Education and Science

Vol 39 (2014) No 176 457-466

The Relationship Between Reading Comprehension and Success in Science

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Abstract

The aim of this study is to define the relationship between reading comprehension and achievement in science. Associational model was used as a method, and 132 eighth grade secondary school students constituted the participants of the study. In order to find out answers for the research questions, Science Items Comprehension Test (SICT), SBS Science Test (national placement test) and Turkish Reading Comprehension Test (TRCT) were used for data collection. Simple linear regression analysis, independent sample t-test and chi-square independence test were carried out for data analysis. After a general overview of the findings, it was seen through the analyses, in which both SICT and TRCT scores were defined as predictor variables, that success in reading comprehension significantly predicts success in science. In addition, it was ascertained that the participants who have a high and low level of achievement in TRCT and SICT have significantly different levels of success in science. When participants' responses to the items of SICT and SBS Science Tests were compared, it was seen that generally there is no significant difference. Finally, regarding the mean scores from SICT and TRCT, it was identified that reading comprehension levels of females are superior to males. Depending on these findings, it was determined that there is a certain level of relationship between success in reading comprehension and success in science.

Keywords

Reading comprehension

Success in science

SBS

Large scale tests

Article Info

Received: 06.20.2014

Accepted: 10.14.2014

Online Published: 12.16.2014

DOI: 10.15390/EB.2014.3693

Introduction

Reading is the basis of the students' success in many areas. Evaluation process is one of those areas which require reading and good reading skills. As well as international TIMSS and PISA tests, which evaluate general achievement levels of students in specific subjects, many other national exams are also practiced. Items are in written form and can be comprehended through reading in these exams, which are generally comprised of multiple choice items. Therefore, reading comprehension is a basic type of skill for evaluating knowledge levels in different areas.

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Reading requires perceptive and motor skills. A written text is transmitted to brain through sense of sight, and comprehension takes place through the mental analysis of the signs in the text (Arıcı, 2012). However, comprehension is mainly possible via cognitive processes. Process of reading comprehension can be realized by creating links between the elements in the text and prior knowledge. During this process, which is called *configuring* by Günay (2003), signs from the text are associated and organized in the mind.

Reading is a personal activity. The main goal of the reader is to fully and accurately comprehend the messages within the context (Demirel, 1990). Comprehension includes the processes such as reaching the main idea and the subordinate ideas, distinguishing the latent thesis and developing an idea about writer's intentions by going beyond the words and sentences. While defining comprehension, Bloom (1995) also emphasizes the reader's noticing the ideas that are not expressed by the writer and expanding the scope of thinking. Hence, comprehension involves reaching not only the content clearly put into words but also the opinions between and beyond the lines.

During the process of comprehension which is related to cognitive aspect of reading, expectations and prior knowledge of the reader play a specific role (Çiftçi & Temizyürek, 2008; Yalçın, 2001). Reader has a responsibility of acquiring given information by decoding the message within the text, which functions as a tool to form understanding, and by relating it to the formerly acquired information. In order to accomplish that, the reader requires a certain amount of information related to subject and code knowledge in order to analyze the text. Prior knowledge enables the reader to make inferences in order to attain the latent information in the text.

Moreover, the individuals who have good reading skills become successful in many fields such as mathematics, science, geography (Kutlu, Yıldırım, Bilican & Kumandaş, 2011; Aslanoğlu, 2007; Çiftçi, 2007; Sever, 1993). Bloom (1995) also highlights that a relationship is present between reading comprehension and success in mathematics, science, language and literature. Reading is considered to be the best way of acquiring information (Koç & Müftüoğlu, 1988). Good readers are also academically more successful as they accomplish acquisition and processing of information better. It was ascertained in some research studies that students' success in reading affects their success in other courses (Ural & Ülper, 2013; Baş & Şahin, 2012; Göktaş & Gürbüztürk, 2012; Aksoy & Doymuş, 2011; Oluk & Başöncül, 2009). From this point of view, it can be thought that reading comprehension contributes to success in other fields at a certain level. Carnine & Carnine (2004) claim that teaching different strategies of reading in order to increase success in reading also enhances the ability to understand scientific texts better. According to a research study conducted on university students by Kolıć-Vehovec, Bajšanskı & Zubkovıć (2011), it is proved that students who use reading strategies are more successful in comprehending scientific texts.

It is a common opinion that Turkish students are not successful enough in science tests at large scale international exams which are held to evaluate students' levels of achievement. According to the results of TIMSS that was performed in 1999, Turkey could only rank 33rd among 38 countries and ranked 31st among 59 countries in 2007. Keeping in mind that 8th grades took this exam in 1999, it can be concluded that outcomes of science education are not sufficient. Many research studies were conducted to investigate the factors leading to under achievement in science education (Tekbıyık, Camadan & Gülay, 2013; Korkmaz, 2012; Şad, 2012; Akgün, 1999; Albayrak, 2009; Yiğit & Akdeniz, 2002; Demirci, 1996; Gürdal, 1992). In these studies, teachers' incompetence, problems related to methodology, physical inadequacy, such factors as family contribution, self-regulation, identifying problems and explaining scientific facts were taken into account among the reasons for failure.

No studies directly investigating the effect of Turkish students' success in reading comprehension on their success in science have been encountered. Basic reading comprehension is thought to affect success in science to a certain extent as it does in the other courses. In this regard, the aim of the present study is to identify the relationship between achievement in reading comprehension and achievement in science. In this respect, the study addresses the following research questions:

1. Is Science Items Comprehension Test (SICT) a significant predictor of achievement in SBS Science Test?
2. Is Turkish Reading Comprehension Test (TRCT) a significant predictor of achievement in SBS Science Test?
3. According to the scores obtained from SICT, is there a significant difference related to the mean scores on SBS Science Test between the upper group who received higher scores and lower group who scored poorly?
4. According to scores obtained from TRCT, is there a significant difference related to the mean scores on SBS Science Test between the upper group who received higher scores and lower group who scored poorly?
5. Is there a significant difference between paired item scores of SICT and item scores of SBS Science Test?
6. Do the participants' mean scores on SICT significantly differ from one another according to gender?
7. Do the participants' mean scores on TRCT significantly differ from one another according to gender?

Method

Associational model was adopted in this study. According to Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel (2012), research studies examining relationships and connections are usually called associational research studies. These studies focus on tests of predictive and explorative associations or differences between groups.

The study was conducted with 132 eighth grade students in Antalya. Three schools were selected for application. For the selection of these schools, the levels of achievement in "the Exam for Transition from Primary to Secondary Education" (TEOG-national placement test) were taken into account and relatively classified as high, moderate and low success levels. 53.8% of the participants were female (n=71) and 46.2% of participants were male (n=61).

Data Collection Tool

As an instruments of data collection, Science Items Comprehension Test (SICT) which was developed by Şekercioğlu, Bayat & Bakır (2014), the SBS Science Test, which was a collection of science items involved in 2012 and 2013 SBS Science Tests and finally Turkish Reading Comprehension Test (TRCT), which was developed by Girgin (2012) were utilized.

Science Items Comprehension Test (SICT): 30 of the 40 items asked in 2012 and 2013 at SBS Science Test were transformed into reading comprehension items by eliminating the choices. After the analysis carried out to determine psychometric properties of instrument, 9 items were decided to be excluded from test and the instrument took its final form with 21 items. According to confirmatory factor analysis, it was seen that items of the instrument accumulated under one factor and contribution of that factor to the total variance was computed as 64.98%. As a result of the confirmatory factor analysis that was performed to determine whether one factor structure of SICT was confirmed as a model or not, fit indices were found as $\chi^2(188)=261.64$, $p=.00031$, $\chi^2/df=1.39$, RMSEA=.039, NNFI=.97, CFI=.97, SRMR=.054 and GFI=.90. For discrimination of 21 items in SICT, item analysis was performed between upper group of 27% and the lower group of 27%, and it was

seen that all the items were below the degree of acceptance (r_{jx}<.01). Except for the items of 11 and 29, it was seen that item discrimination levels which were calculated with point-biserial correlation coefficient technique range between .38 and .61. It was found that difficulty level of SICT ranges from .42 to .77 and average difficulty level is .57. Furthermore, KR-20 internal consistency level was calculated to be .86 for 21-item SICT form (Şekercioğlu, Bayat & Bakır, 2014).

SBS (national placement test) Science Test: It consists of 21 items that were selected among a total of 40 items involved in SBS Science Tests applied to 8th graders in 2012 and 2013 depending on their pairing with the items of SICT.

Turkish Reading Comprehension Test (TRCT): TRCT consists of 25 multiple choice items, difficulty levels of which range from .24 to .83, and average difficulty is .50. KR-20 internal consistency level was calculated to be .79 for 25-item TRCT form (Girgin, 2012).

Data collection instruments were applied to the participants every other day. In order to apply the instruments to the study group, all legal permissions were obtained from Antalya National Education Directorate.

Analysis of Data

In order to seek answers for the research questions, simple linear regression analysis, independent sample t-test and chi-square independence test were performed.

In order to define upper and lower groups for the 3rd and 4th research questions, mean±df criterion was taken as a basis. Accordingly, since it was mean=9.08 and df=3.68 for SICT, participants who scored 13 and above were defined as the upper group, and the participants who scored 5 and below were defined as the lower group. Since it was mean=12.61 and df=4.54 for TRCT, participants who scored 17 and above were defined as the upper group, and the participants who scored 8 and below were called the lower group.

Results

In order to find out whether SICT scores are significant predictor of SBS Science Test scores for the participants, simple linear regression analysis was applied. Findings of the analysis are provided in Table 1.

Table 1. Simple Linear Regression Analysis for Predictiveness of SICT Scores

Variable	B	Standard Error(B)	β	t	p
Constant	7.116	.856		8.316	.000
SICT Scores	.399	.087	.371	4.562	.000

As can be seen in Table 1, SICT scores significantly predict SBS Science Test scores. It was seen that the relevant predictive variable accounts for the variance of predicted variable at a rate of 14%, R=.37, F(1,131)=20.810, p=.000.

In order to find out whether TRCT scores are significant predictor of SBS Science Test scores for the participants, simple linear regression analysis was applied. Findings of the analysis are shown in Table 2.

Table 2. Simple Linear Regression Analysis for Predictiveness of TRCT Scores

Variable	B	Standard Error(B)	β	t	p
Constant	6.188	.931		6.646	.000
TRCT Scores	.360	.069	.414	5.188	.000

As can be understood from Table 2, TRCT scores predict SBS Science Test scores significantly. It was seen that the relevant predictor variable explains variance of predicted variable at a rate of 17%, R=.41, F(1,131)=26.919, p=.000.

In accordance with the scores participants obtained from SICT, independent samples t-test was carried out in order to determine whether there is a significant difference at SBS Science Test scores between upper achievement and lower achievement groups. Findings of the analysis are shown in Table 3.

Table 3. The Difference between SICT Upper and Lower Groups' Mean Scores on SBS Science Test (Independent Samples T-Test)

GROUPS	n	mean	sd	t	df	p	η^2
UPPER[1]	25	14.72	2.89	4.897	45	.000	.348
LOWER[2]	22	10.18	3.46				

[1] Mean+sd (13 points and above)
[2] Mean–sd (5 points and below)

As can be seen in Table 3, in accordance with the scores participants received from SICT, there is a significant difference at SBS Science Test scores between upper and lower achievement groups, $t(45)=4.897$, $p=.000$, $\eta^2=.348$. In this respect, average SBS Science Test scores of the upper group, the students who reached higher achievement levels at SICT (mean=14.72), are higher than the mean scores of lower group (mean=10.18). It can be stated that the effect size of the aforementioned difference is "large" (Cohen, Manion & Morrison, 2007).

In accordance with the scores participants obtained from TRCT, independent sample t-test was performed to determine whether there is a significant difference between SBS Science Test scores of upper and lower achievement groups. The findings attained through the analysis are illustrated in Table 4.

Table 4. Difference between Upper and Lower Groups of TRCT Scores and SBS Science Test Scores (Independent Sample T-Test)

GRUPS	n	mean	sd	t	df	p	η^2
UPPER[1]	33	13.06	4.11	4.716	54.549	.000	.264
LOWER[2]	31	9.03	2.60				

[1] Mean+sd (17 points and above)
[2] Mean–sd (8 points and below)

As is clear from Table 4, according to the scores participants obtained from TRCT, there is a significant difference between SBS Science Test scores of upper and lower achievement groups, $t(54.549)=4.716$, $p=.000$, $\eta^2=.264$. In this regard, average SBS Science Test scores of the upper group, the students who reached higher success levels at TRCT (mean=13.06), are higher than the mean scores of lower group (mean=9.03). It can be stated that the effect size of aforementioned difference is "large".

In order to find out if there is a significant difference between each item score of SBS Science Test and the item scores of SICT which were transformed into and paired with reading comprehension items, chi-square independence test was applied. Findings attained through the analysis are demonstrated in Table 5.

Table 5. Differences between SICT and SBS Science Test Paired Item Scores (χ^2)

ITEMS	$\chi^{2(a)(b)}$	p
SICT 1 * SBSST 1[c]	.005	.941
SICT 2 * SBSST 2	.772	.395
SICT 3 * SBSST 3	2.981	.084
SICT 4 * SBSST 4	.753	.385
SICT 5 * SBSST 5	1.534	.215
SICT 6 * SBSST 6	.012	.912
SICT 7 * SBSST 7	.943	.331
SICT 8 * SBSST 8	.440	.507
SICT 9 * SBSST 9	2.339	.126
SICT 10 * SBSST 10	1.128	.288
SICT 11 * SBSST 11	4.373	.039
SICT 12 * SBSST 12	.065	.799
SICT 13 * SBSST 13	3.255	.071
SICT 14 * SBSST 14	5.328	.021
SICT 15 * SBSST 15	.937	.333
SICT 16 * SBSST 16	.425	.515
SICT 17 * SBSST 17	.749	.387
SICT 18 * SBSST 18	1.636	.201
SICT 19 * SBSST 19	3.327	.068
SICT 20 * SBSST 20	.952	.329
SICT 21 * SBSST 21	.328	.567

[a] Pearson χ^2
[b] df=1
[c] SBS Science Test

As can be seen in Table 5, except for two items, there is no significant difference between 19 item scores of SBS Science Test and SICT. A significant difference is present only between SICT and SBS Science Test paired item 11 ($\chi^2(1)=4.373$, p=.039), and item 14 ($\chi^2(1)=5.328$, p=.021).

In order to find out whether there is a significant difference between the participants' mean scores on SICT according to gender, independent samples t-test was applied. Findings obtained through the analysis are displayed in Table 6.

Table 6. The Difference between the Mean Scores on SICT according to Gender

Gender	n	mean	sd	t	df	p	η^2
Female	71	10.07	4.00	3.571	126.456	.001	.089
Male	61	7.92	2.89				

As illustrated in Table 6, there is a significant between the participants' mean scores on SICT according to gender, t(126.456)=3.571, p=.001, η^2=.089. In this regard, the mean score of female students (mean=10.07) is higher than that of male students (mean=7.92). It can be stated that the effect size of aforementioned difference is "medium".

Finally, in order to find out if there is a significant difference between the participants' mean scores on TRCT according to gender, independent sample t-test was carried out. The findings reached through the analysis are provided in Table 7.

Table 7. The Difference between the Mean Scores on TRCT according to Gender

Gender	n	mean	sd	t	df	p	η^2
Female	71	13.51	4.48	2.485	130	.014	.045
Male	61	11.57	4.43				

As demonstrated in Table 7, there is a significant difference between the participants' mean scores on TRCT according to gender, t(130)=2.485, p=.014, η^2=.045. In this regard, the mean score of female students (mean=13.51) is higher than that of male students (mean=11.57). It can be said that the effect size of the aforementioned difference is "medium".

Discussion, Conclusion and Suggestions

The general result obtained from this study is that there is a relationship between success in reading comprehension and success in science to some extent. Depending on the analysis conducted for the first research question, it was found that reading comprehension can explain 14% of the variance of success in science. This finding is in line with the results of the studies carried out in other fields (Kutlu, Yıldırım, Bilican & Kumandaş, 2011; Aslanoğlu, 2007; Çiftçi, 2007; Sever, 1993). The position of comprehension ability in understanding acquisition is between the material and the student. With this aspect, reading comprehension is a function activating other equipment which provides success in order to find answers for science items. In this respect, inefficient reading comprehension should prevent the use of other equipment to some extent.

The fact that the scores that the students get from TRCT explain the Science scores by 17% is one of the other important findings obtained from the research. This finding is also supports the previous one. Therefore, it is thought that comprehension level of the students in general subjects is similar to their comprehension level in science items. But, in a study aiming to search the role of reading comprehension success in science, it is thought that developing test directly on the main texts is a truer method. Because, comprehension is a fact come out as a result of organization of information in the text and prior knowledge of the reader (Güneş, 2007). Therefore, understanding the science items is possible with science accretion. In this respect, it is thought that a material consisting of science items and aiming to measure comprehension ability present reasonably truer results than reading comprehensible tests consisting of general subjects.

The fact that the students with overachievement in SICT obtained high scores from science items indicates that reading comprehension ability grounds the success in the related field. Likewise, the failure of the students who also fail in SICT approves this fact. Moreover, the scores received from TRCT also support the this result. The students achieving this test also did well in science tests. These findings show the function of reading in terms of success in science. This result is also consistent with the results of studies carried out in terms of the scores which were obtained from the international large scale exams. The studies carried out depending on the results of TIMSS performed in 2007 and PISA performed in 2006 showed that the failure of Turkish students in science field differed depending on the number of books these students have in their homes and education of their parents (Bayraktar, 2010; Anıl, 2009).

In the analysis performed according to the fifth research question, it was generally seen that there is no significant difference between SICT and paired item scores of SBS Science Test. In this case, the lack of a significant difference between success in SICT and success in SBS Science Tests approves the general problem and claim of the research. In other words, it was found that the answers for SICT and SBS Science Tests were consistent with each other.

Finally, according to the scores of both SICT and TRCT, it was seen that females are more successful than males. This finding is also consistent with the results of other studies (Kutlu, Yıldırım, Bilican & Kumandaş, 2011; Topuzkanamış & Maltepe, 2010; Gelbal, 2008; Çiftçi & Temizyürek, 2008). Additionally, PISA data also show that females are more successful than males in OECD countries.

When the obtained results are evaluated generally, it is seen that there is a significant relationship between success in reading comprehension and success in science. Yet, the situation highlighted in this study is to use materials in which reading texts peculiar to related field are common in order to be able to make the correct comparison for the studies in which success in reading comprehension and success in a particular field are compared. It is recommended to test the research problem of this study or similar problems for different fields and groups.

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