BACKGROUND MUSIC AND CONTENT EXPANSION IN AN E-BOOK AS SUPPORT FOR STORY COMPREHENSION FOR PRE-SCHOOLERS

Anat Ben Shabat[1]

Abstract

Do multimedia components in e-books support pre-schoolers' story comprehension? Participants included 160 low SES children (aged 5 to 6), who were randomly assigned to one of 4 groups: reading an e-book (a) accompanied by background music and content expansion; (b) without music but with expansion; (c) with music but without expansion; (d) without music and without expansion (control). Pre-tests and post-tests examined children's story comprehension. The findings show that the combination of background music and content expansion was the most efficient way for children's story comprehension. Content expansion support without background music was more effective than background music alone. Although quiet background music in itself was less supportive for story comprehension, it created a beneficial synergetic effect when it appeared together with the story content.

Keywords: e-book, preschool, multimedia, early literacy, story comprehension, background music, content expansion

[1] Dr., Head, Departmrnt of Early Childhood Education, Faculty of Education, Beit Berl Academic College of Education, **Israel**. E-mail: anatbensha@gmail.com. ORCID: 0000-0002-9614-6092

Introduction

E-books for young children designed for language and literacy support were found to be effective for story comprehension among children from a low socioeconomic status (SES) (Korat & Shamir, 2007; Yuksel-Arslan et al., 2016).

The power of multimedia as a learning tool is embedded in a combination between spoken text, illustrations, background music and/or vocal effects (Mayer, 2009), that may help children develop a coherent representation of the story content (Lowe & Schnotz, 2014). According to the dual-coding model (Sadoski et al., 2012), verbal and visual information is encoded and stored in separate memory systems, one for language and one for spatial information. Simultaneous presentation of these components, including dynamic animations (Smeets & Bus, 2013), may support text understanding, in particular for children with poor language skills. However, research on effective e-books for story comprehension is still rare, and the findings are inconsistent (Roskos et al., 2011).

Background music and story comprehension

Although background music is a major characteristic of children's e-books, few studies have been performed on this issue, and the results on story comprehension are inconsistent and sometimes even conflicting. On the one hand, it has been claimed that background music has perceptual-auditory prominence, which may help children focus their attention on the story content (Barr et al., 2008) and may support story comprehension (Hallam et al., 2002). On the other hand, background music was also reported as a possible distraction for young children's attention (Verhallen & Bus, 2009; Smeets & Bus, 2012) and raises the importance of researching this topic. Studies on different types of background music found that soft fast music had a positive influence on learning, while loud fast music hindered learning (Thompson et al., 2011; Lehmann & Seufert, 2017).

According the arousal-and-mood hypothesis, listening to background music does not have a direct influence on cognitive abilities, but affects it through arousal and mood, mainly influenced by the tempo (Husain, Schllenberg and Tompson (2002)). These findings suggest the need to establish more research on the music effect to understand the actual role of music in storytelling. In the present study, we investigated the influence of soft background music on children's story comprehension.

Story comprehension

Story comprehension is considered to be a high-order cognitive ability, which comprises an important step in the process of literacy acquisition and school achievements (van Kleeck, 2008). It requires cognitive and linguistic competence, including knowledge of a variety of facts and situations and the ability to draw conclusions (Kintsch & van Dijk, 1978; van den Broek, 1990). Story comprehension also requires knowledge of the narrative schema, including elements such as the story's background (time, place, characters), the problem caused by the event that leads to the action, and the solution (Cain & Oakhill, 1999). This knowledge includes details that are clearly and explicitly mentioned in the text, as well as a deeper understanding constructed by building a connection between explicitly presented units of information. A deep understanding of the story is an important goal for all children, and in particular for children at risk for language learning.

An e-book intended to enhance story comprehension via support at the inference level was used in this study. This support expands the ideas raised by the story, with particular focus on thoughts and feelings of the characters, similarly to meaningful mediation performed by educators and parents when reading a book to their children (Bennett et al., 2002). We assumed the child will understand the explicit information in the text from the repeated reading during the course of the intervention program, whereas the more complex ideas will be supplied via explaining characters' emotions or thoughts and supporting the idea why they felt or thought that way. Furthermore, contrary to previous studies that tested story comprehension using only a closed-ended questionnaire (Korat, Shamir & Arbiv, 2011, Korat & Shamir, 2012), in the present study we used also open-ended questions and story retelling aiming to cover different levels and aspects of comprehension.

Multimedia additions and story comprehension

Content expansions are hotspots included in educational e-books and provide an extension to the story text. In a series of studies, content expansions have been found to be effective in promoting story understanding among children, especially when they referred to the implicit content (Sari et al., 2019; Roskos et al., 2016). This support expands

the ideas that appear in the story and the characters' thoughts beyond the "here and now" that emerges from the visible content similar in a way to adults' mediation.

This story version includes expansions at the level of inference in which information implied from the story is processed. In this version, at the end of each screen narration, an automatic expansion of the story content appears, at the level of inference.

Part of the support was repetition of information from the visible text and only part of it was at the level of allusion, which is beyond the "here and now" and is considered a higher level. The assumption underlying the current study is that content expansion combined with quiet background music - both of which are multimedia features present in the e-book - may serve as a source of good support in understanding the story. This work uses an e-book designed to advance story understanding through support by expanding at the level of analogy. Content expansions in the e-books in previous studies addressed details, mostly adding new supporting details or repeating explicit information that appeared in the text. However, story comprehension was not maximal, and 70% success was observed using a closed-ended questionnaire, with only 43% success in story retelling (Segal-Drori, Korat, Shamir, & Klein, 2010). Furthermore, content expansions can sometime be distracting and not supportive for children's story comprehension, especially when including content not relevant to the story line (Takacs et al., 2015).

We assumed that content expansion, combined with automatic animations congruent with the story text referring to the implicit content, may support story comprehension more effectively than listening to the story without this support. Such expansion may support children in providing answers to open-ended questions. We assumed that the information the children absorb from the multimedia additions, including content expansion that will be well-embedded in their working memory, will serve them effectively when answering questions on the story content.

Very few studies tested differences in the story comprehension of young low SES children with different language levels (Bus, 2009; Mol & Bus, 2011). Important characteristics that affect the demands of processing a narrative may be the child's prior knowledge of the subject matter around which the narrative revolves, the ability to engage in top-down processing

and identify central information in the narrative, the complexity of the story, and the need for inferences. The existence of prior knowledge allows the narrative to be assimilated into memory more easily, thus reducing the demands of processing (Fisch, 2000). We therefore tested the extent to which children's initial vocabulary and comprehension level will influence their progress post-intervention.

The present study

In this study we examined whether multimedia elements in e-books, such as background music and content expansion, will support children with initial poor language. The content expansions open at the end of each page, while the background music is played. The more complex the task, the more cognitive resources are required for its processing. Any situation that reduces the number of available resources such that it turns their attention to something else may negatively impact performance on a given task (Henry et al., 2012; Salame & Baddeley, 1989). Cognitive load on working memory may occur when all joint processes exceed the child's total cognitive ability (Mayer & Moreno, 2003), which may harm story comprehension. This raises the question of whether the animations we suggest for story content support, combined with background music, may create a cognitive overload for young children (Sweller et al., 2011).

However, according to the theory of synergy, multimedia can support word learning and story understanding through the synergistic relationship between them (Neuman, 2009, 2013). According to Neuman, the information from television, computer and other forms of media can lead to synergistic interactions between the channels of written text, spoken text, image and movement, which may increase literacy development in children. The innovation in this model refers to multimedia. When multimedia is used to present a new text, a joint action of the auditory and visual representations and the mobility of the animation will yield a better result than the representation of each system individually. Similar evidence reported by Chambers and colleagues indicated that use of multimedia can advance story understanding (Chambers et al., 2008).

Not all research findings reported to date are compatible with this model of the influence of background music on story comprehension. It is therefore important to test this question, especially among children from a low SES.

It is customarily accepted that children with better language progress more, according to the Matthew Effect, which is described as "the rich get richer" (Stanovich, 1986).

In the present research we examined the influence of background music and content expansion, separately and combined, on children's story comprehension and production ability. We also tested the extent to which the children's initial vocabulary and story comprehension contributed to progress in story comprehension post-intervention.

We focused on children from a low SES in order to test whether the multimedia components, especially background music with content expansion, will contribute to better story understanding, which are considered to be complex skills.

We hypothesized that: 1) The greater the combined support, the higher the story comprehension test scores. Thus, the combination of soft background music and content expansion will be more effective for supporting story comprehension compared to all other interventions (content expansion only, background music only, no support) and reading in the combined version (background music and content expansion) will support children's progress, in particular, the three stages of the open-ended questionnaire. 2) The children's initial vocabulary and story comprehension levels will contribute to story comprehension post-intervention and the children's comprehension progress with the combined support.

Method

Participants and Sample Design

The participants included 160 kindergartners (84 boys and 76 girls) from a low SES. SES was determined according to the Israeli Central Bureau of Statistics (2015) based on area of residence and parents' education and occupation. The participants' mean age was 68.51 months (SD=5.37; range 46-78 months). Chi-square tests showed no differences between the groups in the children's age ($\chi^2(3)$=3.61, p=.31) and gender ($\chi^2(6)$=5.94, p=.43).

The participants were recruited from 8 public kindergartens in three large cities in Israel. They were all were born in Israel, Hebrew speakers, non-readers, with typical language abilities according to their teacher's report. The teachers were not involved in the research process and materials. All kindergartens had the same curriculum used in Israel, according to which

there is no formal teaching of reading and writing in kindergarten. Story reading is a common activity in kindergartens, occurring 2-3 times a week.

The children in each kindergarten were randomly divided into 4 groups of reading the e-book: (1) With content expansion and background music; (2) With content expansion but without background music; (3) Without content expansion but with background music; (4) Without background music and without content expansion (control). The children in all groups read the story independently 4 times. In the present study we use the term "read" for describing the activity which the child performed with the e-book, even though these are kindergartners who listened to the story and did not read the printed text. Table 1 presents the research groups according to age and gender including PPVT and Shatil test distributions across research groups.

-Insert Table 1 about here-

Research Tools

The e-book: We used a digital version (Korat, Turgeman & Shifrin, 2013) of the printed Hebrew book *Grandmother's Magic Knitting Needles* (Shimshoni, 2009), that includes an introduction, a main problem and a solution (Mandler & Johnson, 1977). Each page contains a colourful illustration that covers half of the page, and a short text (about 20 words). The story tells of a grandmother who knits a warm garment for anyone who asks. Her uniqueness is revealed in that she can listen to others, bond with them and "warm their hearts". For the digital version, the printed book was shortened to 13 pages, with accurate preservation of the text and illustrations.

The digital e-book includes 4 versions: (1) The control condition contains the basic narrated version of the story without any other conditions. (2) The music condition contains the basic narrated version of the story with background music. The background music is soft and constant. It is composed of a repeating pattern of two musical measures, which contain sounds in a narrow range which is heard along the entire story. No additional vocal effects or other distractions were included. (3) The content expansion condition was planned to expand the content appearing in the story, especially focusing on thoughts and feelings of the characters. It appears automatically after the narrator finished reading the short text. For example, one expansion indicates the relation between the thought about the man's lack of friends and his sense of sadness and loneliness. It also

describes the man's emotional state compared to others, by connecting his sense of internal physical coldness to his sense of loneliness. No hotspots appear on the screen, and no background music appears at all along this condition. (4) The music and story content expansion version includes the basic narrated version of the story with background music as well as the content expansions. The children could use the e-book independently by clicking the forward button.

Tests

Peabody Picture Vocabulary Test (PPVT): We used the Hebrew PPVT test (Solberg & Nevo, 1979) based on Dunn and Dunn's (1965) version, which includes 110 items (score range 0-110), to evaluate the children's general verbal receptive level. This test was performed only in the pre-intervention stage.

Initial general story comprehension level test (Shatil, 2001): This is a general test, designed to examine the children's level of story comprehension prior to the intervention. We decided on this tool since its testing method is parallel, at the conceptual level, to what we examined in this study: it includes questions with a similar structure that focus on details and inference. The children listened to a story (*Boas and Lassie*) (88 words) told in a cassette. The experimenter mentioned 12 items that refer to the story content to the children: 6 items of identifying details and 6 items of inference. Only half of the items are correct. The children were asked to answer true/false. Each correct answer was awarded one point (range 0-12). Cronbach's alpha reliability of the test was α=.72.

Means and SDs of these two pre-intervention measurements by the four groups appear in Table 1. The F-test results showed that PPVT scores differed across groups, while the Shatil test's combined scores did not, yet a post-hoc pairwise comparison resulted in no significant group difference (p>.05, adjusted by the Bonferroni correction for multiple group comparison).

Three story comprehension tests: retelling, content and open-ended questions, were created for the focal story of this study.

Story comprehension of the target book – closed-ended questionnaire: The children were presented with 16 items related to the e-book story content and were asked to answer true/false. Half of the items were correct

and half incorrect. Half of the correct items involved details and half required inference. The score range was 0-16. Cronbach's alpha reliability for the test was α=.60.

Open-ended questions: The children were asked 7 open-ended questions regarding the illustrations. Answers were coded as follows: 0 points for an incorrect answer, 1 point for a partial answer, 2 points for a complete answer. Table 2 (see Appendix 1) describes the procedure of constructing and analysing the questionnaire and the results of the inter-rater reliability analysis, where two experts rated the children's answers. Inter-raters' agreements ranged from 85 to 100 percent and from .80 to 1.00 Kappa values across the seven open-ended questions.

Story retelling tests: The children were asked to look at a printed book, which contains the illustrations of the book without the written text, and to tell the story they just read. The experimenter said: "I brought the book that you just read on the computer. Please browse page after page and on each page tell me the story as best as you can". The children's talk was audio-recorded and later transcribed verbatim. Two analyses were used for coding the comprehension level:

(A) Story structure: On the first pages of the children's retrieved story, we focused on the background. On the next pages we checked whether the problem and the solution appeared (Rumelhart, 1975). Referring to at least two of these components was awarded 2 points, referring to only one component was awarded 1 point, and if there was no reference to a component, the child received 0 points. The score range was 0-17. Cronbach's alpha reliability for this measure was α=.74.

(B) Story content: The target story was divided into 12 units of content according to the sequence of events. Each unit that appeared in the retold story was awarded 1 point (range 0-12 points). Cronbach's alpha reliability for this measure was α=.71.

Standardization of the scores was performed in order to reach a score in the 0-100 range. The score of the PPVT test is the number of words correctly recognized by the child, and the score in the general story comprehension test is a mean of 12 items that were transformed to a 0-10 scale. The scores of "story structure" and the "open-ended questions test" included the values 0, 1 and 2 and were multiplied by 50. The scores for story

comprehension and the closed-ended questionnaire included the values 0 and 1 and were multiplied by 100.

Procedure

Pre-intervention: The participants were first tested in two general tests – the PPVT for evaluating their vocabulary and Shatil's story comprehension test (Shatil, 2001).

Pre-tests: Each child read the target e-book *Grandmother's Magic Knitting Needles* individually on a computer in the continuous reading version, without background music and without content expansion. Reading was carried out using a headset. When they finished reading, the children were given three tests: retelling of the story, open-ended questions on the story, and a closed questionnaire for story comprehension.

Intervention: All participants were randomly divided into four equal groups. Each group read in a different version. The intervention included reading the e-book four times, individually, in the allocated version. Each session lasted approximately 15 min. Readings took place in the kindergarten, in a quiet place, at 2-3-day intervals. An experimenter was present during the reading and supplied technical support to the children without instruction.

An interim test: The children were tested individually in the open-ended questionnaire after the second reading.

Post-tests: The children were tested individually in the same series of tests administered in the pre-test stage (except for the PPVT and Shatil's story comprehension test). The post-test was administered 2 to 3 days after the last reading. All tests were administered by the researcher using headphones, during the kindergarten day, while the other children were playing. The children were not familiar with the printed version of the story and were not aware of the differences between the various reading versions of the digital book.

Results

To test the hypotheses, we first performed a two-way between-within analysis of variance by group (between: control, with background music without content expansion, without background music with content expansion, with background music and content expansion) to test the hypotheses across pre- and post- time (within: as repeated measurements).

The analyses were performed on story structure, story content and story comprehension with a closed questionnaire. Post-hoc marginal mean rankings were added using Latin letters for ranking based on pairwise comparisons adjusted with the Bonferroni correction for the p<.05 rejection criterion in multiple comparisons. More specifically, the ranking of marginal means, i.e., group sub-means, was presented by Latin letters, where "a" or "A" indicated the smallest mean for group and time categories, respectively. If no mean difference was found from either higher or lower means, both letters were attached to the mean value. For example, "ab" represents a sub-group mean that did not differ from the "a" mean and the "b" mean". Table 2 presents the ANOVA results.

-Insert Table 2 about here-

Table 2 shows significant differences by time and group for all outcome variables. Achievements in the post-intervention stage were higher than in the pre-intervention stage. A difference was found between the groups across all measures, as well as significant interactions between groups and time. These interactions were decomposed to estimate marginal mean differences based on the multiple pairwise comparisons and are illustrated in Figures 1, 2 and 3. Significant differences (p<.05) are indicated by lines connecting two components for which the means differed. Figure 1 presents the origins of the interaction for story structure.

Story comprehension via analysis of the story structure

-Insert Figure 1 about here-

Figure 1 shows no differences between the groups in presenting the story structure pre-intervention, whereas the group that read the e-book with background music and content expansion exhibited the highest score in the post-intervention stage (M=51.39, SD=20.55). The group that read the story with content expansion but without background music achieved a higher score in understanding the story structure (M=29.03, SD=18.98) compared to the group that read the e-book with background music but without content expansion (M=17.92, SD=19.22), and compared to the control group (M=18.89, SD=19.98). The greatest contribution to understanding the story structure was with the version that included background music and content expansion, followed by the version with content expansion. Background

music as the sole support did not support understanding the story structure. Figure 2 presents the sources of the interaction for story content.

Story comprehension via content analysis

-Insert Figure 2 about here-

Figure 2 indicates that children who read the story with background music and content expansion received a higher score in story content in the pre-intervention stage (M=19.23, SD=17.76) than children in the control group (M=9.81, SD=12.56). However, in the post-intervention stage, the group that read the story with background music and content expansion received a significantly higher score in story content (M=73.65, SD=19.07) than the other groups. The group that read the book without background music but with content expansion received a higher score in story content (M=54.23, SD=22.91) than the group that read with background music and without content expansion (M=37.50, SD=24.21), and the control group (M=29.84, SD=23.75). The score of the story content was higher for all groups in the post-intervention stage than in the pre-intervention stage. However, the differences differed between the groups. The version which included both background music and content expansion supported the children's progress more than all other versions. This was followed by the version with content expansion as the sole support. Figure 3 presents the origins of the interaction for the closed questionnaire.

Story comprehension via analysis of the closed questionnaire

-Insert Figure 3 about here-

Figure 3 shows that in the pre-intervention stage, the children who read the story with background music and content expansion received a higher score in the closed questionnaire (M=63.97, SD=12.81) than the control group (M=54.06, SD=17.37). However, in the post-intervention stage, the group that read the book with background music and content expansion received a significantly higher score in the closed questionnaire (M=89.69, SD=11.80) than the other groups. The score of the group that read the book with content expansion but without background music was higher (M=76.56, SD=13.33) than that of the group that read the story without content expansion but with background music (M=69.06, SD=18.18), and higher than the score of the control group (M=62.66, SD=18.53). The combined support version afforded the greatest support for story

comprehension as measured by the closed questionnaire. Content expansion as the sole support also contributed to progress in this measure.

Influence of the initial vocabulary and story comprehension levels on story comprehension by group

Following the ANOVA results, we expected to find group differences in the progress the children made from pre- to post-intervention measurements, i.e., post-intervention minus pre-intervention scores. Beyond groups, the explanatory variables were the children's age, the PPVT and the story comprehension test scores. Specifically, in the first step, the main effects of age, the PPVT and the story comprehension test were entered. The variable of group was entered in the second step. Because this is a categorical variable, three dummy variables representing the four groups were defined: children who read the e-book with background music and content expansion compared to children in the control group; children who read without background music but with content expansion compared to children in the control group; and children who read with background music but without content expansion compared to children in the control group. In the third step, paired interactions between the PPVT and the group variables and between the general story comprehension test and the group variables (a total of 6 interactions) were entered. Table 3 presents the regression results

-Insert Table 3 about here-

Table 3 shows that the first part of the second hypothesis was not confirmed except for the positive effect of age on story content (β=.22, p<.01). In step 2, which tested the added contribution of the research groups, groups made a significant 17-34% contribution to explaining the variance of the improvement in the measures story structure, story content and the closed questionnaire. The second group showed greater progress in story structure and content compared to the control group (β=.24, p<.01; β=.40, p<.001; respectively). The mixed intervention group showed superiority over the control group in all three outcome measures (story structure: β=55, p<.001; story content: β=.63, p<.001; closed questions: β=.51, p<.001). In step 3, paired interactions between the PPVT and the general story comprehension test and the group variables were tested. Four significant interactions and two marginally significant interactions were found. The PROCESS

procedure (Hayes, 2013) was used to test the origin of the interactions. The slopes between the PPVT and improvement in story structure scores were calculated for testing the interaction between the PPVT and the group that read the e-book with background music and content expansion compared to the control group (β=-.20, p=.03). Figure 4 presents the origins of the interaction.

-Insert Figure 4 about here-

Figure 4 shows a negative correlation between the PPVT and improvement in story structure for the group that read the story with background music and content expansion (b=-.90, p=.02). The lower the score on the PPVT, the higher the improvement in the measure of story structure. Children with an initial low vocabulary who read the book with the combined support of background music and content expansion progressed significantly more than their peers in the other groups. A positive correlation was found between the PPVT and improvement in story structure for the group that read the story with background music but without content expansion (b=.69, p=.02): the higher the score on the PPVT, the greater the improvement in the story structure measure. Children with a high initial vocabulary level progressed in reading also with the support of background music only. No significant correlation between the PPVT and improvement in the story structure was found for the other groups. The slopes between the PPVT and improvement in story content were calculated for the different groups to test the interaction between the PPVT and the group that read the e-book with background music but without content expansion compared to the control group (β=-.18, p=.04). Figure 5 presents the origins of the interaction.

-Insert Figure 5 about here-

Figure 5 shows a negative correlation between the score on the PPVT and improvement in story content for the group that read the story with background music and content expansion (b=-.74, p=.05). The lower the score on the PPVT, the greater the improvement. A positive correlation was found between the PPVT score and improvement in the story content for the group that read the story with background music but without content expansion (b=.88, p=.004): the higher the score on the PPVT, the greater the improvement in story content. No significant correlation between the score on the PPVT and improvement in the story content was found for the other

groups. The slopes between the PPVT and improvement in the closed-ended questionnaire were calculated to test the interaction between the PPVT and the group that read the e-book with background music and content expansion compared to the control group ($\beta=.13$, $p=.07$).

The findings show that the children improved from the pre-test to the post-test in all measures in all research groups and in the control group (presentation of the story structure, representation of the story's content units and story comprehension as tested by the closed questionnaire). Children who read the story with background music and content expansion received a higher score in the post-intervention stage in all research measures compared to the children in all other groups. Children who read the story with content expansion but without background music received a higher score on all measures compared to children who read with the support of background music only or compared to the control group. The group that read the story with content expansion but without background music progressed more than the group that read with background music but without content expansion and more than the control group, in the measures of story structure and story content.

It was further found that the higher the children's score on the PPVT, the higher the score in the story content and the closed questionnaire in the post-intervention stage. The lower the score on the PPVT of the children who read the story with background music and content expansion, the greater their progress in story structure, story content and the closed questionnaire. The higher the score on the PPVT of the children who read the book with support only of background music, the greater their progress in story structure and story content. The higher the children's score on the general story understanding test, the higher their scores on the measures of story structure, story content and the closed questionnaire in the post-intervention stage.

Discussion

Our main finding is that children who read the story with background music and expansions focused on the story content comprehended the story better compared to those from the other groups. This indicates that a combination of these two media makes a more significant contribution to story comprehension than the support of each of these components

separately. These findings are innovative, given the existing literature. A possible explanation for these results is the creation of a higher level of attention as the basis for deep comprehension. Background music may create emotional arousal (Mayer, 2009) and concentrated attention (Richter & Courage, 2017) and may thus support deep understanding. Listening to background music can foster learning, while the arousal-and-mood hypothesis also takes characteristics of the melody into account (Lehmann & Seufert, 2017).

As expected, children who read with content expansion understood the story, could retell it better and include more elements that appeared in the original text than the children in all other groups. To date, expansions reported in the scientific literature afforded general support for the story content and achieved approximately 70% understanding in the closed questionnaire (Korat & Shamir, 2007). In the present study, the participants were given support of expansions at the inference level, which are directed toward understanding levels beyond the explicit text, and an understanding of approximately 90% in the closed questionnaire was achieved. Content expansions at the inference level comprised a good source of support for the children's narrative knowledge, and for understanding the story structure and content, as expressed in their retold story. Nonetheless, the children's level in these measures was lower than the level obtained from a combination of the two media components. A possible explanation for this finding is that the content expansions at the inference level supplied additional information beyond what appears in the explicit text in the story. The content expansions apparently supported the children's knowledge regarding the different elements of the story and afforded them broader information on the plot. When the children were asked to retell the story, they had more available information regarding the illustrations presented to them and their retold stories in the post-intervention stage exhibited better story comprehension.

Soft background music as a separate support did not promote the children in any of the measures. This indicates that the content expansions are the main component that supports story comprehension beyond the written text, whereas background music alone cannot comprise significant support for content understanding. When these particular content expansions were provided together with soft background music, the children's

understanding of the story improved. This is, actually, the main finding of the present study.

The repeated readings particularly improved the abilities of children who read the e-book with background music and content expansion (not in the tables). Children who read with content expansion but without background music progressed in the open-ended questions only after the fourth reading, compared to those who read with background music only and compared to their scores after the second reading. Thus, repeated reading is important for children's progress (Kaderavek & Justice, 2002; Walsh & Blewitt, 2006). However, digital elements such as background music and content expansion make a contribution beyond repeated reading without such a support.

The findings show that children whose initial vocabulary level was lowest and who read the e-book with the combined support improved in presentation of the story structure, understanding the story content and answering the closed questionnaire more than those whose initial vocabulary level was high. Similar findings were reported by Littelton and colleagues (2006), who found that children with a low initial literacy level progressed in story comprehension following independent reading of an e-book more than those with a high initial level. However, when the initial vocabulary level was high, the children progressed more in presenting the story structure and understanding the story content when they read the story with one media support. Support of one kind was sufficient for advancing children whose initial level was high, whereas children with a low initial level needed both supports. The innovation of our findings is that children with poor vocabulary can benefit from repeated independent readings of an e-book, when given suitable software with support that includes background music and content expansion which improve story comprehension and retelling.

The children who exhibited a low level of story comprehension pre-intervention and received content expansions only progressed more in their answers to the closed comprehension questionnaire. Those who exhibited a high initial level and read the book with combined support progressed more in answering the closed questionnaire for story comprehension. In order to understand the story, children who were weaker in story comprehension benefited more when given content expansion without

background music, whereas those who had a high initial level improved when given support for the story content together with background music. These findings differ from those presented above regarding the contribution of the initial vocabulary level to story comprehension for children at different levels with reference to the type of support they were given. There, the combination of media supported story comprehension more for children who had a low initial level. These differences may stem from the fact that these are independent measures. Story comprehension is a broader cognitive ability that includes several different skills (Berl et al., 2010; van Kleeck, 2008), whereas vocabulary is a more focused and less cognitively demanding ability. For a child with a low story comprehension level, support of background music together with content expansion may pose a difficulty in the learning process. This is not the case regarding a focused cognitive difficulty related only to poor vocabulary. In contradistinction, when a child exhibits a high story comprehension level with broader cognitive competence, he/she can benefit from a book that includes background music and content expansion support, and the combined support helps the child better understand the story.

The achievements of children with better vocabulary and basic story comprehension were higher compared to children with a lower level. This finding is in line with the Matthew Effect, according to which "the rich get richer" (Stanovich, 1986), where those who were strong initially, were strengthened even more. Thus, a general good understanding level of a story helps comprehension at a higher level in more advanced stages of learning. The findings stress the extent to which initial linguistic richness, including story comprehension, is important in infancy, and the extent to which early intervention at this age may be critical for reducing future academic gaps. However, it should be noted that in certain situations, the e-book technology was more beneficial for children with a low initial level, as presented above.

Research limitations and recommendations

Future studies should test the initial level of the different groups more carefully in order to better elucidate the intervention effect, since some differences appeared between groups from the beginning. Furthermore, using only one e-book in this intervention study seems unsuitable for drawing broad conclusions regarding the efficiency of the structure of this

e-book. Several e-books with similar structure but different content would be more convincing. This study shows that e-books enhanced with suitable multimedia means may support young children's story comprehension, including that of children from a low SES. Our conclusion is that well designed e-books that include soft background music and suitable content expansion for the story have good chances of advancing young children's story comprehension.

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