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Assessment of First-Grade Students' Literacy and Numeracy Levels and the Influence of Key Factors

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Abstract. The acquisition of literacy and numeracy in early years education provides children with an essential skill for learning and life. This study aims to assess the literacy and numeracy skills of first-graders in Qatari governmental schools. It also determines whether there is a relationship between numeracy skills and literacy skills and whether these are influenced by such factors as parents' educational level, students' prior knowledge, and gender. Study participants included 80 students (21 male, 59 female). The study used a quantitative research approach, and descriptive statistics were determined using Statistical Packages for Social Sciences (SPSS). The researchers used two research instruments: a numeracy survey and a literacy survey. The results demonstrated that participants attained a high level of oral language, phonological awareness, print awareness, knowledge of letters, and basic addition and subtraction facts with numbers 0–10. The results of the study also revealed that students possessed a medium level of writing development, place value, and adding and subtracting two-digit numbers and a low level of numeracy skills related to basic word problems, patterns, clocks, geometry, measuring, and money. In addition, the results demonstrated significant differences between male and female first-grade students, with male students having better literacy and numeracy skills than female students. The results s revealed no statistically significant differences in both literacy and numeracy related to pre-school knowledge, while there were significant differences

in children's literacy and numeracy related to parents' educational level. These results were discussed and recommendations for practice and research were presented accordingly.

Keywords: literacy; numeracy; first-grade students; primary education.

Introduction

The acquisition of literacy and numeracy in students' early years forms essential skills for later learning and life. Researchers reported that academic skills gained during a child's early years, such as mathematics and reading, have an impact in the long term in relation to their academic development and consequent career success (Jordan, Hanich, & Uberti, 2003; National Early Literacy Panel [NELP], 2008; National Research Council [NRC], 2009; Snow, Burns, & Griffin, 1998). Children who experience academic struggles during their early years are likely to similarly experience trouble later in life (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Chall, Jacobs, & Baldwin, 1990). There is evidence showing that support and intervention offered to young children before such difficulties have become permanent can enhance their academic performance (NELP, 2008; National Mathematics Advisory Panel [NMAP], 2008). The present study aims to assess literacy and numeracy skills of first-graders in Qatari governmental schools. It also investigates the relationship between numeracy and literacy and explores the influences of some factors such as gender, students' prior knowledge, and parents' educational levels. The following section reviews the literature in order to provide background information and to build a credible theoretical context by identifying literacy and numeracy skills and reviewing the literature regarding factors affecting the development of these skills.

Literature Review

Numeracy skills

Many researchers (Jordan, Kaplan, Locuniak, & Ramineni, 2007; NMAP, 2008; NRC, 2009; van de Rijt, van Luit, & Pennings, 1999) have pointed to a number of components belonging to mathematics skills that are built in early childhood and are crucial in their future academic development. These early skills include numeracy, geometry, patterning, and problem solving and their acquisition is cumulative, meaning that they build upon each other and thereby establish a foundation upon which subsequent and more advanced skills can develop (Aunola et al., 2004; NMAP, 2008; Purpura, Baroody, & Lonigan, 2013). In other words, as mathematical development incorporates a wide range of skills and fundamental concepts, numeracy is the main focus of this study.

According to many researchers (Baroody, Reid, & Purpura, 2013; Clements, 2007; Clements & Sarama, 2004; Gravemeijer, 2002), children follow a certain sequence in acquiring knowledge in terms of early numeracy, also referred to as a learning trajectory. Early numeracy consists of a cluster of skills and concepts (Jordan et al., 2007; NMAP, 2008; Purpura & Lonigan, 2013) that form a

connected system of knowledge (Baroody, 2003; Gersten & Chard, 1999; NMAP, 2008).

In their model of developmental phases, Purpura et al. (2013) proposed that early numeracy skills develop in three primary but also overlapping phases, namely informal numeracy, numeral knowledge, and formal numeracy. Ginsburg (1977) also showed how the skills acquired by children both prior to and outside their formal schooling contribute to their informal numeracy knowledge. The mathematical skills in the phase of informal numeracy have little involvement with algorithms or symbols, focusing instead on associating number words with quantities and comprehending the relationships between different quantities. For example, two-year-old children have been shown to possess one-to-one correspondence and the ability to identify basic numbers (Mix, 2009; Sarama & Clements, 2009). Krajewski and Schneider (2009) suggested that informal numeracy development itself contains three overlapping levels, whereby the first and second levels are the foundation for the third. The first level has children comparing number sets and learning verbal sequences. In the second level, students connect the verbal sequence to the fixed number set via one-on-one correspondence, thus cementing the cardinality principle. The third level builds upon the knowledge gained in the first two levels, and children become capable of changing given quantities to form new number sets. These early, informal skills are predictive of later achievement (NMAP, 2008; NRC, 2009; Starr, Libertus, & Brannon, 2013).

According to the developmental phases model, numeral knowledge forms the second phase, wherein the child starts to identify numbers and learns their names, thereby distinguishing them from other signs and symbols (Krajewski & Schneider, 2009; Sarama & Clements, 2009). Nevertheless, knowledge of the names of numerals alone does not lead to an in-depth understanding of the concept of numbers. Furthermore, it appears that certain aspects of numeral knowledge can only be comprehended once children have obtained informal numeracy education (Krajewski & Schneider, 2009; Sarama & Clements, 2009). They can then apply the informal knowledge in a domain that is both theoretical (Baroody & Wilkins, 1999) and empirical (Purpura et al., 2013). Purpura and Ganley (2014) reported a significant dependence of formal numeracy skills on literacy-related skills.

The third phase of the developmental phases model refers to the learning of mathematical concepts through formal instruction in a school setting, which includes but is not restricted to the comprehension of place value and the decimal system (Ginsburg, 1977). Children begin knowing basic combinations early on in kindergarten (NMAP, 2008). Such knowledge was found to be crucial for later learning stages (Jordan, Kaplan, Ramineni, & Locuniak, 2009; Jordan & Levine, 2009; Mazzocco & Thompson, 2005) and can be malleable through intervention (Baroody, Eiland, Purpura, & Reid, 2012; 2013; Clarke et al., 2011; Fuchs et al., 2009).

In this study, we assess children relative to the learning outcomes that are expected at a given point in students' formal instruction, specifically, by the end of Grade 1 in Qatari schools. By this point, students are expected to know: 1)

numbers of two-digit numbers including the following subdomains: a) number notation, b) representation and place value, c) comparison and order, d) patterns in number sequence, e) basic addition and subtraction facts with numbers 0–10, f) adding and subtracting two-digit numbers, and g) basic word problems. 2) Time, including: reading of time to the hour and half-hour, ordering of events within a day, description of the duration of an event or when it will take place, months of the year. 3) Geometry and measurement, including: a) types of lines, b) basic shapes, such as a circle, square, rectangle, and triangle, and their properties, c) classification of 2D shapes, d) measuring and comparison of lengths in non-standard units. 4) Money, including: a) values of riyals and dirhams, b) counting of riyals to QR100 and dirhams up to 1 QR, and c) finding simple totals and change.

Literacy skills

In a literate society, the majority of children experience the beginnings of literacy in the very early stages of childhood (Morrow, 2011; Teale, 1986). From an early age, children start recognizing and making sense of the print around them.

Exposing children to literacy experiences during their early years is crucial. These experiences can provide children with the motivation for learning to read and write. As the growth of literacy experiences in children's early life is ongoing, it is important for children to continue their literacy growth when they enter kindergarten through developmentally appropriate practice (IRA and NAEYC, 1998). Therefore, settings for early childhood education, like kindergartens and primary schools, are responsible for promoting literacy and teaching these skills in an appropriate manner. Fisher (2000) pointed out that early childhood educators should discover the best way to help each child achieve a high level of literacy.

Early literacy experiences also help children develop confidence, skills, and independence with the written word around them (The National Literacy Strategy, 2000). Research indicates that in order to build reading and writing skills, children first need to have acquired a set of certain literacy skills (Lonigan, Burgess, & Anthony, 2000; Niessen, Strattman, & Scudder, 2011) including print awareness, phonological awareness, knowledge of letters, oral language, and writing development. A growing body of research has shown that these literacy skills are strongly related to children's literacy acquisition and considered vital to the development of children's reading and writing abilities (Anthony et al., 2002; Lonigan, Schatschneider, & Westburg, 2008; Morrow, 2011; Owodally, 2015). In the view of Peeters, Moor, and Verhoeven (2011), these skills are crucial in developing literacy skills in that children who lack them will often struggle.

Phonological awareness, one of the literacy skills that children should acquire in their early years, refers to a child's understanding that a spoken word comprises separate components of sound that flow together during the pronunciation of words (Adams, 1990; Bradley & Bryant, 1983). This is "the ability to notice, think about, or manipulate the individual sounds in words" (Torgesen & Mathes, 1998, p. 2). Phonological awareness includes certain

features, such as identifying, blending and segmenting phonemes as well as the awareness of rhyming words.

Print awareness refers to children's understanding of the nature and uses of print. There are a number of components in children's print awareness that are primarily related to understanding how print is presented and what its functions are. These include knowing how a book should be handled, understanding that print conveys meaning, distinguishing print from surrounding pictures, noticing print in the day-to-day environment, and knowing that spaces separate words and that words are arranged in a linear fashion (Heroman & Jones, 2010; Morrow, 2011; Strickland & Schickedanz, 2004; Walpole, Chow, & Justice, 2004).

According to Phillips et al. (2012), the strongest predictor of reading proficiency at a later age is alphabet knowledge, or the knowledge of letters, which refers to the ability to identify letters and understand letter sounds (Levin & Ehri, 2009).

Early writing development requires a certain level of familiarity with the tools of writing – not only implements but also writing conventions – as well as the emergence of skills with which children can express their ideas through written symbols, including letters (US Department of Health and Human Services 2010, 15). Emergent writing instruction is often a combination of varying degrees of four elements, including mechanisms of writing, concepts of writing, conventions of writing, and composing (Muzevich 1999). These elements are essential in promoting children's early literacy skills (Al-Maadadi & Ihmeideh, 2016).

These literacy skills, including an awareness of print and phonology, a knowledge of letters, oral language, and writing development, form the foundation of the literacy test used in the current study.

Factors affecting literacy and numeracy skills

The literature review above has addressed different factors that affect children literacy and numeracy skills. Numerous studies have noted that the effects of parents' educational level and parental intervention on students' numeracy and literacy achievement are becoming more evident (Coneus and Sprietsma, 2009; LeFevre et al, 2009; Manolitsis et al., 2009; Abuya et al., 2012; Abuya et al., 2015; Segers et al., 2016). For more details, Abuya et al. (2015) found that while there is a statistically significance of the mother's level of education, its relationship with the numeracy and literacy skills of her children is negative. Meanwhile, the mother's and father's education have a positive and significant effect on the child's literacy and numeracy achievement. The study argued that as much as the educational level of the mother has an important influence on a child's academic skills in relation to literacy and numeracy, the importance of father's education should not be ignored (Abuya et al. 2015). Coneus and Sprietsma (2009) reported that the children of an educated mother are expected to possess better cognitive abilities due to the quality of learning provided by the mother. They also addressed one challenge inherent in such research: while direct and indirect activities can be differentiated based on parental reporting, the parents

involved in their study differed in their descriptions of the learning activities they used with their children. Some used both direct and indirect activities, while others preferred a specific type. In the same domain, other researchers (LeFevre et al, 2009) have found that the level at which parents reported home activities was related to a child's numeracy and literacy performance.

Another study conducted by Manolitsis et al. (2009) found that the frequency at which Greek parents taught their children contrasted sharply with their Canadian counterparts, and Greek children performed lower on literacy and numeracy tests. This could be due to orthographic differences, how parents perceived their educational responsibilities, or when Greek parents begin to teach their children arithmetic skills. Moreover, Canadian parents showed a high use of technological aids in numerical education. The use of calculators and computer programs correlated positively with high numeracy levels. In another study, Segers et al. (2016) assessed 60 kindergartners' early literacy and numeracy skills and, based on parent questionnaires, explored the relationship with their home literacy and numeracy environment. The researchers found that the home numeracy environment is a unique factor in predicting early numeracy skills.

In addition to parents and their interventions, children's pre-school knowledge is another factor that affects their literacy and numeracy skills and that has been examined in other studies (Burchinal et al., 2009; Murray and Harrison, 2011; Melhuish et al., 2013; Anders et al., 2013). More specifically, a meta-analysis of 20 studies of children's school performance based on their academic records (Burchinal et al., 2009) concluded that students exposed earlier to numerical and linguistic exercises performed considerably better. This meta-study also found that less privileged children who were engaged in early numerical activities were capable of greater degrees of improvement than their more privileged classmates.

Murray and Harrison (2011) followed a sample of 104 kindergarten children from the beginning to the end of their first year of primary school in order to examine the effect of children's pre-school experiences and other characteristics such as learning readiness and gender. Children's literacy and numeracy achievements were assessed at the end of the school year. The results of the study showed no significant correlation between early literacy and numeracy performance and either the experiences that children had made before starting school or the quality of teaching they received. The study also revealed that parental education did not have a significant effect on their children's literacy and numeracy skills. Murray and Harrison's study (2011) also highlighted that schools and designers of educational policies should take gender into consideration, in particular ensuring that boys in early education receive more specialized support.

In a longitudinal study of children's development between the ages of 3 and 11, Melhuish et al. (2013) examined various forms of preschool provision and how these preschool experiences affected child development. The study sample targeted 683 randomly chosen pupils from 80 preschools, revealing that literacy and numeracy performance at age 11 was associated with preschool experience.

The results of the study revealed that high-quality preschools had consistent effects that resulted in improved achievement in English and mathematics at Key Stage 2. The results also indicate that high-quality preschools have a positive effect on student progress in English and mathematics. Anders et al. (2013) argued that the quality of a preschool's processes has notable effects on children's numeracy development until age 7. The researchers recommended strengthening efforts to ensure high-quality preschool education.

In addition to the factors examined and raised in the previous studies, some studies have explored how literacy and numeracy skills have a positive relationship (Lee and Lawson, 2006; Purpura and Napoli, 2015), with Purpura and Napoli (2015) in particular focusing on the symbiotic relationship between the two skills. Children who have strong literacy skills are likely to also have strong numeracy skills, and vice versa, and students who improve in one area are likely to improve in the other as well.

Background and Significance of the Study

The State of Qatar is a developing country. Despite a massive educational reform program instituted over the last 13 years, students have demonstrated low levels of achievement on international mathematics tests such as TIMSS (2011, 2015), National Center for Education Statistics (2012, 2016), and PISA (2012). Based on the literature review and analysis above, which highlights the importance of the acquisition of literacy and numeracy (L&N), the present study aims to assess literacy and numeracy skills of first-graders in Qatari governmental schools. It also investigates the correlation between numeracy skills and literacy skills and explores the influences of parents' educational level, students' prior knowledge, and gender.

Such research is of significant importance as it relates to the assessment of literacy and numeracy skills in early years, with special consideration of examining the correlation between these skills and the effect of some factors. The results of this study will better inform researchers, educators, and decision makers about the acquisition of literacy skills and numeracy skills and thus direct them toward intervention or treatment as needed. In turn, this may improve students' literacy and numeracy skills starting in the early years of their education and thus indirectly enhancing their learning in the future.

Research Questions

The study aims to answer the following three questions:

1. What are the levels of literacy and numeracy among first-grade students?
2. Is there any relationship between students' literacy skills and their numeracy skills?
3. Do factors such as parents' educational level, students' pre-school knowledge, and gender affect students' literacy and numeracy skills?

Methods

Research design

This study used a quantitative research design and a literacy and numeracy test survey method. We implemented a descriptive research design that involved collection of quantitative data in order to answer the three key research questions. The test survey design suits the current study. The sample used in the study consisted of 110 (30 students as a pilot study and 80 students involved the research study) end-of-year first-grade students who were selected as a convenience sample. This survey design (L & N test) enables quantitative descriptions to represent the acquisition of literacy and numeracy skills by assessing a sample selected within the population (Creswell, 2014).

Instruments

To assess the literacy and numeracy levels for first-grade students, the researchers developed two research instruments. The first one was the numeracy test. Based on the literature review and to assess the acquisition of numeracy skills, the researchers used the "End-of-the-Year Test - Grade 1" developed by Math Mammoth, which was retrieved from the following location: https://www.mathmammoth.com/preview/tests/End_of_Year_Test_Grade1.pdf .

The test consisted of eight parts including the following domains: basic addition and subtraction facts with numbers 0–10 (28 points), place values and two-digit numbers (13 points), adding and subtracting two-digit numbers (19 points), basic word problems (14 points), patterns (4 points), clocks (10 points), geometry and measuring (7 points), and money (5 points). The original test was modified for use in the Qatari curriculum. Some parts were deleted, such as part c of question 17 and all parts of question 18. This was done in order to reduce the amount of word problems in the test and to add another question related to patterns. In addition, questions related to geometry and measuring (questions 21 and 22) were changed to fit into the context of the Qatari curriculum. In money-related questions, pictures of coins and money (questions no. 23 and no. 24) have also been adapted to the Qatari context. Overall, the test was scored out of 100.

The second research instrument was the literacy test. Based on the literature review (i.e. Clay, 1979, Morrow, 2011, Robertson & Salter, 2007), we constructed a five-part test to assess the acquisition of literacy skills in Arabic Language based on the following domains: oral language (10 points), phonological awareness (23 points), print awareness (38 points), knowledge of letters (10 points), and writing development (19 points). The total score of the literacy test was also out of 100.

The two survey tests consisted of two sections. The first section included demographic information such as parents' educational level (for both mother and father), pre-school experiences (whether the students attended kindergarten or did not), and student gender. This information was gathered with the cooperation of teachers and parents. The second section consisted of test items.

Because the tests were too long to be completed by children in one class, the tests were implemented at different times over the course of a week.

Validity and reliability of the research instruments

To establish the validity of the two research instruments, we first translated the numeracy test into Arabic. To ensure the equivalent meaning of the items, two experts who are bilingual in Arabic and English did the translation as well as a back translation, whereby the back-translation was done by an independent translator who did not see the original version before translating the instrument back to the first language. For construct validity, two experts in mathematics and two experts in Arabic education were consulted in order to give their judgment about the test questions. The next step consisted of implementing the tests for 30 students as a pilot sample; these students were not among the study participants. During the development phase of the research instruments, the changes highlighted by the validation panel and the field testing were taken into account. To satisfy the construct validity, the Mann-Whitney U test (Table 1) was utilized to satisfy the discrimination validity of the research instruments (Creswell, 2014), and the results displayed in Table 1 below revealed statistically significant differences between the lower quartile and the upper quartile in the two literacy and numeracy tests. In turn, this indicates that the two research instruments satisfy discrimination validity.

Table 1: Mann-Whitney U test results

Instrument	Percentiles	N	Mean Rank	Sum of Ranks	Z Value	Sig. (t-tailed)
Literacy test	75th	7	0.12	84.00		
	25th	8	4.5	36.00	-3.267	0.001
Numeracy test	75th	7	0.12	84.00		
	25th	8	4.5	36.00	-3.246	0.001

In order to establish the reliability of the research instruments, the internal reliabilities (Cronbach's alpha coefficient) were determined for the literacy and numeracy tests. The calculated alpha coefficient was 0.733 for the literacy test and 0.765 for the numeracy test, thus indicating a satisfactory level of reliability (Robinson, Shaver, & Wrightsman, 1991).

Participants and data collection

The research was conducted at the end of the 2018–2019 academic year. The tests were distributed to more than 123 first-grade students across four governmental primary schools in Qatar. Of the thirty students who participated in the pilot study, the responses of thirteen were excluded because they did not complete the tests. The final participants were 80 students (21 male, 59 female). Parents' educational levels included non-educated, prep school or less, high school, high diploma, bachelor's degree or post-graduate. Students' pre-school knowledge was classified based on whether or not they attended kindergarten.

Students and their parents in the participating schools were asked to volunteer to take part in this research, and they were informed regarding the study

purpose. Students were asked to do the two literacy and numeracy tests, and they were assured of confidentiality.

Data analysis

This study followed a quantitative research approach. Descriptive statistics were utilized via Statistical Packages for Social Sciences (SPSS 15.0). To answer the first research question, the means and standard deviations were calculated for the parts of the literacy and numeracy tests, as well as for the tests in their entirety. A comparison was made between the mean scores of the responses on the two tests to determine the skill levels that the participants attained. To answer the second research question, which asks if literacy skills correlate with numeracy skills among students, a Pearson correlation analysis was utilized. An analysis of Variance (ANOVA) was also utilized in order to examine whether there were statistically significant differences between the mean scores of the literacy and numeracy skills related to the effects of gender, pre-school knowledge, and parents' educational level. In addition, a Tukey *post hoc* test was utilized for multiple comparisons based on parents' educational level.

Findings

1. First-grade students' levels of literacy and numeracy

In order to answer the first research question, which concerns first-grade students' levels of L&N, the means and standard deviation were calculated for the parts of the literacy and numeracy tests and for the tests in their entirety. Students' levels in each part of the tests were then classified into three levels. A low level was assigned if the mean score was less than 50% of the total score of the measured part. A medium level was assigned if the mean score was greater than 50% and less than 75% of the total score of the measured part. Finally, a high level was assigned if the mean score was greater than 75% of the total score of the measured part. This procedure was utilized for each part of the L&N tests and for the tests in their entirety. The cutoff point between low and medium levels of achievement was set at 50% because a successful grade in the Qatari Educational System is considered to be at least 50%.

1.1. Findings related to the literacy test

As shown in Table 2 below, participants attained a high level of almost all literacy skills including oral language, phonological awareness, print awareness, and knowledge of letters. The exception was writing development; students demonstrated a medium level of this final skill. The findings, therefore, show that the study participants had a high overall literacy, with a mean score of 82.1750 out of 100.

Table 2: Means, standard deviations and levels of literacy skills

	Total Score	Mean	Std. Deviation	Low Level	Medium Level	High Level	Literacy Level
LD1 : oral language	10	8.5438	1.41688	< 5	5- 7.5	> 7.5	High
LD2: phonological awareness	23	19.9375	3.91069	< 11.50	11.5- 17.25	>17.25	High
LD3: print awareness	38	33.5500	5.50236	< 19	19- 28.5	> 7.5	High
LD4: knowledge of letters	10	8.7875	1.90066	< 5	5- 7.5	> 7.5	High
LD5: writing development	19	11.7125	5.55284	< 9.5	9.5- 14.25	>14.25	Medium
Literacy	100	82.1750	13.34359	< 50	50- 75	> 75	High
*** LD: Literacy Domain**							

1.2. Findings related to the numeracy test

As shown in Table 3, the findings revealed a high level of only one numeracy skill: basic addition and subtraction facts with numbers 0–10. The results also revealed a medium level of numeracy related to place values and two-digit number awareness and to adding and subtracting two-digit numbers. While the findings demonstrated a low level of numeracy skills related to basic word problems, patterns, clocks, geometry, measuring, and money, the overall findings demonstrated a medium level of numeracy skills for the participants in the study, with a mean score of 55.4000 out of 100.

Table 3: Means, standard deviations and levels of numeracy skills

	Total Score	Mean	Std. Deviation	Low Level	Medium Level	High Level	Literacy Level
ND1: basic addition and subtraction facts with numbers 0–10	28	21.0312	6.73708	< 14	14- 21	> 21	High
ND2: place values and two-digit number awareness	13	7.3500	3.99715	< 6.5	6.5- 9.75	>9.75	Medium
ND3: adding and subtracting two-digit numbers	19	11.1375	5.92088	< 9.5	9.5- 14.25	> 14.25	Medium
ND4: basic word problems	14	4.7875	3.75076	< 7	7- 10.5	> 10.5	Low
ND5: patterns	4	1.9750	1.63796	< 2	2- 3	>3	Low
ND6: clocks	10	2.7625	2.48664	< 5	5- 7.5	>7.5	Low
ND7: geometry and measuring	7	3.2250	2.11669	< 3.5	3.5- 5.25	>5.25	Low
ND8: money	5	1.8688	1.84827	< 2.5	2.5- 3.75	>3.75	Low
Numeracy	100	55.4000	22.59570	< 50	50- 75	> 75	Medium
*** ND: Numeracy Domain**							

2. The relationship between L&N skills among students

To answer the second research question, which asks if there is a relationship between literacy and numeracy skills among study participants, we utilized a Pearson correlation analysis for the data representing the mean scores of the literacy test and mean scores of the numeracy test.

Table 4: Pearson correlation analysis of literacy and numeracy skills

		Literacy	Numeracy
Literacy	Pearson Correlation	1	.226*
	Sig. (2-tailed)		.044
	N	80	80
Numeracy	Pearson Correlation	.226*	1
	Sig. (2-tailed)	.044	
	N	80	80
*** Correlation is significant at the 0.05 level (2-tailed).**			

As shown in Table 4, a Pearson correlation determined that there was a weak, positive correlation between literacy and numeracy, which was statistically significant ($r = .226$, $n = 80$, $p = .044$).

3. Factors affecting literacy and numeracy skills

To address the study's third question, the means and standard deviations were calculated (Table 5) for each group based on gender (female and male), pre-school knowledge (attended kindergarten or not), and the education level of each parent (non-educated, prep school or less, high school, high diploma, bachelor's degree or post-graduate). In addition, a one-way ANOVA was utilized to examine whether there were statistically significant differences between the mean scores of the various groups for each of the literacy and numeracy skills related to the effect of gender, pre-school knowledge, or parents' educational level.

Table 5: Means and standard deviations based on gender, pre-school knowledge, and parents' education

Factor	groups	Literacy			Numeracy		
		N	mean	Std. Deviation	N	mean	Std. Deviation
Gender	Female	59	80.0678	13.33923	59	49.4322	21.68514
	Male	21	88.0952	11.72137	21	72.1667	15.89916
Pre-school knowledge	No	21	80.5476	14.81208	21	56.5000	23.66221
	Yes	59	82.7542	12.86715	59	55.0085	22.40006
Mothers' education	Non-Educated	2	51.0000	8.48528	2	35.5000	20.50610
	Prep School or Less	27	82.4444	12.21154	27	56.2037	24.04333
	High School	22	80.9091	14.00054	22	50.3409	19.91613
	High Diploma	9	84.7222	9.58225	9	62.1667	28.92879

	Bachelor's Degree or Post-Graduate	20	85.1750	12.66291	20	58.8250	20.31351
Fathers' education	Non-Educated	2	51.0000	8.48528	2	35.5000	20.50610
	Prep School or less	13	79.6923	14.96320	13	56.3462	17.03230
	High School	28	79.4643	13.26226	28	44.6964	21.31915
	High Diploma	12	86.6667	5.77350	12	60.0833	21.54576
	Bachelor's Degree or Post-Graduate	25	86.8400	11.50337	25	66.2400	22.21351
Total		80	82.1750	13.34359	80	55.4000	22.59570

3.1. Differences in literacy and numeracy related to the effect of gender

The one-way ANOVA revealed statistically significant differences in both literacy and numeracy skills related to gender. In particular, the one-way ANOVA demonstrated that the difference was statistically significant for literacy, with $F(1, 78) = 5.957$, $p = 0.017$, while for numeracy, it also showed a statistically significant difference, with $F(1, 78) = 19.313$, $p = 0.000$. Referring to Table 5, these results suggest that male students have better literacy and numeracy skills than female students.

3.2. Differences in literacy and numeracy related to the effect of pre-school knowledge

The one-way ANOVA revealed no statistically significant differences in either literacy or numeracy related to pre-school knowledge. In particular, no statistically significant difference for literacy was found by the one-way ANOVA, with $F(1, 78) = 0.420$, $p = 0.519$, while the case was the same for numeracy, with no statistically significant difference and $F(1, 78) = 0.067$, $p = 0.797$. Referring to Table 5, these results suggest that students who attended kindergarten and those who did not have similar literacy and numeracy skills.

3.3.1 Differences in literacy and numeracy related to the effect of mother's education

The one-way ANOVA revealed statistically significant differences in literacy related to the education of the participant's mother. In particular, the one-way ANOVA showed that while there was a statistically significant difference for literacy, with $F(4, 75) = 3.513$, $p = 0.011$, there was no such statistically significant difference for numeracy, with $F(4, 75) = 0.988$, $p = 0.419$. These results suggest that a mother's education has an effect on the literacy of a participant but does not necessarily affect their numeracy.

A *post hoc* test (Tukey HSD) was utilized to determine exactly where the means differed. This test revealed that participant literacy was statistically significantly

higher when the mother's education is at the level of prep school or less (82.4444 ± 12.21154 points, p = 0.009); high school (80.9091 ± 14.00054 points, p = .016); high diploma (84.7222 ± 9.58225 points, p = 0.008); and bachelor's degree or post-graduate (85.1750 ± 12.66291 point, p = 0.004), compared with students with non-educated mothers (51.0000 ± 8.48528 points).

3.3.2 Differences in literacy and numeracy related to the effect of father's education

The one-way ANOVA revealed statistically significant differences in both literacy and numeracy related to a participant's father's level of education. In particular, the one-way ANOVA revealed that in the case of literacy, there was a statistically significant difference, with $F(4, 75) = 5.117$, $p = 0.001$, while for numeracy there was also a statistically significant difference, with $F(4, 75) = 4.083$, $p = 0.005$. These results suggest that a father's education has an effect on the participant's literacy and numeracy.

A *post hoc* test (Tukey HSD) was utilized to determine exactly where the means differed. This test revealed that participants' literacy was statistically significantly higher when the father's education level was at prep school or less (79.6923 ± 14.96320 points, p = 0.021); high school (79.4643 ± 13.26226 points, p = .017); high diploma (86.6667 ± 5.77350 points, p = 0.001); and bachelor's degree or post-graduate (86.8400 ± 11.50337 points, p = 0.004) compared with students with non-educated fathers (51.0000 ± 8.48528 points). In the case of numeracy, the Tukey *post hoc* test showed that for students whose fathers had attained an education level of bachelor's degree or post-graduate, their numeracy skills were statistically significantly higher (66.2400 ± 22.21351 points, p = 0.003), compared with students whose fathers had a high school education (44.6964 ± 21.31915 points).

Discussion

Literacy and numeracy are vital life skills, and as we have seen in the literature review, researchers have argued that their acquisition affects the long-term improvement of students' learning and later success in their careers (Jordan, Hanich, & Uberti, 2003; National Early Literacy Panel [NELP], 2008; National Research Council [NRC], 2009). As a result, and as also observed in the literature, researchers are mainly interested in studying the impact of different factors affecting literacy and numeracy. Yet, no studies to date have examined the acquisition of literacy and numeracy skills in the Qatari context, taking into consideration an exploration of the relationship between these skills and various factors that may affect them. The innovation of this current study lies in its identification of specific skill levels in specific dimensions that reflect the acquisition of literacy and numeracy. In addition, the valid and reliable research instruments developed and utilized in this study have the unique capacity to assess students' skills in specific dimensions (five literacy dimensions and eight numeracy dimensions) based on the literature review. Our study contributes to this literature by using the existing analytical framework to construct practical measuring tools and processes.

In general, these findings revealed that the study participants showed high levels of literacy. This result was satisfactory, highlighting low need for future literacy improvement in the Qatari context. In particular, participants showed a high level of literacy in most dimensions, including oral language, phonological awareness, print awareness, and knowledge of letters. One exception is in writing development, where the study demonstrated a medium level of skill. The reason could be due to the fact that kindergarten and first-grade teachers in Qatari schools focus on pre-writing skills, including how to form letters and the actual mechanisms underlying writing, while giving little importance to composing skills. This result is line with that of Al-Maadadi and Ihmeideh (2016), who found that Qatari kindergarten teachers tend to neglect the composing domain in comparison to the other domains of pre-writing.

For numeracy skills, the findings of the study demonstrated a medium overall level of numeracy among the participants. Looking at the findings in more depth, we observe that participants attained a high level of only one numeracy skill: basic addition and subtraction facts with numbers 0–10. The results revealed a medium level of numeracy skills related to place values and two-digit number awareness, as well as adding and subtracting two-digit numbers. These are somewhat more advanced skills, so the results could be explained by teachers prioritizing the basic addition and subtraction facts with numbers 0–10. These results support the importance of the current research and offer a deeper explanation of previous results with which they are aligned. These previous results showed low levels of achievement on international mathematics tests such as TIMSS (2011, 2015), the National Center for Education Statistics (2012, 2016), and PISA (2012). Our research findings also demonstrated a low level of numeracy skills related to basic word problems, patterns, clocks, geometry, measuring, and money. With the exception of word problems, these results were unexpected. We suggest that one possible reason for this finding is that teachers often pay less attention to having students acquire these skills at an early age. Another reason for the low level of performance in the dimension of money may be the fact that in children's daily life experiences, there may be limited opportunities to practice money-related skills.

Our study also showed a weak, positive correlation between literacy and numeracy, which was statistically significant. Our result is consistent with other studies that have found a positive correlation between literacy and numeracy skills (Lee and Lawson, 2006; Purpura and Napoli, 2015).

One of our most interesting observations was the significant difference between male and female first-grade students in both literacy and numeracy, with male students demonstrating stronger skills. This result is consistent with other studies addressing the effect of gender on classroom performance (Murray and Harrison, 2011) and aligned with a study by Murray and Harrison (2011), which highlighted that schools and educational policy designers should take gender into account and suggested providing more specialized support for boys in early education.

Our findings revealed no statistically significant differences in either literacy or numeracy related to pre-school knowledge. This result was not expected and was not consistent with other studies (Burchinal et al., 2009), which have concluded that students exposed to numerical and linguistic exercises at an earlier stage performed considerably better.

However, the results of our study did align with Murray and Harrison (2011), which showed that children's pre-school experiences and the quality of the classroom environment were not significantly related to early literacy and numeracy outcomes. These results can be explained by Melhuish et al. (2013), who found that the consistent effects of high-quality preschools resulted in improved attainment of English and mathematics skills at Key Stage 2. They also argued that high-quality preschools have a positive effect on English and mathematics progress among students. Another explanation has also been addressed by Anders et al. (2013), who argued that the quality of the processes involved in preschool has a notable effect on children's numeracy development until age 7.

As previous studies have conveyed, the influence of parents' educational level and intervention is becoming more evident in student numeracy and literacy achievement (Coneus and Sprietsma, 2009; LeFevre et al, 2009; Manolitsis et al, 2009; Abuya et al. 2012; Abuya et al., 2015; Segers et al., 2016). The findings of the current study revealed statistically significant differences in children's literacy related to a mother's education. The Tukey *post hoc* test indicated that the literacy of the participants was statistically significantly higher if the mother's education level had reached prep school or less, high school, high diploma or bachelor's degree or post-graduate, compared with students with non-educated mothers. On the other hand, for numeracy, the study's findings revealed no statistically significant difference related to the mother's level of education. These results suggest that a mother's education has an effect on participant literacy but does not necessarily affect their numeracy.

Regarding a father's education, the results of the study revealed statistically significant differences in both literacy and numeracy related to the father's education level. The Tukey *post hoc* test demonstrated that the participants' literacy tended to be statistically significantly higher for students whose father's education level had reached prep school or less, high school, high diploma, or bachelor's degree or post-graduate, compared with students with non-educated fathers. Meanwhile, the Tukey *post hoc* test showed that participants' numeracy tended to be statistically significantly higher for students whose fathers held a bachelor's or post-graduate degree than it was for students whose fathers have a high school education.

The results of the current study differ to some extent from the work of Abuya et al. (2015), who found that although a mother's education has statistical significance, it is negatively correlated with both the literacy and numeracy skills of the student. On the other hand, our findings agree with Abuya et al. (2015) and Coneus and Sprietsma (2009), who found that the interaction of both the

mother's and father's education has a positive and significant effect on their children's literacy and numeracy achievements. We can conclude on a similar note to Abuya et al. (2015), who argued that as much as a mother's education is important in the children's literacy and numeracy, the importance of the father in children's literacy and numeracy should not be ignored. The non-significant role of a mother's education in the acquisition of children's literacy could be explained by the findings of Coneus and Sprietsma (2009), who highlighted different activity types and how much parents reported engaging in such activities with their children. We suggest another reason for the non-significant impact of a mother's education, similar to that of LeFevre et al. (2009), who found that the level at which parents reported home activities was related to a child's numeracy and literacy performance. Specifically, the home literacy and numeracy environment could contribute to our findings, as Segers et al. (2016) also concluded.

Conclusions

This study investigated literacy and numeracy levels demonstrated by students at the end of Grade 1. We identify several areas based on the existing literature in order to explore our findings and formulate relevant interventions if necessary. First, we observed a medium level in writing development, place values, and adding and subtracting two-digit numbers, and a low level of numeracy skills related to basic word problems, patterns, clocks, geometry, measuring, and money. More in-depth research would identify the reasons for this weakness and suggest quick intervention by educators to address it.

Another area for future research to examine is in regard to one of the most interesting findings in this study, which is that male students have significantly higher literacy and numeracy skills than female students. More research would explore the causes of these differences.

Another research avenue could explore some of our unexpected results. In contrast to some existing work, our findings revealed no statistically significant differences in either literacy or numeracy as related to pre-school knowledge. We recommend further in-depth study to explore how the early kindergarten curriculum, teachers' qualifications, and the quality of pre-school knowledge and activities contribute to how well children develop early skills in literacy and numeracy.

Lastly, this study has found statistically significant differences in children's literacy related to the mother's education level and statistically significant differences in both literacy and numeracy related to the father's education level. These results imply that it would be worthwhile for parents, teachers, and schools to investigate the positive role of parents in enhancing their children's literacy and numeracy. Indeed, we recommend future research to examine the impact of the parental role on children's acquisition of these skills, including home and environment activities that may impact on

children's skills in terms of literacy and numeracy, indirectly affecting their success both academically and in life.

Disclosure statement

The author reported no potential conflicts of interest.

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