

## Exploring the relationship among new literacies, reading, mathematics and science performance of Turkish students in PISA 2012

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### Abstract

Turkish students on average had lower scores than OECD countries on mathematics, science, and reading at international assessment programs. As PISA measures the extent to which 15-year-old students are prepared to handle the challenges they may encounter in their future lives, and evaluates students' ability to reflect and to apply their knowledge and experience to real-life situations, low scores on this assessment should be investigated carefully. Therefore, in this study we aimed to explore the relationships between new literacy skills, reading, mathematics, and science performance of Turkish students. The results showed that new literacy skills measured in PISA had two dimensional structure including at and outside of school new literacy skills. These new literacy skills were shown to predict reading performance significantly, at school negatively and outside of school positively. It was also shown that reading performance and new literacy skills were effective in the prediction of both mathematics and science performances.

**Keywords:** PISA 2012, new literacies, reading performance, mathematics performance, science performance.

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### Introduction

The overall aim of the current research was to explore the relationship between new literacies and reading performance of Turkish students. Additionally, the relationship among new literacies, reading, mathematics, and science performance of Turkish students was investigated. This topic is novel in a way that the relationship among new literacies, reading, mathematics, and science performance using international assessment data has not been investigated so far. It is argued that on the one hand new literacy skills are required for good reading performance, on the other hand a good reading performance is necessary for better performance in mathematics and science. Considering Turkish students performed lower than average in mathematics and science at international assessment programs such as the Programme for International Student Assessment [PISA] (OECD, 2013a), exploring the relations among new literacy skills, reading, mathematics, and science performance may help to draw attention to the measures which might increase student performance on these subject domains.

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PISA provides important datasets for researchers as it claims to measure the extent to which 15-year-old students are prepared to handle the challenges they may encounter in their future lives, and evaluates students' ability to reflect and to apply their knowledge and experiences to real-life situations. PISA uses the term mathematical literacy, scientific literacy, and reading literacy to cover the broader concept of knowledge and skills in mathematics, science, and reading. This literacy concept of PISA is based on the student capacity to apply acquired knowledge and skills to different mathematical, scientific, and reading problems and challenges they may engage in their future lives (OECD, 2013b). Investigating relationships among new literacy skills and reading, mathematical, and scientific literacy performances of students is expected to provide new clues about how to increase student performance which is important for future development of the countries.

### *The concept of new literacies*

The concept of the new literacies was used first time by Gallego and Hollingsworth (1992). They defined literacy as "it is a slippery notion. Once traditionally limited to communication processes taught in school, literacy has moved beyond the confines of text and into the functional and workplace world of information processing, economics, and politics." (Gallego & Hollingsworth, 1992, p. 206). This concept means that literacy is rapidly changing as new information and communication technologies [ICT] emerge. Since then, the concept of new literacies has represented a variety of views (Baker, 2010). What is more, with the ICT, literacy is new every day since it continuously appears online (Leu, 2000). The social context of the current period has produced new ICT, and the new literacies that these technologies demand. There are different perspectives regarding the content and the definition of the new literacy skills. Some scholars use the concept of new literacies to shed light on social practices of literacy that are occurring (Street, 2003), others utilize the term of new literacies to define crucial new strategies and dispositions which are required for online research and comprehension (e.g., Coiro, 2003), others use new literacies as new discourses, new semiotic contexts, multimodal contexts, and multiliteracies (Hull & Schults, 2001; Kress, 2003), and even some include ICT to describe and broaden the content of the terms of new literacies (Kuiper & Volman, 2008).

As it is stated so far, there are different perspectives to conceptualize the rapidly changing literacy context. The rapidly changing character of literacy results in some challenges for theory development. A dual level theory has been recently proposed to respond to this problem (Leu, Kinzer, Coiro, Castek, & Henry, 2013). As it is argued that, today both the nature and meaning of literacy have become deictic because we live in an age of ICT which needs new literacies (Leu, 2000). The new literacies include the skills which are essential to successfully use the rapidly changing ICT that continuously come out in our world. A briefer definition of the new literacies may never be possible since their most important characteristics regularly change as new technologies for information and communication continually appear (Leu, 2002). Now, new literacies are constructed based on two levels including lowercase and uppercase new literacies (Leu et al., 2013; Leu, Forzani, Rhoads, Maykel, Kennedy, & Timbrell, 2014). The theory including lowercase and uppercase new literacies is based on an open-source approach and invites researchers to contribute to theory development and to benefit from others' contributions (Leu et al., 2013). Lowercase theories investigate a specific area of new literacies and/or a new technology, such as the social communicative transactions occurring with text messaging (Lewis & Fabos, 2005). In addition to this, lowercase theories explore a focused disciplinary base, such as the semiotics of multimodality in online media (Kress, 2003, as cited in Leu et al., 2014). Uppercase theories are related to the internet which makes new social practices possible with technologies such as social networks, blogs, e-mail, instant messaging, and etc. (Leu et al., 2013; Lewis & Fabos, 2005).

PISA uses various types of texts, like sentences and paragraphs but also lists, forms, graphs and diagrams on reading and other assessments (Schleicher, Zimmer, Evans, & Clements, 2009) to adjust itself to a slippery notion of the literacy. PISA 2012 measures students' new literacies by considering use of ICT at school and outside of school through ICT familiarity questionnaire. In accordance with PISA 2012, while at school activities are related to access to ICT (availability of ICT at school) and how often students use ICT for the activities including browsing, using email, downloading, uploading, doing homework, chatting, posting, playing, practicing and drilling, sharing, and etc., outside school activities concerns the same practices of the students out of school context (OECD, 2013b).

#### *The relationship between new literacies and reading performance*

New forms of reading and writing are appearing as the Internet and other new technologies for literacy enter our classrooms (Leu, 2002). New ICT provide a variety of new texts which introduce new supports as well as new challenges that can have a great impact on an individual's ability to comprehend what he or she reads (Coiro, 2003). The past few decades have witnessed a shift in becoming literate. Nowadays, particularly becoming a proficient reader depends on the degree to which we have new literacy skills that are required for reading and understanding the texts produced by information and communication technologies. There is accumulating research indicating that increasing the awareness of new literacy skills of the students, make positive and significant contribution to their reading success (Chase & Laufenberg, 2011; Coiro, 2003, 2009; Cope & Kalantzis, 2009; Henry, 2006; Leu, 2002; Leu, Gregory McVerry, Ian O'Byrne, Kiili, Zawilinski, Everett-Cacopardo, Kenndy, & Forzani, 2011; Mills, 2010; Schmar-Dobler, 2003). The study conducted by Dreyer and Nel (2003) revealed that the students who received strategic reading instruction supported by technology had higher marks on reading comprehension tests compared to the students in the control group. Significant learning and motivational gains for students have been extensively documented when new literacies are integrated into official literacy curricula. Educational initiatives have aimed to reduce the disconnections between students' experiences, identities, values, and patterns of engagement with new literacy skills (Bulfin & North, 2007). In another study, Sutherland-Smith (2002) examined the effects of teaching web literacy skills on reading success and found that using internet technology effectively had a significant impact on reading. Another study (López, 2010) focused on improving students' use of whiteboard technology and the effects of it on reading. The results indicated that increasing the students' literacy skills related to effectively using whiteboard technology had a profound impact on reading success. Also, Corio (2011) investigated the extent to which new reading comprehension proficiencies may be required when adolescents read for information on the internet. The research findings showed that increasing the awareness of the students regarding how to locate, critically evaluate, synthesize, and communicate information using the internet made significant contribution to their reading comprehension level.

#### *The relationship between reading and mathematics performance*

International literacy assessments have attracted wide interest in research community and provided data to examine relationships between student performances in different subject domains. Research studies have revealed a positive association between students' reading and mathematics performances. For example, Vilenius-Tuohimaa, Aunola, and Nurmi (2008) found a strong relationship between students' mathematical word problem solving skills and reading comprehension. Their findings suggested that technical reading skills were a predictor of mathematical word problem skills and reading comprehension. However, after controlling for the technical reading skills, mathematical word problem solving skills and reading comprehension were still closely related, suggesting other factors influencing mathematical and reading performances. Pape (2004) examined middle school students'

problem-solving behaviors and found that students who had better reading comprehension used more advanced problem-solving strategies. A longitudinal study was conducted with students from third grade through eighth grade (Grimm, 2008). The study revealed that students who had a higher level of reading comprehension in third grade had larger gains in problem solving and data interpretation compared to students who had a lower level of reading comprehension in third grade (Grimm, 2008). However, students' reading comprehension was not found to be a strong predictor of their computational skills. This finding suggests that reading comprehension is more associated with a conceptual understanding of mathematics. Reading comprehension was also found to effect students' work with algebraic equations as well (Duru & Koklu, 2011). Students who had weak reading comprehension had difficulties in translating algebraic representations to words. Studies focusing on children with learning disabilities have also found positive correlations between reading and mathematics performances (Geary, Hamson, & Hoard, 2000; Light & DeFries, 1995). For instance, children who experienced learning disabilities in reading also experienced deficits in mathematical reasoning (Light & DeFries, 1995).

#### *The relationship between reading and science performance*

Science is another subject domain that has been found to associate with reading performance (Cromley, 2009; Demps & Onwuegbuzie, 2001). For instance, Cromley (2009) used PISA 2000, 2003, and 2006 datasets to examine the relationship between reading performance and science performance. The researcher found that students with higher reading comprehension levels tended to have higher achievement levels in science. O'Reilly and McNamara (2007) examined how high school students' reading skills and metacognitive reading strategy knowledge were related to students' science achievement as measured by traditional content-based tests. They found moderate correlations between both measures of reading ability (reading skills and strategy knowledge) and science achievement measures. Furthermore, reading skills and strategy knowledge helped both low and high achieving students improve science test scores, indicating reading skills and strategy knowledge helped to compensate lack of science knowledge. Reading interventions such as prior knowledge acquisition, enhancing text, identifying main idea and summarization were also found to help students with learning disabilities understand science text (Mason & Hedin, 2011). The high correlation between science performance and reading performance found in research studies might be due to common cognitive processes shared by these two subject domains. Several researchers have suggested that reading and doing science require similar cognitive skills such as describing patterns, comparing and contrasting, determining cause and effect, and drawing conclusions (Armbruster, 1992; Kumar & Bristor, 1999).

#### *Present Study*

In this study we aimed to identify the relationship between new literacy skills and reading performance of Turkish students using PISA 2012 dataset. Additionally, the extent to which reading performance that was associated with new literacy skills could predict mathematics and science performances of Turkish students was investigated. This study contributes to the reading literature by exploring relationship between reading performance and new literacy skills that 15-year-old students engaged at and outside of the school and to the mathematics and science education literature by showing importance of reading skills on mathematics and science performance of the students.

The research questions of this study are:

1. To what extent do the new literacy skills predict reading performance of the students?
2. To what extent does the reading performance associated with new literacy skills predict mathematics and science performance of the students?

## Method

### *Participants*

The data of this study was obtained from the PISA 2012 data set. In PISA, the target population is all 15 years-old students of participating countries. This study used 4848 Turkish students who attended PISA 2012 (2370 females and 2478 males). Turkish students who attended PISA 2012 were generally 9th or 10th graders (27.2% and 66%, respectively). In PISA 2012, two-stage stratified sample design was used. In the first step, the sample of at least 150 schools was selected with a chance of selection proportioned to the number of their eligible 15-year-old students. In the second step, nearly 35 students were chosen with the equal probability from these selected schools (OECD, 2013b).

### *Measures*

PISA gathered data on student's reading, mathematics and science performance and student's background characteristics via subject related exams and a student questionnaire, respectively. The reading, mathematics and science exam items of PISA are either in multiple choice format or in open-ended format. Sample items of PISA could be reached using the following link: <http://pisa-sq.acer.edu.au/>. PISA reports five plausible values for reading, mathematics and science separately as a performance representation of each participating student. These plausible values were standardized on a common scale with a mean of 500 and standard deviation of 100 using the Item Response Theory (OECD, 2014). In this study, five plausible reading, mathematics and science values of students were used as the performance indicators in these subject areas.

The questionnaire items of PISA related to new literacy skills are in Likert format asking frequency of using these skills at and outside of the school (1: never or hardly ever; to 5: every day). Specifically, 9 items such as how often a student uses a computer for email, browsing the internet for schoolwork, or doing homework at school and 8 items such as how often a student uses a computer for email, reading news on internet or obtaining practical information from the internet outside of the school were asked. These 17 items related to at and outside of the school reading related activities were used to represent new literacy skills based on the definition of the new literacies (Coiro, 2003; Leu, 2000, 2002; Leu et al., 2013; Leu et al., 2014).

### *Data Analysis*

We investigated first whether at and outside of the school new literacy skill items described above provided a measurement model as expected. In order to test this, a confirmatory factor analysis was conducted. After assessing the fit of this measurement model, a path model was tested in which new literacy skill items were associated with reading performance and reading performance was proposed to predict mathematics and science performance of the students. The figure of the confirmatory factor analysis and path analysis is given in the result section (See Figure 1). A good measurement or path model means the difference between covariance matrix obtained from student data and covariance matrix implied by the hypothesized model is minimum (Ullman, 2001). The fit of the proposed models to the obtained data was assessed based on the following criteria. SRMR values are expected to be below .08 (Hu & Bentler, 1999), CFI and TLI values are expected to be around .95 (Hu & Bentler, 1999), and RMSEA values are expected to be below .08 (MacCallum, Browne, & Sugawara, 1996). In the last section, identified relationships between new literacy skills, reading performance, mathematics performance and science performance were investigated in terms of direction and magnitude.

In PISA, the sample selection method is not simple random sampling and there is a rotational item booklet design in which not every student answers all the items but a student answers

one portion of the items. For these reasons, PISA reports five plausible values for each student based on each subject domain which makes it different from traditional data sets. As the data structure is different, the analysis methods are also different. It is necessary to use special programs which take into account these plausible values (Rutkowski, Gonzalez, Joncas, & von Davier, 2010). When the analysis is related to structural equation modeling which includes plausible values, MPLUS (Muthen, & Muthen, 2012) is leading program which is capable of conducting related analysis. Therefore, all the confirmatory factor analysis and path analysis of the study were conducting using MPLUS program.

**Results**

The internal consistency of the new literacy skill items related to at and outside of the school was evaluated by the Cronbach’s alpha reliability coefficients. The analysis showed values .89 and .91 for new literacy skill used at and outside of the school respectively. These values indicate good reliability (Cicchetti, 1994).

*Building a Measurement Model Based on New Literacy Skills*

We first evaluated whether student questionnaire items that were related to at and outside of the school new literacy skill items provided a measurement model. In order to test the measurement model, a confirmatory factor analysis was conducted. In the model, 9 items were hypothesized to be associated with at school new literacy skills and 8 items were hypothesized to be associated with outside of school new literacy skills. The confirmatory factor analysis results showed that as RMSEA, CFI, TLI and SRMR values were within expected range, the fit of the data to the proposed model was good (See Table 1). The standardized factor loadings of the observed variables to their latent variables (at and outside of the school) were all significant, positive and had high values (ranging from .76 to .88 for at school and .68 to .88 for outside of the school). The correlation between latent variables at and outside of the school was .24 ( $p < .001$ ), which indicates a weak association between these latent variables as expected. Therefore, we concluded that at and outside of the school new literacy skills items could build a measurement model and we will investigate what extent these latent variables could predict reading performance of the students.

**Table 1.** *Measurement Model for New Literacy Skills*

Model	$\chi^2/df$	RMSEA	CFI	TLI	SRMR
Two-factor model	27.46*	.08	.97	.96	.07

\* $p < .001$

*Predicting Reading Performance using New Literacy Skills*

After building a measurement model based on at and outside of the school new literacy skills, what extent this model could predict reading performance was investigated. The figure of the model that was used to predict reading performance was given as a part of the path model of the study (See Figure 1). The path analysis results showed that as RMSEA and SRMR values were within expected range, and CFI and TLI values were somewhat lower than expected, the fit of the data to the proposed path model was acceptable (See Table 2). In the model, both at school and outside of the school new literacy skills were found to predict reading performance significantly. Outside school reading skills predicted reading performance positively ( $\beta = .19$ ), however, at school reading skills predicted reading performance negatively ( $\beta = -.31$ ). Overall, this model explained 11% of the variance in reading performance. Therefore, for our first research question, we concluded that, new literacy reading skills could predict reading performance of students in PISA. However, it is necessary

to note that, as the explained variance was moderate, there are other factors that could be influential in predicting reading performance also.

Table 2

*Path Model for New Literacy Skills and Reading Performance*

Model	$\chi^2/df$	RMSEA	CFI	TLI	SRMR
Path model1	35.25*	.08	.89	.88	.06

\* $p < .001$

*Predicting Mathematics and Science Performance using Reading Performance*

The second research question was related to predicting mathematics and science performance based on reading performance. The figure of this path model was given in Figure 1. In the model, at and outside new literacy skill items were used to predict reading performance and reading performance was used to predict mathematics and science performance. The path analysis results showed that as RMSEA and SRMR values were within expected range, and CFI and TLI values were close to expected values, the fit of the data to the proposed path model was good (See Table 3). In the model, reading performance was found to predict both mathematics and science performance positively and significantly ( $\beta = .81$  and  $\beta = .85$ , respectively). Overall, this model explained 65% of the variance in mathematics performance and 72% of the variance in science performance. Therefore, for our second research question, we concluded that, reading performance could predict mathematics and science performance of students in PISA. Having high R2 values in these predictions indicates that PISA mathematics and science performance have high level of association with reading performance. A student with high level of reading ability is expected to have high scores on mathematics and science.

**Table 3.** *Path Model for Predicting Mathematics and Science Performance*

Model	$\chi^2/df$	RMSEA	CFI	TLI	SRMR
Path model2	26.83*	.07	.92	.90	.06

\* $p < .001$

*Predicting Mathematics and Science Performance using New Literacy Skills*

We investigated relationships between new literacy skills and reading performance and then relationships among reading, mathematics, and science performance. Therefore, we indirectly evaluated relationship between new literacy and mathematics and science performance. In this part of the study, additionally, the direct relationship between new literacy and mathematics and science performance was investigated. In the model, at and outside new literacy skill items were used to predict mathematics and science performance. The path analysis results showed that as RMSEA and SRMR values were within expected range, and CFI and TLI values were close to expected values, the fit of the data to the proposed path model was good (See Table 4). In the model, outside of the school literacy skills was found to predict both mathematics and science performance positively and significantly ( $\beta = .19$  for both), whereas at the school literacy skills was found to predict both mathematics and science performance negatively and significantly ( $\beta = -.21$  and  $\beta = -.25$  respectively). Overall, this model explained 7% of the variance in mathematics performance and 8% of the variance in science performance. Although we had low R2 values in these

predictions, it could be concluded that new literacy skills had a role in explaining variance of mathematics and science performance.

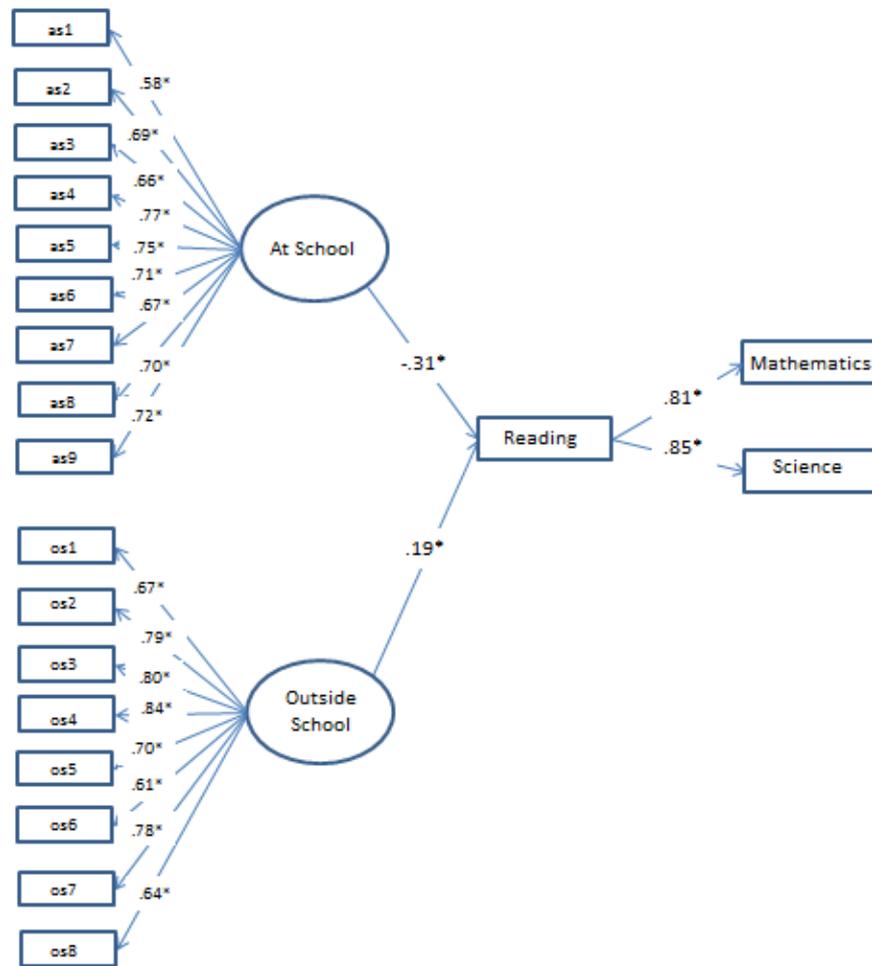


Figure 1. The measurement and path model based on new literacy skills, reading, mathematics and science performance

Table 4. Predicting Mathematics and Science Performance using only New Literacy Skills

Model	$\chi^2/df$	RMSEA	CFI	TLI	SRMR
Path model2	30.39*	.08	.91	.89	.06

\* $p < .001$

### Discussion

Turkish students on average had lower scores than OECD countries on mathematics, science, and reading at international assessment programs such as PISA (OECD, 2013a). As PISA measures the extent to which 15-year-old students are prepared to handle the challenges they may encounter in their future lives, and evaluates students' ability to reflect and to apply

their knowledge and experience to real-life situations (OECD, 2013b), low scores on this assessment should ring a bell for future of a country. Therefore, it is necessary to investigate the relationship between related factors and reading, mathematics and science performance of students to form a basis for prospective initiatives to increase performance of students in Turkey and other countries. With this motivation, in this study new literacy skills measured in a part of PISA student questionnaire were considered as an important factor that could be related to student performance, especially in reading. This study is novel in a way that we evaluated not only relationships between new literacy skills and reading performance, but also associations among reading, mathematics and science performance of 15 years old students using highly standardized PISA dataset. The results showed that new literacy measured in PISA had two dimensional structure: at school and outside of school new literacy skills. Additionally, these at school and outside of the school new literacy skills were shown to predict reading performance significantly, at school negatively and outside of school positively. This model explained around 11 percent of the variance in reading performance. Finally, it was shown that reading performance was effective in the prediction of both mathematics and science performance with the R square values of .65 and .72, respectively. Incentives behind these relationships are discussed in detail in the following paragraphs.

#### *The relationship between new literacies and reading performance*

There is wide consensus among educators that development and spread of information and communication technologies have a profound effect on learning and teaching (Warschauer & Matuchniak, 2010). The rapidly changes in ICT make also teaching and learning approaches become different. Additionally, this change affects the way people play, socialize, and participate in life across multiple social contexts (Ito, Horst, Bittanti, Boyd, Herr-Stevenson, & Lange, 2008). Many researches have extensively documented that when new literacy skills are integrated into curricula, significant and positive learning outcomes emerge in learning settings (e.g., Bulfin & North, 2007; Goodfellow, 2004; Grisham & Wolsey, 2006).

Although scholars who are interested in new literacy studies have particularly stressed the importance of using potentials of literacy practices supported with electronic environments that children use in school as well as out of school contexts (see, e.g., Knobel & Lankshear, 2009; Lanksher & Knobel, 2003; Leu et al., 2013; Leu et al., 2014; Mills, 2010), the current research findings revealed that at school new literacy skills predicted reading performance negatively. This negative relationship may be concerned with teacher knowledge and teachers' sense of efficacy regarding using new literacy skills effectively in their classrooms. Another reason of the negative relationship might be frequency of opportunities which the students have access to new ICT at schools. However, how such technologies are put to use is even more important. Each of these reasons will be elaborated in the following paragraphs.

One of the reasons for the negative relationship of at school new literacy activities on the reading performance would be teacher knowledge and teachers' sense of efficacy related to new literacies. In accordance with the study conducted by Coppola (2004), without teacher knowledge on how to use technology, all attempts of a teacher in learning settings are time consumption and would be unsuccessful. Additionally, Anne, Krista, Timothy, and Peggy (2010) argued that positive teacher beliefs play important roles in using technology and related skills in their classrooms. That's why, Anne et al. suggested that professional development seminars should be organized to improve positive beliefs and knowledge in teachers' use of technology and related skills. Some of research (e.g., Cüre & Özdener, 2008; Usluel, Mumcu, & Demiraslan, 2007; Yurdakul, 2011) showed that teacher education programs in Turkey do not provide a rich content regarding use of new information and communication technologies and related skills effectively for preservice teachers. Hence, when preservice teachers are qualified as a teacher and appointed to any school district, they encounter different problems and could not support their students to increase awareness and

efficacy of technology and related skills. Other researchers (e.g., Göktaş, Yıldırım, & Yıldırım, 2008; Gülbahar, 2008; Kayaduman, Sırakaya, & Seferoğlu, 2011; Yalın, Karadeniz, & Şahin, 2007; Yurdakul, 2011) have argued that while teachers are aware of importance of new literacies, they do not know how to use and integrate them into curricula. Also, learning outcomes and learning strands in the curricula's content do not sufficiently provide new insights into teachers' understanding of new literacies and technology.

Regarding the frequency and how students use the technology, there is a growing research which has argued that there are different factors that influence how people access technology. Socio-technical factors, which support or constrain use of new information and communication technologies in schools, strengthen educational inequity (Warschauer & Matuchniak, 2010). The comparative study, which was carried out by Warschauer, Knobel, and Stone (2004) reported that the schools from high socioeconomic status tended to provide more opportunities, technical support, professional development for increasing awareness of school staff and students in regard to new literacies than the schools that were from low socioeconomic status. These opportunities seem to support students' positive engagement with new literacies. However, when students do not use these technologies effectively in schools, learning outcomes may be negatively affected.

The current research also revealed that out of school new literacy activities of the students positively and significantly predicted reading performance of the students. According to Ito et al. (2009), there are two primary underlying categories of outside school online practices including friendship-driven and interest-driven. Friendship-driven practices essentially involve hanging out with their peers online. The main devices for hanging out are social network sites, instant messaging, and computer, internet, video games. Friendship-driven activities include chatting or flirting; uploading, downloading, or discussing music, images, and video; updating profiles and writing on friends' walls; and playing or discussing games (Warschauer & Matuchniak, 2010). Ito et al. define interest-driven activities as communicating, game playing, and sharing of media. Compared to friendship-driven activities, interest-driven activities bring participants into communication and collaboration with people of diverse ages and backgrounds around the world rather than principally with their own local peers by using new media. The study conducted by Selwyn, Potter, and Craner (2009) argued that whilst the majority of children felt that information and communication technologies use led to gains in learning, the nature of schools constrain use of these technologies in educational settings effectively. This disparity on access to technologies between inside and outside schools leads students to engage more expansive with digital media outside of the classroom. In addition to this, it has been widely cited that teachers have been using information and communication technologies infrequently in classroom settings and when used, it is just for information transmission rather than the facilitation of students' knowledge construction (Chai, Koh, Tsai, & Tan, 2011; Hobbs & Tuzel, 2015). Also, some of the studies have documented that students engage in new literacies require using information and technologies outside school and experience them more than they access inside schools (e.g., Afshari, Bakar, Luan, Samah, & Fooi, 2009; Lai & Pratt, 2004; Sahay & Avgerou, 2002). Beside this, the school limits children's use of new literacies in the school borders. Empirical research of the new literacy studies has frequently documented authentic literacy practices that are situated in informal contexts of learning. In other words, children find the suitable environment enriched with technology outside school (Hull & Schultz, 2001; Street, 2003). All these factors stated above may have had a positive and significant effect on the prediction of the students reading performance scores by out of school new literacy activities based on PISA 2012 data.

*The relationship between new literacies, reading, mathematics and science performance*

Our findings suggested that students who had higher reading skills also had higher mathematics and science skills. This finding is in line with current research findings (Cromley, 2009; Demps & Onwuegbuzie, 2001; Duru & Koklu, 2011; Grimm, 2008; Pape, 2004; Vilenius-Tuohimaa, Aunola, & Nurmi, 2008). Obtained high R2 values indicated that there was a strong relationship between these variables. Although our results could not be interpreted as causality, a gain in reading performance might be resulted in a gain in mathematics and science scores of students as suggested by reported studies above. Considering that PISA measures students' ability to reflect and to apply their knowledge and experience to real-life situations, and PISA items requires word problem solving skills, proficient readers are expected to be more successful in mathematics and science. This study suggests enhancing reading performance might help to increase students' mathematical literacy and scientific literacy. Low ranking of Turkish students on PISA mathematics and science performance also reflected on the percentage of students who reached higher proficiency levels, namely higher order thinking skills. Turkish students who reached the 5th and 6th proficiency levels in PISA 2012 on mathematics was 5.9% (OECD average was 12.6%); on Science was 1.8% (OECD average was 8.4%) and on reading was 4.4% (OECD average was 8.4%) (OECD, 2013a). In order to catch with OECD average, one of the aims could be to increase reading proficiencies of the students. PISA uses not only continuous texts like sentences and paragraphs but also non-continuous texts like lists, forms, graphs and diagrams on reading and other assessments (Schleicher, Zimmer, Evans, & Clements, 2009) as modern life requires modern citizens to engage with both types of texts. Therefore, using more of non-continuous texts in educational activities and assessment systems would be expected to increase Turkish students' performances in mathematics, science, and reading.

Another finding of the study was that new literacy skills measured on PISA also could predict mathematics and science performance of students. Although shared variance among new literacy skills and mathematics and science performance was low, there was a significant relationship. Especially, outside of the school new literacy skills measured by how often a student uses a computer for email, reading news on internet or obtaining practical information from the internet predicted mathematics and science performances positively. As modern life requires us to process and synthesize mathematical and scientific information we find in emails, electronic news and internet surfing, students who are proficient on these skills were found to be somewhat better performers in mathematics and science. However, at school new literacy skills negatively correlated with mathematics and science performances. This finding is similar with the relationship between at school new literacy skills and reading.



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