with e-books and its effect on vocabulary and story comprehension. The last part of the chapter will discuss the findings of the studies and recommendations for the future.

1 Students at Risk for Learning Disabilities: Definitions and Characteristics

Learning disabilities are considered one of the most common types of disability with a lifetime prevalence of about 10% (Johnson 2017; Margalit 2014). Learning disabilities are characterized by language, memory, and phonological awareness difficulties that can already be detected at preschool age (Hebbeler and Spiker 2016; Pears et al. 2016). Young children with a delay in a cognitive, communicative, physical, or social-emotional domain (Margalit 2014) are defined as having a "developmental delay" or being "children at risk for learning disabilities." When such children are still young we must address indications of neuropsychological difficulties, some of which may develop into learning disabilities that will be manifest during the acquisition of literacy skills like vocabulary, phonological awareness, and concepts about print (CAP).

Literacy development is a central process in the life of a child. At a young age, children acquire the written and spoken language (Lonigan et al. 2000). The process of learning to read is a part of a developmental sequence that begins early in the child's life and continues into formal schooling (Whitehurst and Lonigan 1998). Studies have shown that differences in the emergent literacy skills of young children predict later differences in reading and writing acquisition, reading comprehension, and academic achievement in general (Haughbrook et al. 2017; Lonigan et al. 2011).

Students with learning disabilities have low awareness of cognitive processes and therefore have difficulties in monitoring and controlling their learning. They can have a diverse mix of difficulties in the areas of memory; attention span;

instruction following; visual or spatial perception; and performing metacognitive activities such as planning, regulation, information processing, and coding. Indeed, metacognitive difficulties affect achievement in areas like problem solving, language, reading, arithmetic, attention, and memory (Garrett et al. 2006). It is therefore important to improve the metacognitive abilities of these children.

2 Metacognition and Children with Learning Disabilities

The term metacognition refers to the ability of individuals to think about their thinking and their awareness of cognitive processes (Flavell 1979). The metacognitive system is in charge of cognitive mental processes and controls the regulation and monitoring of these processes through planning, monitoring, and evaluation (Pintrich 2002). Research findings indicate a link between metacognitive ability and achievements in various areas, including literacy (Chatzipanteli et al. 2014; Özsoya and Ataman 2009; Zepeda et al. 2015).

Scholarly literature relates to two types of metacognitive guidance, general and specific: (a) General metacognitive knowledge is usually acquired generically and not necessarily in relation to an individual task. It affects performance in a wide range of learning domains and it is assumed that this acquired knowledge can be transferred to new situations; and (b) specific, in contrast to general, metacognitive knowledge, is acquired in each content domain individually. This means that cognitive activity and implementation of thinking strategy must be carried out in a focused manner within the domain of the learning task (Veenman 2012; Veenman et al. 2006).

Research shows executive function deficits in students with learning disabilities (Moura et al. 2014; Toll et al. 2011; Varvara et al. 2014). There is a link between academic skills and executive functions (Toll et al. 2011; Varvara et al. 2014). Deficits in executive functions can manifest in difficulties in organizing, planning, and monitoring (Ward 2006). Studies have consistently shown that students with learning disabilities regulate poorly and benefit from strategy instruction that combines practice with self-regulation that includes metacognitive ability (Graham and Harris 2003; Wong et al. 2003).

Students with learning disabilities generally lack metacognitive skills and have difficulty performing effective metacognitive thinking processes, monitoring understanding, and adapting strategy to task (Antoniou and Souvignier 2007; Klassen 2010; Martini and Shore 2008). They do not use self-questioning to clarify the purpose of a task and how to achieve it while using regulation (Desoete and Roeyers 2002; Garrett et al. 2006). When students with learning disabilities have metacognitive deficits, they are limited in their ability to use strategies that may compensate for them (Mason et al. 2006; Wong 1986). Research findings suggest that improvement in metacognitive abilities promotes academic abilities in general (Andersen 2016; Boyle et al. 2016), in particular, literacy abilities (Bulgren et al. 2013; Lovett et al. 2014).

The computer as part of a technological learning environment can provide the learner support and improvement in self-regulation processes vis-à-vis cognition and metacognition (Azvedo 2007).

3 Promoting Literacy Among Children with LD: Multisensory Learning and e-Books

The unique characteristics of children with learning disabilities require multisensory learning (visual, auditory, and sensory) to provide a variety of input channels to compensate for deficits (Hetzroni 2004; Lipka et al. 2006; Shamir and Margalit 2011; Van Daal et al. this volume). This can be achieved by exposing the learner to various technological aids such as computers, iPads, tablets, smartphones, and more, which make use of multimedia platforms and the simultaneous use of different media formats (text, graphics, color, animation, images, sound, music, video, and games) that help simplify and streamline learning processes. Multimedia presentation consists of two channels, one verbal, such as printed or narrated text, and one non-verbal, like photos, pictures, animation, video, and games (Geva 2010).

Research findings indicate that young students at risk of failure in school can be helped by computer technology to develop various skills that affect learning achievement and processes: such technology promotes academic learning (Huffstetter et al. 2010; Kiru et al. 2017) and extends the attention span when carrying out a task (Vernadakis et al. 2005). In addition, computers help these learners advance their literacy in fields like alphabetic principles and reinforcement of phonological awareness (Torgesen et al. 2010), word recognition (Hitchcock and Noonan 2000), comprehension (Blok et al. 2002), development of metacognitive skills, and conceptual knowledge (Clements 2002).

According to the dual coding theory (Paivio 1986) and the working memory model (Baddeley 1986), humans process verbal and nonverbal information in separate channels. When information is received through the senses it is processed in both channels in combination and thus is learned more effectively than if it were processed only through one channel. According to the theory of synergy (Neuman 2009), young people, especially children at risk for reading difficulties, will read better when using a variety of computer, radio, television, and printed materials, such as books. These theories are supported by the cognitive theory of multimedia learning, which focuses on the integration of a symbolic system used in various media (Mayer 2003, 2005). In-depth learning occurs when information is presented verbally and nonverbally to the learner, as well as in snippets of information presented in close time proximity rather than individually. In this way, children are not required to hold the voice narration and the illustration in their working memory for a long period time in order to form the connection between them. Thus, the cognitive load on the learner is lighter and learning is easier.

One tool that combines multimedia resources that children of different ages are exposed to is the electronic book, also called e-book, CD-ROM storybook, and interactive story. The e-book is popular among adults and youngsters, including kindergarten children (Bus et al. 2015; Zucker et al. 2009). e-Books appear in various formats, such as for CD-ROM, tablets, iPads, and more, and are able to augment the written version with hypertext and multimedia (Anuradha and Usha 2006). The story in an e-book is presented through two channels – one verbal and one visual – as opposed to a one-channel presentation, thus improving the understanding and recall of unfamiliar words (Bus et al. 2015) and story comprehension (Zipke 2017). Much like set out in the dual coding theory, in which the verbal and nonverbal systems are combined, it can be assumed that children will remember and comprehend stories and difficult words better (Paivio 2007).

The quality of commercial e-books is not uniform and most cannot be considered to support literacy. This finding emerges from comprehensive surveys in Israel (Korat and Shamir 2004) and in Holland (de Jong and Bus 2003). The e-books examined did not include enough dynamic aids to support the story plot, like highlighting a word as it is being read, reading the book before options for play are presented, hotspots to support comprehension, and a dictionary option to enrich the child's vocabulary. It was also found that in commercial books special effects that do not support the plot may distract the child from the story content and cause cognitive overload (Sweller 2005). However, when nonverbal narration and animation are synchronized, e-books can advance story comprehension (Bus et al. 2015, this volume).

Because commercial e-books differ in terms of their educational value and ability to advance literacy, educational e-books and multimedia resources with the potential to benefit learning have been developed to promote literacy ability in young children, including vocabulary and phonological awareness (Brueck et al. this volume; Korat and Shamir 2008; Shamir and Korat 2007; Wood 2005). The text and illustrations in an educational e-book are similar to the print version, but e-books incorporate literacy support features and various multimedia tools (Labbo 2000, 2005; Pearman 2008; Roskos et al. 2011). Much like reading a book out loud is a means of promoting literacy, children can listen to a narrator read the digital text for them, see words highlighted as they are being read, see pictures, hear music, and operate hotspots that activate animation. Animations in an educational e-book expand the plot, prompt the reader to focus on storyline events, and support story comprehension and spoken and written language development (de Jong and Bus 2003; Korat and Shamir 2008; Labbo 2000; Lefever-Davis and Pearman 2005; Shamir and Korat 2007, 2015).

Some studies support the finding that activities using educational e-books with or without adult support have advanced various areas of literacy among typically developing children regarding vocabulary (de Jong and Bus 2004; Korat 2010), phonological awareness (Chera and Wood 2003; Shamir 2009; Shamir and Korat 2007), written word recognition (de Jong and Bus 2002; Lewin 2000; Wood 2005), and CAP (Shamir et al. 2008).

Studies comparing children reading an e-book independently with no intentional adult intervention to an adult reading the same book to them from a print version reported consistent improvement in spoken language, that is, vocabulary and story comprehension (de Jong and Bus 2004; Doty et al. 2001; Korat and Shamir 2007; Segers et al. 2004), and inconsistent improvement in literacy skills like word reading and phonological awareness (Chera and Wood 2003; Korat and Shamir 2007; Wood 2005). In other words, there is disagreement among scholars regarding to what extent e-books support various aspects of literacy, as well as which students would benefit most from the use of technology (Shamir and Korat 2015; Zucker et al. 2009).

It should be noted that most of the studies focused on a typically developing population or one characterized by low socioeconomic status (Ihmeideh 2014; Korat et al. 2011; Shamir and Korat 2015; Shamir et al. 2017). A meta-analysis of 43 studies about the impact of technology on the literacy development of children using e-books included studies about children with low socioeconomic status, children from immigrant families, and children with gaps in language and literacy. The results from these studies indicated that multimedia elements have a small but statistically significant positive effect on story comprehension and expressive vocabulary. Information obtained from nonverbal multimedia, like animation and background music, can help comprehension as long as it is synchronized with the story plot (Takacs et al. 2015).

Research among children at risk for LD is still in its infancy and there are many questions regarding the use of educational e-books to promote their emergent literacy. As to vocabulary and story comprehension, Shamir et al. (2011) investigated the effect of independent reading with an e-book without adult mediation on vocabulary and story comprehension among kindergarteners at risk for learning disabilities, as opposed to typically developing kindergarteners. Good progress in vocabulary was found in both groups, though it was higher among the typically developing kindergarteners. Another study by Shamir et al. (2012) investigated the effect of activity with an e-book without adult mediation compared to reading the same book in print version among kindergarteners at risk for learning disabilities. Vocabulary, phonological awareness, and CAP were examined. The findings were inconsistent. Activity with the e-book resulted in improved phonological awareness and vocabulary, but no improvement in CAP. These findings indicate the need to continue to examine the effectiveness of interventions with an educational e-book in promoting literacy among young children at risk for learning disabilities.

In the next section we present two studies that examined the effects of two different metacognitive approaches used in children's working with e-books. The first study focused on metacognitive guidance embedded in the software of an e-book; the second involved external (i.e., a metacognitive) intervention was carried out prior to the study as preparation for activity with the educational e-book.

4 Metacognitive Guidance to Promote Literacy Skills: Two Studies

The first study focused on the effect of activity with an educational e-book in two situations (with/without metacognitive guidance) on promoting vocabulary and story comprehension (Shamir and Lifshitz 2013). The second investigated the effect of metacognitive intervention with adult mediation prior to and in preparation for working with an e-book on vocabulary and story comprehension.

4.1 Study 1

Seventy-seven children aged 4.5–7 years (M = 5.88, SD = 67) participated in the study. All the children had been identified by the psychological services as having developmental delays placing them at risk for learning disabilities. They were native Hebrew speakers with typical cognitive abilities and no severe emotional, motoric, or language difficulties. The participants possessed normal or higher nonverbal cognitive abilities according to the Test of Nonverbal Intelligence (TONI) (TQ 85 or higher) and verbal abilities lower than their chronological age according to the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk et al. 1968), a gap expected because they were at risk for learning disabilities (APA 2013). Participants were selected only after taking and passing two screening tests that examined verbal and nonverbal cognitive abilities. They first took the TONI test (Brown et al. 1997) followed by the ITPA test.

The purpose of the TONI test is to examine nonverbal intelligence, abstract reasoning and problem-solving abilities. TONI's internal reliability as α = .89 to .97, and a correlation with the WISC-3 test of r = .63 among children with LDs. The ITPA test verbal level by having children retrieve a word using 'auditory association'. The test's target population is children of typical intelligence, aged 4–8. The test's reliability is r = .90 (Paraskevopoulos and Kirk 1969). Raw scores, ranging from 0 to 42, are used to determine the child's linguistic age. Children whose verbal abilities were below their chronological age were selected to participate in the study.

They were randomly assigned to three groups: (a) an experimental group using an educational e-book with metacognitive guidance embedded (EBM) (n = 26), (b) an experimental group using an educational e-book without metacognitive guidance embedded (EB) (n = 25), and (c) a control group that was exposed only to the regular kindergarten program (n = 26). The research question was, what is the effect of activity with an educational e-book embedded with metacognitive guidance as opposed to one not embedded with metacognitive guidance on vocabulary and story comprehension of kindergarteners at risk for learning disabilities.

Activity with the e-book took place once a week in five 20-min sessions. The metacognitive guidance embedded in the educational e-book was general and not aimed at a specific skill. It was based on the educational rationale that ascribes to

multimedia environments learning advantages that can develop a metacognitive environment through pre-planning and post-evaluation (Cooper 2005). The guidance focused on planning and monitoring of learning processes and simultaneously exposed the children to two sensory channels. The visual channel used the symbol of a stop sign and the auditory channel used the sound of a gong. The guidance included narration together with visual and auditory support. The following were the verbal components of the metacognitive guidance:

1. A planning-focused type of metacognitive guidance imparted prior to exposure to new information was aimed at focusing attention on auditory and visual stimuli before the child begins the activity. The narrator says, "Say to yourself: 'I am planning, listening, and observing.'"
2. A comprehension-monitoring type of metacognitive guidance was imparted post-exposure to new information: At the end of each page of the e-book, the narrator says, "Ask yourself: 'Did I understand? If I did, I can go on to the next page. If I did not? I will go back to listen to/read the page again.'" After each screen, the narrator directs the children to monitor comprehension of the new information they were exposed to.

All the children in the experimental groups took a "fitting the picture to the word" vocabulary test pre- and post-intervention. The test included 22 words, half from the e-book and half from the Peabody Picture Vocabulary Test (PPT-R new version, Dunn and Dunn 1981). Each word appeared with three pictures. The child was required to identify the picture that represented the word. Each correct answer earned a score of one, with possible raw scores ranging from 0 to 20.

After the intervention, three components of story comprehension were tested: word recall, quotation recall, and key concept recall. The score range for key concept recall was 0–48; for quotation recall, 0–109; and word recall, 0–356.

To examine differences between the groups pre-intervention and to examine if there was a difference if the words were taken from the book or not, an ANOVA 3 X 2 analysis was performed (experimental group X type of word) with words from the book and not from the book serving as the repeated-measures variable. No significant differences were found between the experimental groups ($F(2, 74) = .04$, $p > .05$). There was also no significant difference between words from the book and words not from the book ($F(1, 74) = .46$, $p > .05$) and no significant interaction of the experimental groups X type of words ($F(2, 74) = .67$, $p > .05$). These findings indicate there were no differences between the experimental groups regarding words from the book and not from the book as measured pre-intervention.

To investigate the research question, a MANOVA 3 X 2 analysis (experimental groups X time) was performed with time serving as the repeated-measures variable. A significant difference was found between the two measurements ($F(2, 73) = 31.02$, $p < .001$, $\eta^2 = .46$). To identify the source of the differences, separate variance analyses were performed on the words from the book and not from the book parameters.

The analyses indicated there were significant differences between pre- and post-measurements both for words from the book ($F(1, 74) = 42.57$, $p < .001$, $\eta^2 = .37$) and words not from the book ($F(1, 74) = 15.30$, $p < .001$, $\eta^2 = .17$).

A significant interaction of groups X time was found in the MANOVA analysis ($F(4, 146) = 3.19$, $p < .05$, $\eta^2 = .08$), that is, there were differences between the experimental groups regarding changes in pre- and post-measurements in variance analyses performed for each word type separately. A significant interaction of experimental groups X time was found only with respect to words from the book ($F(2, 74) = 3.95$, $p < .05$, $\eta^2 = .10$). Figure 1 shows the interaction of groups X time with respect to words from the book.

Simple effects analyses performed to compare the pre- and post-measurements for each of the experimental groups separately revealed a significant difference in the two time measurements among members of the EBM group ($F(1, 25) = 26.76$, $p < .001$, $\eta^2 = .52$) and among members of the EB group ($F(1, 24) = 35.19$, $p < .001$, $\eta^2 = .59$). However, no significant difference was found in the control group, ($F(1, 25) = 1.58$, $p < .05$).

A difference was found between achievements of the participants in the two experimental groups compared to the control group, but only with respect to vocabulary from the e-book. In addition, improvement among participants assigned to the EBM group was no greater than for the EB group.

After the intervention, story comprehension was examined through story recall, which was made up of three components: word recall, quotation recall, and key concept recall. Because the distribution of scores was abnormal, comparisons were made using Mann-Whitney non-parametric analyses, which showed no significant differences between the participants in the two experimental groups. However, it is possible to see that for the participants assigned to the EB group, the finding regarding the parameters measured during the story recall process ($M = 16.64$; SD = 8.11) using words from the story ($M = 37.92$; SD = 29.87) and quotations from the story ($M = 5.16$; SD = 5.86) was higher than the means among participants assigned to the EBM group in the story recall process ($M = 16.42$; SD = 8.33, $U = 317.50$, $p = .89$) using words from the story ($M = 24.65$; SD = 25.75, $U = 240.00$, $p = .10$) and quotation from the story ($M = 2.92$; SD = 6.04, U = 234.00, $p = .08$), although the differences were not significant.

In conclusion, the results showed that participants assigned to the experimental groups showed statistically significant improvement in vocabulary as compared to participants assigned to the control group. The improvement, however, was no higher among the EBM group than among those working with the same e-book without metacognitive guidance. In story comprehension as well, no advantage was found for activity with an e-book embedded with general metacognitive guidance.

The purpose of the study described below was to examine the impact of a metacognitive intervention program given prior to activity with an e-book for promoting vocabulary and story comprehension of young children at risk for learning disabilities.

4.2 Study 2

The intervention in the second study was based on the findings from the first one that indicated that young children at risk for learning disabilities did not benefit from general metacognitive guidance embedded in a computer program. The hypothesis of the present study was that in light of the young age of the participants and their literacy difficulties, there is a need for a preliminary metacognitive training program prior to activity with an educational e-book. In the present research, a specific type of training program was developed focusing on developing self-direction, regulation, and monitoring of learning and vocabulary acquisition while listening to/reading an e-book. The intervention was carried out by an adult mediator in preparation for activities with e-books.

Research Questions:

1. To what extent will there be differences in vocabulary and story comprehension skills between the group assigned to the experimental metacognitive intervention, the group assigned to the e-book alone, and the control group?
2. To what extent will the e-book alone group improve more in vocabulary and story comprehension skills than the control group?

Ninety first graders aged 6–7 years (M = 78.75, SD = 4.98 months) participated in the study. They had all been defined by the psychological services as having developmental delays that placed them at risk for learning disabilities. All were integrated into regular elementary school classes. In order to assess the cognitive level of the participants and their suitability for the study, two screening tests were conducted to test verbal and nonverbal cognition, as in the first study.

The specific intervention program consisted of illustrated fun cards suitable for young children. The intervention program is called **AAA**, the Triple A Model, which stands for "Aim, Action, Assessment": **A**im (to strive to understand the task, that is, "Which words on the page don't I know the meaning of?"), **A**ction (carrying out the task using an appropriate strategy, like "I look at the picture" or "I press on the on-screen explanation bubble), and **A**ssessment (quality assessment, reflexive questions about comprehension, like "Did I understand the meaning of the word?" or "What did I do to understand the meaning of the word?"). Each letter A in the Triple A model was colored in either the red, yellow, or green of a traffic light to remind the young children of the order their thinking needed to follow. The study was developed based on research literature about the metacognitive aspect of self-directed learning and the literature that underlines the deficits children with learning disabilities have vis-à-vis metacognitive skills like self-regulation and monitoring comprehension (Brown 1978; Flavell 1976; Wong 1987).

Each intervention session was divided into three parts: acquisition, implementation, and summary. They began with an adult imparting around 7 min of specific metacognitive content, that is, selecting a difficult word from a specific page in the educational e-book and activating the program according to the illustrated fun cards to improve understanding of the word. The learners then received clear instructions,

following which they engaged independently with the e-book for about 20 min. The e-book was presented to both experimental groups in a predetermined order: the first two times in the "read with dictionary" mode and then twice in the "read and play" mode. At the end of the activity, a 5-min summary was held with the adult in order to both reflect on the activity during the current session and provide a basis for the start of the next one.

The participants in the study were divided randomly into three equal groups: The first experimental group worked with an electronic book only (EB) (n = 30), the second experimental group worked with an e-book after a specific metacognitive intervention with an emphasis on understanding an unfamiliar word (EBSM) (n = 30), and the third was a control group that continued its regular activities in the school (n = 30). The children in the experimental groups engaged once a week with the e-book for an average of 20 min over 4 weeks according to the mode order outlined above. The children in the specific metacognitive intervention group received specific metacognitive intervention for about 7 min before engaging with the e-book. The participants were tested pre- and post-intervention in vocabulary and post-intervention only in story comprehension.

Vocabulary was measured in two tests: the first was fitting the picture to the word, in which a child was presented with several pictures and was required to point to the picture that best represented the word. There were ten words in the tests, the score range was 1–10. Reliability was found to be $\alpha = .77$. (The test was developed in line with Shamir et al. 2012). The second was "story word definition," in which the child was required to answer true or false regarding whether a sentence defined the word. The word appeared once with the correct definition and once with the incorrect one. There were 20 sentences in the test, the score range was 0–20. The test was developed in line with Coyne et al. (2007) and reliability was found to be $\alpha = .71$.

Story comprehension was measured post-activity in three tests: first, by a "joint story retell" test, in which the researcher stops reading the story at agreed-upon places and the child completes a word or phrase. The score range was 0–24. The test was developed in line with Skarakis-Doyle et al. (2008) and reliability was found to be $\alpha = .67$. The second test consisted of 12 true or false questions describing an occurrence from the story and testing information and analogy. The participants had to answer true or false for each sentence. The score range was 0–12. The test was developed in line with Korat and Shamir (2012) and reliability was found to be $\alpha = .61$. The third test was picture sequence, in which the participant was asked to arrange four pictures in the correct sequence of the story. The score range was 0–4, $r_{tt} = .60$.

Prior to intervention, no differences were found between the three groups in vocabulary as assessed by the fitting the picture to the word and the story word definition tests ($F(4, 174) = .07$, $p > .05$). However, statistically significant differences were found post-intervention, as indicated in the MANOVA 2 X 3 analysis (groups X time), with time serving as the repeated-measures variable ($F(2, 86) = 541.49$, $p < .001$, $\eta^2 = .93$). There was also a significant interaction of groups X time ($F(4, 172) = 63.96$, $p < .001$, $\eta^2 = .42$).

The analyses performed separately on the fitting the picture to the word test revealed significant differences between the three groups with respect to time ($F(1, 87) = 483.49$, $p < .001$, $\eta^2 = .85$). Indeed, for the control group, the post-intervention measurement was higher ($M = 3.80$, $SD = 1.19$) than the pre-intervention measurement ($M = 3.23$, $SD = 1.25$); for the EB group, the post-intervention measurement was higher ($M = 6.10$, $SD = 1.40$) than the pre-intervention measurement ($M = 3.10$, $SD = 1.27$); and for the EBSM group, the post-intervention measurement was higher ($M = 8.57$, $SD = .97$) than the pre-intervention measurement ($M = 3.10$, $SD = 1.47$). In addition, significant interaction between groups and time were found ($F(2, 87) = 106.70$, $p < .001$, $\eta^2 = .71$).

Further analyses performed separately on the story word definition test revealed significant differences for the three groups with respect to time, ($F(1, 87) = 775.35$, $p < .001$, $\eta^2 = .90$). Indeed, for the control group, the post-intervention measurement ($M = 10.90$, $SD = 1.18$) was higher than the pre-intervention measurement ($M = 9.83$, $SD = 1.60$); for the EB group, the post-intervention measurement ($M = 14.90$, $SD = 1.93$) was higher than the pre-intervention measurement ($M = 9.77$, $SD = 1.27$); and for the EBSM group, the post-intervention measurement was higher ($M = 18.37$, $SD = 1.35$) than the pre-intervention ($M = 9.70$, $SD = 1.91$). Thus, significant interactions between groups and time were found ($F(2, 87) = 152.22$, $p < .001$, $\eta^2 = .71$).

In addition, the test results showed that whereas for the control group improvement was minor, a significant improvement was found in both the EB and EBSM groups. In a simple effects analysis performed to examine the differences for each test separately pre- and post-intervention, the control group showed a significant difference in the fitting the picture to the word test ($F(1, 87) = 5.71$, $p < .05$, $\eta^2 = .0.6$). This was seen also in the EB group ($F(1, 87) = 159.98$, $p < .001$, $\eta^2 = .65$) and the EBSM group ($F(1, 87) = 531.20$, $p < .001$, $\eta^2 = .86$).

Similar results were found in the story word definition test, where significant differences were found in the control group ($F(1, 87) = 11.97$, $p < .001$, $\eta^2 = .12$), in the EB group ($F(1, 87) = 277.32$, $p < .001$, $\eta^2 = .76$), and in the EBSM group ($F(1, 87) = 790.48$, $p < .001$, $\eta^2 = .90$). According to the η^2 measure, improvement in the control group appeared to be very low, followed by a higher improvement in the EB group, with the highest improvement of all in the EBSM group.

A simple effects analysis was performed to compare the differences in change between the groups in pre- and post-measurements. The results indicated significant differences between the control group and the EB group ($F(1, 58) = 104.35$, $p < .001$, $\eta^2 = .64$) and between the control group and the EBSM group ($F(1, 58) = 195.53$, $p < .01$, $\eta^2 = .77$). There was also a significant difference between the EB group and the EBSM group ($F(1, 58) = 38.51$, $p < .001$, $\eta^2 = .40$).

The findings for the vocabulary tests showed significant differences between the EBSM and the control groups and between the EBSM and the EB groups.

Story comprehension tests on the e-book they read were administered only to the two groups that engaged with the e-book (the e-book alone or combined with the specific metacognitive program). Three parameters were derived from the responses received from the participants picture sequence, joint story retell, and true or false question tests. In order to examine whether there were differences between the two

experimental groups in these measures, one-way MANOVA analyses were performed. ($F(3, 56) = 38.75$, $p < .001$, $\eta^2 = .68$).

The analyses performed on each measure separately revealed significant differences between the two groups in all three measurements. For picture sequence, the difference was significant ($F(1, 58) = 7.58$, $p < .01$, $\eta^2 = .12$) between the EBSM group ($M = 3.43$, $SD = 1.10$) and the EB group ($M = 2.40$, $SD = 1.73$); for joint story retell, the difference was significant ($F(1, 58) = 68.50$, $p < .001$, $\eta^2 = .54$) between the EBSM group ($M = 12.57$, $SD = 2.34$) and the EB group ($M = 8.20$, $SD = 1.69$); and for the true or false question test, the difference was significant ($F(1, 58) = 53.94$, $p < .001$, $\eta^2 = .48$) between the EBSM group ($M = 11.10$, $SD = 1.96$) and the EB group ($M = 8.83$, $SD = 1.09$). That is, the average comprehension of participants who engaged with the e-book with specific metacognitive intervention was found to be better than among the participants in the e-book alone group for all parameters.

To summarize, the findings suggest that the specific metacognition intervention program was effective for children at risk for learning disabilities in respect both of vocabulary and story comprehension in comparison to those who engaged with the electronic book alone. In addition, the e-book group without metacognition intervention showed an improvement in these measures as compared to the control group.

5 Improving Vocabulary and Story Comprehension: Does Metacognition Matter?

Difficulties in acquiring language and developing emergent literacy skills may put young children at risk for LD (Kim et al. 2017; Stetter and Hughes 2010). These difficulties can impact future acquisition of reading and writing in school (Diamond and Powell 2016; Kuder 2017). In addition, such children have deficits in cognitive and metacognitive strategies, which explains their difficulties in reading comprehension. Children at risk for learning disabilities use fewer planning, monitoring, and regulation strategies than their peers without learning disabilities (Antoniou and Souvignier 2007; Berkeley et al. 2010). Therefore, scholars and educators stress the importance of finding ways to intervene in the field of emergent literacy and metacognition among children at risk for learning disabilities.

The two studies presented in this chapter focused on the impact of metacognitive intervention to promote vocabulary and story comprehension using an e-book. The results of the first study indicated that the participants in the two e-book groups significantly improved their vocabulary achievements as compared to children in the control group. However, no benefit was found for using the e-book with metacognitive guidance embedded in comparison to the same e-book without metacognitive guidance. No advantage was found in story comprehension for the group that worked with an e-book embedded with general metacognitive guidance.

In contrast, the findings of the second study suggested that the specific metacognition intervention program administered to children in preparation for e-book activity was effective in both the vocabulary and story comprehension parameters for children at risk for learning disabilities as compared to e-book activity alone. In addition, the group using the e-book without metacognition intervention showed an improvement in these skills as compared to the control group.

The lack of improvement in the metacognition group in the first study can perhaps be explained by cognitive overload generated during the young children's activity with the educational e-book that provided general metacognition guidance. Overload can occur when a learning task consumes more resources than are found in a student's working memory, cognitive load prevents the student from understanding and performing the given task (Chinnappan and Chandler 2010; Sweller 2016). The overload apparently stemmed from the complexity of the task and the objective abilities of the children due to their young age and skills. There may have been too much new information presented in a relatively short period of time and at too rapid a pace. In addition, it may be that the children's low level of activity during the learning process affected their achievements. It seems that due to their young age, cognitive characteristics, and undeveloped metacognitive abilities, prior separate exposure should be considered in order for the metacognitive guidance to have an effect on children. It seems that adult mediation over the course of the activity aiming to reduce the metacognitive overload generated by simultaneous exposure to guidance and learning activity is required.

Indeed, the second study, which applied the conclusions of the first one, used specific metacognitive intervention imparted by an adult as a prelude to activity with the e-book. Its findings present significant and strong results regarding the group that used the e-book with the specific metacognitive intervention. This can be explained by the type of intervention and the disability of the participants.

The findings of the present study indicate that this type of intervention helped promote vocabulary and story comprehension. The metacognitive intervention method used in the second study was probably more effective and did not cause an overload because it was given separately, before the activity with the e-book. In addition, the nature of the metacognitive intervention was specific (e.g., targeted at working with e-books). Thus, we may conclude that for young children at risk for learning disabilities it is important that cognitive activities and implementing thinking strategy are carried out in a focused manner targeted at the learning task, as reported by Veenman et al. for young children in general. Research literature reports that interventions for learning disabilities should include explicit methods that provide repetition, isolation of critical content, and a rationale for what is being taught (Archer and Hughes 2011). Swanson and Sachs-Lee (2000) published a meta-analysis covering 30 years of research with students with learning disabilities aged 6–18. They found that explicit instruction and strategy instruction were both effective approaches. Strategy instruction focuses on processes such as metacognition and self-regulation. Hughes et al. (2017) undertook a historical survey of the concept of explicit instruction that was part of regular and special education. It was identified as a key component of education initiatives and was named one of 22

teaching methods recommended for special education by the Council for Children with Special Needs. In all of the surveys, explicit instruction was identified as effective for teaching students with learning disabilities in content domains like reading, mathematics, and writing (Archer and Hughes 2011; Graham and Harris 2003; Kroesbergen and Van Luit 2003; Solis et al. 2012). According to Hessels-Schlatter et al. (2017) as well, many learners do not spontaneously develop metacognition, leading scholars to urge explicit instruction of metacognitive skills.

The findings of the present research join a growing body of knowledge about the possible benefit of e-books in promoting spoken language; that is, vocabulary and story comprehension for typically developing children (de Jong and Bus 2004; Korat and Shamir 2007; Segers et al. 2004) and for children at risk for learning disabilities (Shamir and Korat 2015; Shamir et al. 2011, 2012).

The unique contribution of the two studies presented here is in providing evidence that indicates that unlike integration of metacognitive guidance within an e-book activity, a prior specific metacognitive intervention can make a difference in improvement of vocabulary and story comprehension of first grade children at risk for learning disabilities. It is important to note that these children show lower vocabulary level than typically developing children. The results confirm the hypotheses and point to the potential for this population when this model is adopted as an effective teaching tool in schools with children with language development delays.

The findings of the current studies are promising for educational purposes. We recommend continuing research with a larger sample and examining other types of metacognitive interventions besides specific metacognitive intervention prior to activities with an educational e-book to promote additional literacy skills among young learners at risk for learning disabilities.

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