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Computer-Based Reading Texts to Support Fourth-Graders' Reading Comprehension[1]

Textos Diseñados en Computador para Apoyar la Comprensión de Lectura en Estudiantes de Cuarto Grado

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Abstract

In this study, four computer-based reading texts with text related static and animated visuals and background sounds were created with a visual programming language by the researchers for fourth grade students. These texts included before-reading, during-reading and after-reading activities. The purpose was to see the effect of these computer-based reading texts on students' reading comprehension. In an experimental research design, elementary school fourth grade students (n = 60) were randomly assigned to either computer-based reading (n = 31) or traditional reading (n = 29) environment. The groups completed a pretest, before-reading, during-reading and after-reading activities and then a posttest. The research has been completed in a six-week period: the pretest in the first week, the four texts in the following four weeks, and the posttest in the sixth week respectively. The results indicated that the computer-based group had significantly better posttest scores than the traditional group had and had significantly better improvement from pretest to posttest. However, there was no significant difference between students' reading comprehension results from pretest to posttest in the traditional group. As a result, presenting students with multimedia-supported reading activities had a positive effect on their reading comprehension. Thus, we recommend teachers to use visually-supported computer-based reading texts to improve students' reading comprehension.

Keywords: Reading Comprehension; Elementary Education; Fourth Graders; Computer-Based Reading; Animated Visuals

Resumen

En un diseño experimental de investigación, estudiantes de cuarto grado (n=60) fueron asignados aleatoriamente a textos diseñados en computador o a condiciones de lectura tradicionales. Los grupos completaron actividades de pre-lectura, lectura y lectura posterior en computador o en formato tradicional respectivamente. Los textos diseñados en computados incluían elementos visuales estáticos o animados y sonidos de fondo. En cada grupo se completó una prueba previa, cuatro textos de lectura y una prueba posterior en un periodo de seis semanas así: la prueba previa en la primera semana, los cuatro textos en las siguientes cuatro semanas y la prueba posterior en la sexta semana. Los resultados mostraron que, aunque no se halló una diferencia significativa entre los resultados de la prueba previa del grupo, el grupo asignado a los textos diseñados por computador obtuvo mejores resultados en la prueba posterior que el grupo tradicional. Además, los estudiantes de cuarto grado, en el grupo de los textos diseñados por computados, mejoró significativamente su comprensión de lectura. No obstante, no hubo una diferencia significativa entre los resultados de comprensión de lectura de la prueba previa a la prueba posterior en el grupo tradicional. Como resultado, el presentar a los estudiantes actividades de lectura con apoyo multimedia tiene un impacto positivo en la comprensión de lectura. Por lo tanto, se recomienda a los profesores textos de lectura individuales y textos de lectura basados en computadora con soporte visual para mejorar la comprensión de lectura de los estudiantes.

Palabras clave: comprensión de lectura; educación primaria; estudiantes de cuarto grado; textos diseñados en computador; elementos visuales animados.

Resumo

Em um desenho experimental de pesquisa, estudantes de quinto ano (n=60) foram designados aleatoriamente a textos desenhados em computador ou a condições de leitura tradicionais. Os grupos completaram atividades de pré-leitura, leitura e leitura posterior em computador ou em formato tradicional respectivamente. Os textos desenhados em computadores incluíam elementos visuais estáticos ou animados e sons de fundo. Em cada grupo se completou uma prova prévia, quatro textos de leitura e uma prova posterior em um período de seis semanas assim: a prova prévia na primeira semana, os quatro textos nas seguintes quatro semanas e a prova posterior na sexta semana. Os resultados mostraram que, mesmo que não se encontrou uma diferença significativa entre os resultados da prova prévia do grupo, o grupo designado aos textos desenhados por computador obteve melhores resultados na prova posterior que o grupo tradicional. Além do mais, os estudantes de quinto ano, no grupo dos textos desenhados por computadores, melhoraram significativamente a sua compreensão de leitura. Embora isso, não houve uma diferença significativa entre os resultados de compreensão de leitura da prova prévia à prova posterior no grupo tradicional. Como resultado, o apresentar aos estudantes atividades de leitura com apoio multimídia tem um impacto positivo na compreensão de leitura. Portanto, recomenda-se aos professores textos de leitura individuais e textos de leitura baseados em computador com suporte visual para melhorar a compreensão de leitura dos estudantes.

Palavras chave: compreensão de leitura; educação primária; estudantes de quinto ano; textos desenhados em computador; elementos visuais animados.

Introduction

Text is extensively used as an important medium in most academic subjects (Soemer & Schiefele, 2018). Thus, reading comprehension is a topic in educational research studies. Öz (2006) defines reading as grasping and vocalizing the meaning of words while the eyes move along reading lines and see the shapes of words. Karadağ and Yurdakal (2016) claim that reading activity includes interpretation and evaluation of what the eyes perceive, which creates a complicated structure. Sever (2011) argues that reading is not a one-dimensional basic process, on the contrary, it is a development process consisting of cognitive, sensory and psychomotor skills.

According to Keskinkılıç and Keskinkılıç (2007), students' reading habits and reading skill especially improve during their elementary education. Additionally, the development of reading skill is important for students to develop their identity and build healthy relationships with the society they live in. In elementary school, there is a great emphasis on reading comprehension as being an important skill in both society and academic achievement (Soemer & Schiefele, 2018). An adequate development of reading comprehension leads to enjoyment of academic success and this skill influences students' academic performance in the long term (Başar & Gürbüz, 2017). Moreover, it is essential that students, especially in elementary school, develop their reading skills, in order to be successful in all content areas. For example, the study conducted by Björn, Aunola and Nurmi (2016), indicates that this will contribute to students' success in other content areas, such as problem solving in mathematics if elementary school fourth grade students achieve reading comprehension well. It might strongly indicate they will not graduate from high school on time if the students' reading comprehension is not well achieved in elementary school (Hernandez, 2011).

As can be inferred from the literature, reading comprehension dramatically influences students' success both in school and life. Therefore, reading comprehension must be taken into consideration and improved with a variety of methods starting from elementary education. The studies in the literature indicate that students don't pay enough attention to and show interest in traditional reading environments (e.g. Gün, 2012). However, taking advantage of computer technology is suggested to enrich classroom learning activities and reading comprehension (Batur & Alevli, 2014). Animated and static objects, and individualized learning can be provided on computers for reading activities. These elements improve students' comprehension, interest, attention, inference making and information retrieval (e.g. Altun, 2018; Çakıroğlu et al., 2018; Roque, Teodoro, Cunanan & Evangelista, 2017; Takacs & Bus 2016; Niknejad & Rahbar, 2015; Ertem, 2010). In this regard, our purpose was to use computer technology for students' reading comprehension and see whether the computer-based readings have any effect on students' reading comprehension. In other words, the purpose of this study was to see the effect of computer-based reading

texts consisting of visuals, animated objects, and sounds on fourth grade students' reading comprehension. Hence, we compared the students' reading comprehension results with a control group who read the same texts in traditional paper format in order to reveal the real effect.

Literature Review

Reading is one of the four fundamental language skills and reading comprehension contributes to both the students' school success and their life. Reading comprehension includes interpreting visuals, finding appropriate titles, determining the characteristics of the characters, and the place and time of the events, and comprehending the conclusions of texts (Kavcar, Oğuzkan & Hasırcı, 2016). Güneş (2014) emphasizes three reading comprehension activities: before-reading, during-reading and after-reading. In these stages, a reader interacts with the texts and the environment where reading takes place while mentally constructing the meaning of texts. The reader undertakes planning in the before reading, in which its plot and type of the texts are guessed. In the during reading, they apply planning while reading the text and compare their pre-knowledge with what is read. In the after reading, they evaluate what they read. In this stage, they check what they understand: what was done, how it was done, and the difficulties they faced. Epçaçan (2009) argues that it is crucial for a reader to be active in before-reading, during-reading and after-reading activities, and use necessary strategies and techniques in order to comprehend a text completely.

The interviews with teachers teaching Turkish lessons reveal that traditional reading environments may not be appealing to students (Gün, 2012). Based on the interviews, teachers mostly report that students showed no interest in reading activities. They believed these activities did not help students to be active, since the students were getting bored while doing the same activities over and over again, and the activities were not suitable to improve reading skills. Individual learning and step-by-step teaching are recommended to solve reading and comprehension issues (Çaycı & Demir, 2006). Additionally, it is recommended that the activities be enriched and the use of information technology in classrooms be enhanced in order to increase reading ability (Batur & Alevli, 2014).

Değirmenci (2014) used educational software called Morpa campus, including animated visuals, reading and listening texts, educational games and interactive activities. She has projected the reading texts in the educational software from the projector to the board for the whole class. She has found no significant difference between reading comprehension scores for first grade students who read texts on the educational software and those who read traditional textbooks. However, the teachers who observed the students' reading processes stated that the educational software was

attractive and useful for students, enriched educational settings, supported teachers, and made them save time, and supported students' active participation. Çakıroğlu et al. (2018) used computer software to improve reading performance of students with learning difficulties in their studies. This software, including stories, allows students to individually progress by personalizing the learning environment the software provides. At the end of their studies, the researchers have interviewed teachers and students. As a result, teachers thought that it is important to use visuals in order to support texts. They commented that students did not display problematic behaviors while using the software and that they liked the stories.

Duke and Pearson (2009) suggest that the visuals are more concrete and memorable than texts. Furthermore, they claim "a visual display helps readers understand, organize, and remember some of those thousand words" (p.112). Moreover, visuals help in representing information through relationships among knowledge, comprehension and memory, which mutually and actively influence each other. Furthermore, concrete or abstract formatted visuals used along with texts are more effective on knowledge and knowledge transfer than text without visuals (Mason, Pluchino, Tornatora & Ariasi, 2013). Enriched meaning construction occurs when visuals and texts are combined with pre-knowledge (Akyol, 2012). Moreover, visuals such as pictures and/or photographs enhance comprehension and expression of a text when used appropriately. Arifin (2015) argues that the use of visuals can improve students' interest and participation in reading comprehension, which contributes to students' achievement in learning dramatically.

In the present study, the reading texts were presented with pictures representing the texts. The texts were designed in a computer-based reading environment. The rationale behind this design comes from the multimedia learning theory. Mayer (2005), the founder of this theory, indicates that learning occurs when learners construct knowledge from learning material, combining words (i.e., text or voice) and pictures (i.e., photos, animation etc.). In addition, when the words and relevant pictures are simultaneously presented near to each other, students learn better than when the words are presented alone. Knowledge construction occurs when learners process information by activating their dual-coding channel (i.e. visual/pictorial and auditory/verbal) in an active manner. A great number of the studies show the effectiveness of this theory in different learning areas.

This theory has positive effects on reading comprehension as well. For example, while doing reading comprehension-related exercises, García, Rigo and Jiménez (2017) observed students made fewer mistakes as they focused more on these multimedia-based exercises. In addition, they remembered more and learned more accurately. This was probably because their motivation was high. Reading a multimedia story has positive advantages over reading a traditional story in terms of vocabulary learning and engagement in reading (Zhou & Yadav, 2017). Interactive multimedia reading

materials are superior to traditional reading materials in students' critical and creative reading (Ayob, 2017). The stories with high interactivity support students' story comprehension in comparison with the stories with low interactivity (Kao, Tsai, Liu & Yang, 2016). Moreover, interactive animated stories are more effective than animated stories and static story books for students' vocabulary learning (Smeets & Bus, 2015).

Some studies show that reading comprehension may not be different on paper versus computer (e.g., see Başaran, 2014; Ertem & Özen, 2014) or may be even better on paper (e.g., see Baştuğ & Keskin, 2012; Ercan & Ateş, 2015; Mangen, Walgermo & Brønnick, 2013). However, texts are not presented differently with extra features, such as static or animated visuals, background sounds or feedback supporting students' reading comprehension in these studies. Texts are given on screen in PDF format, which is not superior to texts presented on traditional paper format in terms of supporting students' understanding. The only difference is that these texts are presented on a computer screen with no additional and supportive features.

One of these features is feedback. Feedback is one of the important elements of education and can be offered by instructors, books, friends or experience. It is generally given after providing knowledge to develop desired behavior, skills or attitude and provided based on learners' performance and understanding (Hattie & Timberley, 2007). Feedback can be given either immediately or with delay. The studies show that immediate feedback better yields students' performance than delayed feedback (Thai, De Wever and Valcke, 2017). Since feedback also has a positive effect on learners' reading comprehension (Burns, Maki, Karich & Coolong-Chaffin, 2017), we provided immediate feedback both in the computer-based reading texts that were provided from computer or in the traditional texts that were provided from the instructor to improve students' reading comprehension in this study.

According to Takacs and Bus' (2016) eye-tracking study, the animated objects, which are supportive for story comprehension, attracted students' attention to the story and helped them comprehend the story well. Altun (2018) examined the effect of multimedia story books on five-year old preschool students' story comprehension. The multimedia story book group comprehended the explicit and implicit meaning of the story significantly better, remembered more story components and retold the story in more detail better than the traditional story group. The results were attributed to the multimedia illustrations as presented in animated format in the story. Animations in e-books make students remember and understand the texts (Roque, Teodoro, Cunanan & Evangelista, 2017). Moreover, dynamic visuals have significantly better impacts on students' reading comprehension (Niknejad & Rahbar, 2015), recalling information and making inferences (Ertem, 2010). A study conducted by Lysenko and Abrami (2014) showed first and second grade elementary school students who completed two digital, interactive, multimedia applications presented on the web outperformed the students who received traditional instruction in reading comprehension.

Technology applications create a positive effect on K-12 students' reading as opposed to traditional reading environments based on a meta-analysis study completed with 84 studies carried out by Cheung and Slavin (2012). However, the studies in reading comprehension in computer environments are limited. Beek, Brummer, Donker and Opdenakker (2018) completed a review on reading comprehension studies conducted between 2000 and 2017. Their focus was on the studies related to the improvement of secondary school reading comprehension. They initially read 321 abstracts of related studies and then removed 304 of them as they were not conducted in a computer environment or digital format. As a result, they have found that only the 17 remaining studies were conducted in a computer environment.

Based on the related literature, we see that the studies in reading comprehension in computer environments are very limited. Moreover, the computer-based environments were not presented with additional features, which are not available in traditional format in these studies. Computer-based texts are mostly presented for the whole class from the projector to boards. Thus, individual learning is not provided. With these gaps in mind, we wanted to examine whether computer-based texts including animated, static objects and background sounds would give students any benefit over their reading comprehension as opposed to traditional reading. The purpose of this study was to see whether computer-based texts have any effect on fourth grade students' reading comprehension. In addition, the purpose was to see whether this improvement, would be larger compared to the control group attending traditional reading activity.

Methodology

Design

A quantitative research method, an experimental design, was used in this study which has been completed in six weeks. In this design, 60 fourth grade elementary school students were randomly assigned to either experimental or control groups: computer-based treatment (n = 31), traditional treatment (n = 29). Both groups have completed a pretest in their classrooms in the first week. In the following four weeks, they have completed four texts including before-reading, during-reading and after-reading activities on either computer or traditional paper format. After the completion of the treatments, both groups have completed a posttest in the sixth week.

Participants

The fourth-grade students (n = 60) who have participated in the experiment are in a public school in Turkey. This school was selected because it is one of the representative schools in the area. Its socioeconomic status, location in the city center and its average success level were effective for this selection. This information was retrieved from the Provincial Directorate of National Education in Turkey. In the school, all the fourth-grade students were invited to the study with the permission of the Provincial Directorate. The assignment was made with basic random sampling method. A Turkish reading comprehension pretest was applied to both groups to see whether two groups start to experiment with similar reading abilities.

Procedure

As a pretest-posttest experimental design, this study has been completed in a six-week period during regular class hours. In the first week, participants have individually completed a reading comprehension test as a pretest in their classrooms. In the following four weeks, they have completed four reading texts, one of which is completed each week, either in computer or traditional paper format. In the last week, all the students have individually completed the same reading comprehension test as in the pretest in their classrooms. The procedure and the texts used each week are shown in Table 1.

Table 1. The study plan and information about the texts used in the study

Week #	Procedure and the Texts Used Each Week			
1	PRETEST WEEK			
2	**Text type**	**The theme of the text**	**The name of the text**	**The plot**
	Narrative Text	Ataturk (Atatürk)	The Mirror of the Self (Kişinin Aynası)	The life of Ataturk, the founder of Republic of Turkey
3	Narrative Text	Health and Environment (Sağlık ve Çevre)	The Rope-Legged Alien Child (İp Bacaklı Uzaylı Çocuk)	Unhealthy nutrition
4	Informative Text	Our World and Space (Dünyamız ve Uzay)	The Life of Astronauts (Astronotların Yaşamı)	A day of an astronaut in space
5	Poem	Production, Consumption and Productivity (Üretim, Tüketim ve Verimlilik)	In the Week of Domestic Goods (Yerli Malı Haftasında)	Introduction to domestic goods produced in Turkey
6	POSTTEST WEEK			

Both treatment groups have completed before-reading, during-reading and after reading activities. However, the completion of these activities was different in some aspects. The procedure for each treatment group and details about each condition were explained below:

Traditional Reading Treatment

This process was completed under the supervision of one of the researchers, who has 5-years of elementary school teaching experience. The traditional reading group completed the experiment in a classroom without laptops. Under these conditions, before-reading, during-reading and after-reading activities were completed in students' classrooms with one of the researchers, as mentioned before. The purpose here was to complete the activities in a traditional class environment. In the before-reading activities, students guessed the plot of the text using the title and the meaning of the most important words from the text written on the board. The during-reading texts were provided to the students in traditional paper format. Students themselves read the texts in the same way as they usually do reading activities in their classrooms. In after reading activity, they searched for the answers to wh-questions (what, where, when, how, why and who) in the text, determined synonyms and antonyms of words from the text, figure out cause and effect relationships and unknown words from the text, and found the relationship between the title of the text and its content. Furthermore, they answered some grammar questions such as making a meaningful sentence, finding misspelled words and punctuating. The researcher gave feedback based on students' answers in the class environment in traditional reading condition. This situation was provided for each individual student who gave the answer and for the whole traditional-reading group. This situation gave the whole group the chance to improve their understanding of text. It was believed that the way of giving feedback could help especially quiet students, who hesitate answering questions.

Computer-Based Reading Treatment

Students in the computer-based reading treatment group completed before-reading, during-reading and after-reading activities in a classroom with laptops brought by the researchers. The computer-based texts were the same as in the traditional format. Unlike the traditional condition, the students completed all the activities (i.e., before, during and after reading) by themselves in an individual learning environment. In the before-reading activity (see Appendix 1), the students guessed the plot of the text using the title and visuals, the meaning of the most important words from the text, and match the words with the relevant pictures, which did not take part in the traditional format. They answered questions in the before-reading activities and received individual feedback provided from the computer. In the during-reading activities (see Appendix 2), the texts were divided into small parts on the screen with related pictures (e.g., static and animated), each of which representing the part of the text that needed to be read. A button was provided at the bottom right-hand corner of the screen for readers to go to the next page upon finishing reading. The purpose here was that they would read each page based on their own reading speed. Static pictures as well as animated ones were also presented for the characters in the texts. In

the after-reading activity (see Appendix 3), unlike the traditional format, the students completed the activity with animated and static visuals. In addition, matching visuals with the words was included in this activity. The students answered the questions in the after-reading activities and received individual feedback provided on the computer based on their own answers. Feedback was unique for each student as each individual student received feedback according to their own incorrect and correct answers in computer-based reading condition. Background music and sound effects were also provided for all activities.

Materials

Texts

The texts used in the implementation stage were selected from a Turkish textbook published by the Ministry of National Education of Turkey (MNE, 2015). There are three types of texts in Turkish: narrative texts, informative texts and poems (MNE, 2018). Two of the texts were narratives, one was informative and one was a poem in this study (see Table 1 above).

Reading Comprehension Test

The reading comprehension test (KR-20 = 0.74) used in this study was developed by Susar Kırmızı (2006). The test included 41 items based on 17 fourth grade learning objectives from the reading domain in the Turkish Curriculum in 2005. The numbers of the items and related objectives are given in Table 2.

Table 2. The translation of the learning objectives in the reading comprehension texts.

Learning Objectives		Item #
1.	*"Search for the answers to question words (e.g. what, where, when, how, why, and who) in a text"*	15, 22, 23, 37, 38, 39
2.	*"Put events in order based on the level of importance"*	9, 18
3.	*"Distinguish the introduction, development and conclusion of a text"*	34, 35
4.	*"Distinguish emotional and exaggerated expressions in a text"*	28
5.	*"Distinguish reality and imagination in a text"*	1, 12
6.	*"Determine the main theme of a poem"*	25, 26, 27
7.	*"Determine the topic of a text"*	13, 24, 32
8.	*"Distinguish the main idea of a text"*	20, 30
9.	*"Determine the story components of a text"*	7, 8, 17
10.	*"Make inferences from a text"*	10, 19
11.	*"Establish cause and effect relationships from reading"*	40, 41
12.	*"Guess the meaning of new words encountered in the text"*	11, 21
13.	*"Answer text-related questions (pre-reading, while-reading, after-reading)"*	3, 14
14.	*"Examine the relationship between the title and the content"*	2, 31, 36
15.	*"Read bold, colored, underlined expressions emphasizing important points"*	4, 5
16.	*"Make different inferences from a text"*	6, 16
17.	*"Find and distinguish the sentence distorting meaning in a paragraph"*	29, 33

In the present study, the reliability coefficient of the test calculated with the Kuder-Richardson formula (KR-20), was 0.88. This value is between 0.70 and 0.90, which indicates a high reliability for the test (Özdamar, 2017).

Data Analysis

A Kolmogorov-Smirnov test was run to see whether the data was normally distributed. The results are shown in Table 3.

Table 3. Kolmogorov-Smirnov Test Results

Groups	*Kolmogorov-Smirnov*	*p*
Computer-based group (pretest)	.191	.005*
Traditional group (pretest)	.165	.041*
Computer-based group (posttest)	.207	.002*
Traditional group (posttest)	.185	.013*

** p<0,05*

Kolmogorov-Smirnov test indicated that pretest scores of neither computer-based group (D (31) = .191, p = .005) nor traditional group (D (29) = .165, p = .041) follow a normal distribution. Additionally, Kolmogorov-Smirnov test results indicated that posttest scores of neither computer-based group (D (31) = .207, p = .002) nor traditional group (D (29) = .185, p = .013) follow a normal distribution. Because the data was not normally distributed, non-parametric tests were used.

Findings

A Mann Whitney U test was used to see whether there is any difference between computer-based and traditional reading groups' pretest and posttest scores. A Wilcoxon Signed-ranks test was conducted to see whether or not the groups increased their reading comprehension scores after being exposed to the treatments.

Pretest Score Comparisons

Table 4. Mann Whitney U Test Results on Fourth Grade Students' Reading Comprehension Pretest Scores

Groups	*n*	Mean Rank	Sun of Ranks	*U*	*Z*	*p*
Computer-based group	31	34.42	1067.00	328	-1.801	0.072
Traditional group	29	26.31	763.00			
Total	60					

A Mann-Whitney test showed that there was no significant difference between students' pretest scores in computer-based reading and traditional groups, U = 328, p = .072.

Posttest Score Comparisons

Table 5. Mann Whitney U Test Results on Fourth Grade Students' Reading Comprehension Posttest Scores

Groups	*n*	Mean Rank	Sun of Ranks	*U*	*Z*	*p*
Computer-based group	31	35.45	1099.00	296	-2.277	0, 037*
Traditional group	29	25.21	731.00			
Total	60					

** p<0,05*

A Mann-Whitney test showed that there was a significant difference between students' posttest scores in computer-based reading and traditional reading groups, U = 296, p = .037.

Traditional Group Reading Comprehension Results

Table 6. Wilcoxon Signed-Ranks Test Results on Fourth Grade Students' Reading Comprehension Scores in Traditional Group

Traditional group	*n*	Mean Rank	Sun of Ranks	*Z*	*p*
Negative Ranks	9	10.17	91.50	-1.686	0.092
Positive Ranks	15	13.90	208.50		
Ties	5				

A Wilcoxon Signed-ranks test indicated that there is no significant increase from pretest to posttest for students in traditional reading group, Z = -1.686, p> .05.

Computer-Based Group Reading Comprehension Results

Table 7. Wilcoxon Signed-Ranks Test Results on Fourth Grade Students' Reading Comprehension Scores in Computer-Based Group.

Computer-based group	*n*	Mean Rank	Sun of Ranks	*Z*	*p*
Negative Ranks	4	6.13	24.50	-3.736	0, 000*
Positive Ranks	21	14.31	300.50		
Ties	6				

*$p<0,05$

A Wilcoxon Signed-ranks test indicated that there is a significant increase from pretest to posttest for students in computer-based reading group, Z = -3.736, p< .05.

Discussion

In this study, we aimed to improve elementary school fourth grade students' reading comprehension with the use of computer-based texts including visuals, animated objects, and sounds. We compared the students' reading comprehension results in the computer-based texts with those in the traditional texts in order to reveal the real effect. The results showed that the fourth-grade students significantly improved their reading comprehension with the computer-based texts. However, there was no significant increase in the traditional text group's reading comprehension.

Mayer (2005) argues that a well-designed learning material combining words and visuals in a multimedia learning environment helps learners build knowledge. Ayob (2017), Zhou and Yadav (2017), and Altun's (2018) studies show students comprehend a story better when it is presented in multimedia form. In this form, visuals and texts are simultaneously presented near to each other. Consistently, in the present study, the texts were presented with visuals as a multimedia learning environment. Accordingly, students' improvements on reading comprehension in the computer-based texts might be attributed to combining visuals and texts in a multimedia learning environment.

The computer-based texts in this study had text-related visuals. These visuals were provided along with the texts in order to support students' reading comprehension. In the literature, visuals are mentioned to be more concrete and memorable (Duke & Pearson, 2009) and they enhance comprehension (Akyol, 2012). Consistently, we can assume that the computer-based group improved their reading comprehension with the use of visuals. Students in the computer-based text group had visual support,

whereas the traditional text group did not. Results showed that the computer-based text group answered the paper-based posttest questions significantly better than the other group did. When students read texts combined with visuals, they gain knowledge and transfer knowledge better compared to the texts without visuals (Mason, Pluchino, Tornatora & Ariasi, 2013). As a result, we can assume that although they solved the posttest reading questions on paper, they seemingly gained knowledge and transferred this knowledge from the computer-based reading to traditional reading.

We used not only static visuals but also animated visuals in the computer-based texts. A great number of studies show that animated visual objects in computer-based reading platforms are effective on students' comprehension, remembering, understanding and inference making (e.g., Altun, 2018; Roque, Teodoro, Cunanan & Evangelista, 2017; Takacs & Bus 2016; Niknejad & Rahbar, 2015; Ertem, 2010). Accordingly, it might be inferred from the claims that students improved their comprehension scores in the computer condition in this study. It can be told that animated visuals in the computer-based texts might be effective on students' reading comprehension results.

An individual learning environment was provided to students in the computer environment in this study. However, the traditional text group was exposed to the texts in their classrooms rather than in an individual learning atmosphere. The students read the texts, which were divided into shorter parts, on computers and based on their own reading speeds. They moved forward on the texts with the "I have read" button upon completing reading each part of the texts. Considering the results were positive in favor of the computer group, we may argue that this outcome can be a result of an individual learning environment. Inconsistently, Değirmenci's (2014) study indicated non-significant difference between reading comprehension in educational software vs. traditional textbooks. In her study, however, an individual learning environment was not provided in the computer condition, as opposed to the present study. Nevertheless, she projected the reading texts in educational software from the projector to the board for the whole class. Thus, the result of the present study might be attributed to an individual reading process.

Since feedback has a positive effect on learners' reading comprehension (Burns, Maki, Karich & Coolong-Chaffin, 2017), an animated character asked questions and provided feedback in the before- and after-reading activities. The feedback explained the correct answer immediately as soon as students answered the questions. Providing immediate feedback rather than delayed feedback yields better learning performance according to Thai, De Wever and Valcke (2017). Additionally, each student in the computer-based reading group received immediate feedback according to her/his individual answer. Thus, the difference in reading comprehension of the experimental and control groups could be attributed to feedback provided immediately and individually.

During the implementation stage, students were seemingly willing to read and enjoyed the reading activities. In an individual computer-based reading environment, where visuals were provided, teachers claimed that students like the reading activities and do not show problematic behaviors in a study carried out by Çakıroğlu et al. (2018). Based on that, we can infer that students' interest, participation and reading comprehension can be increased when they individually complete computer-based reading texts with visuals.

Conclusion

As it is an important skill for language development, reading comprehension is also an indicator for students' academic achievements in general. In this study, we aimed to search for further improvement of elementary school fourth grade students' reading comprehension. We created before-reading, during-reading and after-reading activities in a computer environment. Students read four texts either on computer or traditionally on paper. In the computer condition, we provided static and animated text-related visuals in an individual learning environment. Background music, sounds and feedback were also provided. The results indicated that the students' reading comprehension significantly improved with computer-based reading texts thanks to their visuals, background sounds features and individualized learning opportunities. Additionally, we consider that computer-based learning environments are interesting for students. Based on our observation, fourth-grade students enjoyed such learning activities more than traditional learning activities. Thus, we recommend that teachers use individual and visually-supported computer-based reading texts to improve students' reading comprehension. Moreover, the fourth-grade students are in a public school and coming from low-income families. As a result, it is highly possible that they do not often interact with technological tools in their lives. Thus, this learning environment might be interesting for the students.

Limitations

It was a limitation of our study that the school where the experiment took place was not equipped with computers. For this reason, we, as researchers, took laptops to the school where we implemented our study with the fourth graders. To increase the number of such studies and derive the most benefit from such a type of learning, schools equipped with computers are needed. In addition, we only looked at the effect of computer-based texts on students' reading comprehension in this study. We strongly recommend that students' motivation during reading activities should be measured by future studies, since the students' positive reading comprehension results might be affected by their motivation during their computer-based text reading.

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