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# A Study of Digital Media Literacy of the 5th and 6th Grade Primary Students in Beijing

Hui Zhang<sup>1</sup> · Chang Zhu<sup>1</sup>

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**Abstract** With the aim of examining the digital media literacy of primary school students, a perceived digital media literacy of primary student scale was developed. A cluster sampling was conducted, and 796 primary students in Beijing took part in this study. Results indicated that the instrument demonstrated good reliability and validity. The participants (the 5th and 6th grade primary students) reported rather a high level of critical understanding and technical skills. Regarding digital media literacy, although significant differences appeared within different grades and age groups, there was no significant difference between female and male students. Moreover, primary students' digital media literacy was significantly influenced by students' digital media experience and parental mediation. The implications regarding the findings of the digital media literacy of primary students were discussed.

**Keywords** Digital media literacy · Primary education · Internal variable · Parental mediation

## Introduction

As information and communication technology (ICT) spreads rapidly around the world, digital media and digital technology have influenced the way in which we live. New media have changed the way that knowledge is produced and shared, with the Internet and computers becoming the dominant tools for learning (Gialamas et al. 2013). Within

the context of an information and knowledge society, digital media literacy has been recognized as a key competence that people should possess today (European Commission 2007; Ferrari 2013). Therefore, researchers and teachers pay increasing attention to digital media and the integration of digital media literacy in the school curriculum (Alvarez et al. 2013; Hobbs 2004; Zhang et al. 2014). Zhang et al. (2014) examined teachers' attitudes towards the integration of digital media literacy using Stages of Concern Questionnaire in primary education. The results indicated that most teachers were at the stage of self-concern, which implied that teachers concerned with regard to their role in digital media literacy education. According to Vygotsky (1978), education should work at the zone of proximal development, which lies between the actual developmental level and the level of potential development. This should be done under adult guidance or in collaboration with more capable peers. In order to implement digital media literacy education effectively, understanding the students' digital media literacy level is considered as a prerequisite to education (Arke and Primack 2009; Buckingham 2009). It can provide educators with information about what and how they need to teach. However, the measurement of digital media literacy remains a critical challenge and there are insufficient empirical studies that measure primary students' digital media literacy (Arke and Primack 2009).

In addition, in order to integrate digital media literacy in teaching, it is necessary to identify factors related to student's digital media literacy. Kim et al. (2014) explored relationships between digital media literacy and student-level, and other influential variables, results found that students' ICT daily usage and male students have positive influence on primary students' digital media literacy. Furthermore, parental mediation may play an important role in

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✉ Chang Zhu  
chang.zhu@vub.ac.be

<sup>1</sup> Department of Educational Sciences, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

students' digital media literacy. For example, Valcke et al. (2010) found that primary students' Internet use is related to parental mediation.

According to the China Internet Network Information Center (2015), the majority of Internet users are from the younger generation aged between 10 and 39 years of age (78.1 %), with the age group of 10–19, in particular, accounting for 22.8 %. Within the information context, the importance of being digital media literate has been recognized by Chinese researchers and policy makers. Xu (2013) explored approaches to integrating digital media literacy into the primary school-based curriculum. However, assessing students' prior knowledge of and understanding the levels of using digital technology still acts as a big challenge for teachers when it comes to promoting digital media literacy education (Li and Ranieri 2010). A previous study investigated the digital media literacy of the secondary school students in China and indicated that the performance of secondary students was just "pass" rather than "good" or "excellent" (Li and Ranieri 2010). What is the level of digital media literacy of primary students? The aim of this study is not only to investigate the digital media literacy of primary students, but also to examine internal and external variables associated with primary students' digital media literacy.

## Theoretical Background

### The Definition of Digital Media Literacy

Many terms, such as new media literacy, ICT literacy, ICT competence, digital literacy, digital competence, have emerged over the last few decades in the theoretical reflections on the new media and technologies. These concepts are concerned with helping students develop a critical understanding of the digital media and technologies, the nature of various digital media and information, and of the use and the impact of these technologies (Buckingham 2009; Calvani et al. 2010).

Although these terms overlap and are often used equivalently in most contexts, each term builds on specific assumptions on the scope and relationships among new technologies. Digital media literacy as a more comprehensive concept has been adopted in the present study, using a definition that can be derived from the definition of media literacy. According to the Aspen Institute's Report on the National Leadership Conference on Media Literacy, a media literate person should be able to decode, evaluate, analyse and produce both print and digital media (Aufderheide and Firestone 1993). Livingstone (2004) defined media literacy as the ability to access, analyse, evaluate and create messages across a variety of contexts.

EVAI (2011) stated that media literacy included media use, critical understanding, communication and citizen participation. According to Buckingham (2003), media literacy emphasized both analysing media and creating media. Furthermore, Hobbs (2010) provided a comprehensive framework for media literacy which encompasses the full range of cognitive, emotional and social competencies that includes the use of texts, tools and technologies, the skills of critical thinking and analysis, the practice of message composition and creativity, the ability to engage in reflection and ethical thinking, as well as active participation through teamwork and collaboration. Ottestad et al. (2014) pointed out that the understanding of digital media literacy was impacted on by the ever-changing nature of ICT, in which it requires new competences and applications. Within the new technology context, the concept of media literacy is being extended from print, radio and television to new media such as the Internet and computers (Buckingham 2006; Livingstone 2003).

The definitions of ICT literacy, ICT competence, digital literacy and digital competence are also closely related to digital media literacy. According to ETS (2007), ICT literacy is using digital technology, communications tools and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society. Furthermore, Claro et al. (2012) defined ICT literacy as the capacity to solve problems associated with information, communication and knowledge in digital environments. Similarly, ICT competence refers to higher-order learning processing competences that integrate technical and application skills. These application skills include the basic use of software, the ability to be creative and innovative, solving problems and thinking critically with the Internet and computers (Aesaert et al. 2015a). According to Twining (2013), digital literacy is the ability to operate effectively as a citizen in the twenty first Century, including having an understanding of the nature of digital technology and the impact of digital identities, being able to interact safely in the digital world, being able to locate, organize, understand, evaluate, analyse and (re)present information using digital technology. Ferrari (2013) states that digital competence can be summarized as the ability to cope with information, communication, content creation, safety and problem solving. According to Hatlevik and Christophersen (2013), digital competence refers to students' ability to use technology, and to make use of technology to process, acquire, evaluate information, produce and communicate information with digital technology and media (See Table 1).

As indicated above, although these terms have slight differences in their scope or focal areas, the meanings of the terms actually overlap. They are all related to not only simple technical ICT skills, but also various cognitive and

**Table 1** Brief summary of the framework of digital media literacy

Researchers	Dimensions
Aufderheide and Firestone (1993)	Decode, analyse, evaluate, produce
Livingstone (2004)	Access, analyse, evaluate, create
Buckingham (2007)	Access, analyse, create, communicate
ETS (2007)	Access, manage, integrate, evaluate, communicate
Hobbs (2010)	Use technology, critical thinking, message creation, ethic thinking, active participation
EVAI (2011)	Use, critical understanding, communicate, citizen participation
Claro et al. (2012)	ICT skills, higher-order thinking, problem solving
Ng (2012)	Technical skills, evaluate, think, create, communicate
Hatlevik and Christophersen (2013)	Use technology, make use of technology to process, acquire, evaluate information, produce and communicate information.
Twing (2013)	Locate, organize, understand, evaluate, analyse, interact
Aesaert et al. (2015b)	Technical application, higher-order learning

problem solving abilities. Previous studies indicated that there have been two main reflections and shifts on our understanding of digital media literacy. On the one hand, digital media literacy goes beyond basic technical skills to high-order learning processing (such as communicating and evaluating information in a digital context) (Janssen et al. 2013; Ng 2012). On the other hand, researchers' attention has shifted from digital tools to the information gathered through digital media (Buckingham 2007).

In this study, digital media literacy is considered to be a set of competences or skills from an operational perspective. The conceptual framework of digital media literacy was developed by integrating the above-mentioned dimensions. Four hierarchical components are included, namely technical skills, critical understanding, creation and communication and citizenship participation. Technical skills refer to the basic ability to use digital media or technology, such as in the case of word processing. In order to explore problems and new technological contexts in an appropriate way, technical skills should be taught to students as a prerequisite for the other three aspects (Li and Ranieri 2010), with a specific aim to let students have access to different sorts of digital technology and media and to improve their ability to use them. Critical understanding refers to the use of a critical approach to analyse and judge digital media regarding both quality and accuracy of content, such as dealing with advertisements intelligently on various digital media (Koltay 2011). Being able to analyse and evaluate digital content requires more than simple skills. Consequently, higher-order cognitive processes are necessary, and critical thinking is an essential part of these processes (Claro et al. 2012). Digital media literacy involves "reading" and "writing" in a digital context. Creation and communication refers to produce

digital media texts, and even being able to interact with others through the media (Buckingham 2007). Media literacy education has been identified as a critical approach to citizenship over the past few decades (Hobbs 1998; Prewett and Stein 2009). In the digital environment, it is not sufficient to be a smart consumer. It is also important for one to be a sophisticated citizen (Lewis and Jhally 1998). Citizenship participation under the concept of digital media literacy means that individuals can use new media and technologies to promote social participation, and access a diversity of opinions on digital media (Park 2012). Digital citizenship emphasizes the individual's rights and responsibilities in terms of communicating through the Internet and in real life (Hobbs and Jensen 2009). With regard to each dimension, the development of students' technical skills is the first step towards the development of an advanced stage such as understanding and analysis, creation and communication and citizenship participation (Ala-mutka 2011; Kong 2008).

### Factors Influencing Students' Digital Media Literacy

Previous studies show that students' digital media literacy varies according to internal and external variables. For example, students' digital media literacy influenced by age, gender and students' digital media literacy experience at student level (Claro et al. 2012; Kim et al. 2014), by ICT infrastructure, educational use of ICT use, the completion status of computer courses and school location at school level (Aesaert et al. 2015b; Kim et al. 2014; Liao and Chang 2010), by parental ICT attitude, parental education background, socioeconomic status at family level (Aesaert et al. 2015b; Australian Council for Educational 2011; Claro et al.

2012). Parental mediation is considered as an important factor (Linder and Werner 2012; Nikken and Jansz 2014). At the current stage, digital media literacy education has not yet been included in the Chinese national school curriculum, but is only implemented as an experimental or pilot course in some pilot schools. Therefore, the present study mainly focuses on the relationship between students' digital media literacy and student and family variables.

#### *Gender*

ICT-related activities or attitudes are often studied with a focus on gender issues, although the findings are not always consistent. A significant body of research indicates that ICT-related activities can be viewed as a "male domain" (Meelissen and Drent 2008). For instance, male students show more confidence and less anxiety than female students (Vekiri and Chronaki 2008), and male students use computers more frequently than female students (Li and Kirkup 2007). In contrast, many other studies have reported that female students have a significantly higher digital media literacy than male students (Chang and Liu 2011; Aesaert and van Braak 2015). Female students express more positive perceptions with regard to digital media application skills, learning with media and attitudes towards digital media. Furthermore, some researchers argue that negligible differences are to be found between female and male students (Volman et al. 2005).

#### *Age*

The findings of various studies suggest that it is difficult to isolate age as the major contributing factor that influences ICT-related activities. Chang and Liu (2011) stated that students from different primary grade levels acquired almost the same levels of knowledge and skills and had similar attitudes and perceptions towards media literacy. Li and Ranieri (2010) investigated the digital media literacy of the Chinese secondary school students, and the results showed that age had a significant influence on technical and cognitive aspects. Appel (2012) reported that higher grade students possessed better theoretical and practical computer knowledge than younger students.

#### *Students' Digital Media Experience*

Students' digital media experience refers to the frequency of student usage and experience of digital technology, such as the Internet, tablets, desktops, mobile devices, not only in the context of school, but also at home. Primary students' ICT experience at home was considered as an influential factor with regard to ICT literacy (Aesaert et al. 2015a; Kim et al. 2014). Hakkarainen et al. (2000) found intensive use of ICT at home could improve students' ICT skills.

#### *Parental Mediation*

Parental mediation includes providing guidance about developmental adequacy, assessment of time, concern about content and defining usage rules (Álvarez et al. 2013; Barkin et al. 2006). Previous studies stated that restrictive parental mediation was significantly associated with reduced online risks and reduced time spent online (Lee 2012). Young people largely draw on their media experience outside school (Erstad and Gilje 2008), while parental styles are related to the strategies employed to mediate children's Internet use (Valcke et al. 2010). Recent studies have pointed out that parental mediation plays a significant role in influencing children's digital media education (Nikken and Jansz 2014).

#### *Parental Educational Background*

In addition, parental educational background has an impact on children's Internet use at home. A significant positive relationship was found between the educational level of the mother and students' technical ICT skills and higher-order ICT competence (Aesaert and van Braak 2015). Similarly, the Australian Council for Educational (2011) reported that children with parents who had a Bachelor or higher degree obtained scores higher than those whose parents who had lower educational attainment.

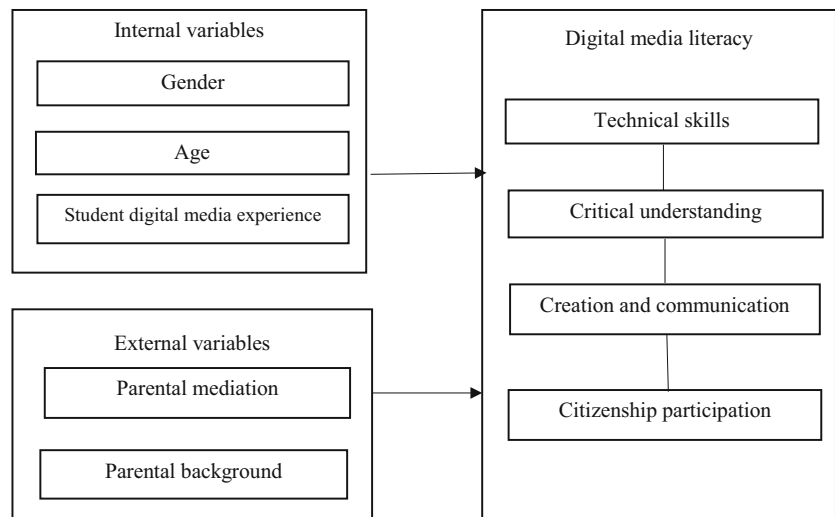
#### **Integrating the Theoretical and Empirical Bases**

Based on previous studies, technical skills, critical understanding, creation and communication and citizenship participation are essential parts of the measurement of digital media literacy (EVAI 2011; Hobbs 2010; Ng 2012). It is also important to take internal and external influential factors such as gender, age, students' digital media experience, parental mediation and parental education background into account. The conceptual model of this research is presented in Fig. 1. It integrates gender, age, students' digital media experience, parental mediation and parental education background and digital media literacy into one research model. This conceptual model is also the base for guiding the research questions of the present study.

#### **Objectives of the Study**

The main objective of this study is to examine the digital media literacy of the 5th–6th grade primary students. Previous studies have stated that digital media literacy was influenced by the digital and technology environment (Livingstone 2003; Ottestad et al. 2014). However, there is

**Fig. 1** Integrated model of the impact of external and internal variables on digital media literacy



a big disparity in the Chinese digital environment between urban and rural areas. In order to ensure that the students have adequate access to digital media and technology, the present study was conducted in Beijing.

Firstly, a measurement tool related to the digital media literacy of primary students is developed and tested. Secondly, the digital media literacy of the 5th–6th grade primary student is measured. Thirdly, the factors associated with the digital media literacy of primary students are examined. Specifically, this study addresses the following research questions:

- RQ1: What is the validity and reliability of the digital media literacy scale?
- RQ2: What is the relationship between each dimension of digital media literacy (technical skills, critical understanding, creation and communication, and citizenship participation)?
- RQ3: What are the levels of digital media literacy (regarding technical skills, critical understanding, creation and communication and citizenship participation) of the 5th–6th grade primary students?
- RQ4: To what extent are student-level factors (gender, age, and basic use of digital technologies) and family-level factors (parental education background and parental mediation) related to primary students' digital media literacy?

**Method**

**Sample**

Cluster sampling was used in this study. This includes different levels of economic development in terms of the districts in Beijing. 900 paper-based questionnaires were

distributed, and a total of 816 questionnaires were collected, representing a 90.67 % return rate. After initial screening, 796 questionnaires from 9 to 13-year-old students were accepted as valid responses. Among the participants, 58.3 % were from the 5th grade, and 41.7 % were from the 6th grade. Among them, 52.1 % ( $n = 414$ ) students were male and 47.7 % ( $n = 380$ ) were female (See Table 2).

**Instruments**

The questionnaire survey was adopted for use with the 5th and 6th grade primary students. The questionnaire includes 42 items, divided into 4 sections (See “Appendix” section). Participants were invited to rate their agreement with each item on a 5-point Likert scale (except in the case of demographical information), ranging from 1-“Strongly disagree” to 5-“Strongly agree”. The first section aims to gather information on students’ demographics such as gender and age. The second section includes 8 items, focusing on students’ digital media experience, such as usage of the Internet, computers and mobile devices. The third section is designed to examine the parental mediation of students’ usage and understanding of digital technology

**Table 2** The nature and composition of participants

Item	Options	Number (%)
Gender	Male	414 (52.1)
	Female	380 (47.7)
Grade	5th	464 (58.3)
	6th	380 (41.7)
Age	9–10	360 (45.3)
	11	309 (39.0)
	12–13	125 (15.7)

Note Two missing data on demographics information



and media. The fourth section is a digital media literacy scale. Based on a thorough literature review, digital media literacy is narrowed down to four dimensions: technical skills, critical understanding, creation and communication, and citizenship participation. Then, a list of initial items relating to digital media literacy was established to represent each dimension of digital media literacy. To ensure that the items covered all related dimensions and that the wording was appropriate, the content validity was examined. Four experts (2 experts on digital media literacy education and 2 primary school teachers) reviewed the scale and deleted items that were unclear or repeated. Then, convenience sampling was used for a pilot test involving 76 primary students. Regarding the internal consistency, the Cronbach's alpha coefficient was calculated with an acceptable result (0.70). The revised scale consisted of 23 items under 4 constructs.

### Data Analysis

First, in order to test the instrument's validity, the data were divided into equal halves. One half of the data was used for exploratory factor analysis (EFA) with varimax rotation. The other half of the data was used for confirmatory factor analysis (CFA). Second, the reliability of the instrument was examined. Furthermore, descriptive statistics were used to examine the students' performance in terms of the four sub-scales of digital media literacy. In addition, *t* test and analysis of variance (ANOVA) were conducted to explore differences in digital media literacy with regard to students' background variables (gender, grade, age). To examine factors associated with the primary students' digital media literacy, multiple regression analyses were conducted.

## Results

### Validity and Reliability of the Digital Media Literacy Scale

In order to test the underlying structure of the digital media literacy measurement (23 items), a principal component analysis, based on a varimax rotation, was performed on the first half of the data ( $N = 398$ ). Before EFA, the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity were conducted to measure the sampling adequacy and the factorability of the data. The results revealed a significant test statistic for Bartlett's test of sphericity ( $p < .001$ ) and a KMO value of .884, meaning that the data were suitable for structural detection. Based on the EFA, the four factors with eigenvalues larger than 1.0 were retained (Kaiser, 1958) and accounted for 53.61 % of the

total variance. Factor loadings for each factor were larger than 0.4, which indicates practical significance (Field 2009). Table 3 summarizes the result of EFA in terms of the digital media literacy scales.

In order to verify whether or not the factor constructs fitted our sample, confirmatory factor analyses (CFA) were performed in AMOS 21, using the second half of the data ( $N = 398$ ). The factor structure of the four subscales for digital media literacy scale was tested with regard to technical skills (TS), critical understanding (CU), creation and communication (CC) and citizenship participation (CP). On the basis of the modification indices (MI), correlated error item changes were conducted. The modified model improved the model fit to an adequate level ( $X^2/df = 2.212$ , the Comparative fit index [CFI] = .927, Goodness-of-fit index [GFI] = .907, the Tucker–Lewis Index [TLI] = .912, Root mean square error of approximation [RMSEA] = .055) (Byrne 2001). Figure 2 presents the factor structural model of the digital media literacy scales.

The reliability of each scale was analysed by the internal consistency estimates of Cronbach's alpha. The Cronbach's alpha scores for all scales were satisfactory and greater than 0.7 (Field 2009) (Table 3).

### Descriptive Results and Group Differences Regarding the Digital Media Literacy of Primary Students

The means and standard deviations of each digital media literacy scale by sample groups are reported in Table 4. The results show that for the primary students in this study, their *critical understanding* scored highest (Mean = 4.07, SD = .85), followed by the dimension of *technical skills* (Mean = 3.58, SD = 1.11), the dimension of *citizen participation* (Mean = 3.02, SD = 1.21) and the dimension of *creation and communication* (Mean = 2.62, SD = 1.05).

In order to test for group differences by gender and grade, *t* tests were conducted. The results showed that there were no significant differences between female and male students for all dimensions of digital media literacy ( $t_{TS} = -1.688$ ,  $t_{CU} = -.415$ ,  $t_{CC} = -.846$ ,  $t_{CP} = .680$ ,  $p > .05$ ). The effect sizes for all dimensions ranged from 0.05 to 0.12 ( $d_{TS} = .12$ ,  $d_{CU} = .03$ ,  $d_{CC} = .06$ ,  $d_{CP} = .05$ ). Between different grades, significant differences were found in the dimensions of *technical skills* and *critical understanding* (See Fig. 3). The mean scores of the 6th grade students ( $M_{TS} = 3.726$ ,  $M_{CU} = 4.196$ ) were significantly higher than those of the 5th grade students ( $M_{TS} = 3.481$ ,  $M_{CU} = 3.982$ ),  $t_{TS} = -3.140$ ,  $t_{CU} = -3.618$ ,  $p < .05$ ). The effect sizes were calculated and ranged from 0.04 to 0.22 ( $d_{TS} = .18$ ,  $d_{CU} = .22$ ,  $d_{CC} = .06$ ,  $d_{CP} = .04$ ).

**Table 3** Results of the EFA of digital media literacy scales

Item	Rotated factor loadings				Eigenvalue	Cumulative variance explained	Cronbach's alpha
	TS	CU	CC	CP			
Technical skills					2.138	53.610 %	.833
TS4	.795						
TS3	.784						
TS5	.712						
TS2	.686						
TS1	.539						
TS6	.418						
Critical understanding					7.418		.855
CU4		.753					
CU10		.739					
CU3		.683					
CU2		.656					
CU5		.641					
CU8		.638					
CU6		.626					
CU7		.601					
CU1		.536					
CU9		.456					
Creation and communication					1.609		.716
CC3	1.609		.819				
CC2			.769				
CC1			.565				
CC4			.482				
Citizenship participation					1.165		.708
CP2				.695			
CP1				.691			
CP3				.672			

TS technical skills, CU critical understanding, CC Creation and communication, CP citizenship participation

An analysis of variance was conducted to compare the digital media literacy in different age groups. The results showed that significant differences were found with regard to *technical skills* and *critical understanding* among different age groups ( $F_{TS} = 6.464$ ,  $F_{CU} = 4.758$ ,  $p < .05$ ). Figure 4 presents the mean scores of primary students among the three age groups. Post-hoc tests showed that 9–10-year-old students scored significantly lower than 11-year-old and 12–13-year-old students in the scales relating to *technical skills* and *critical understanding* ( $p < .05$ ).

**Relationship Between Each Dimension of Digital Media Literacy Scales**

Analyses of bivariate correlations between each dimension of digital media literacy were computed. Table 5 gives an overview of the correlation analyses between each

dimension of digital media literacy. The results show that all dimensions of digital media literacy are significantly positively related to each other ( $p < .01$ ). Furthermore, the strongest correlation was found between students' *technical skills* and *critical understanding* ( $r = .580$ ).

**The Influence of Student and Family Variables on Digital Media Literacy of Primary Students**

In order to investigate the influence of student level and family variables on the digital media literacy of primary students, four regression models were examined in the following order: Model 1 (age), Model 2 (Model 1 + students' digital media experience), Model 3 (Model 2 + parents' educational background), and Model 4 (Model 3 + parental mediation). As there was no significant difference between female and male student with regard to digital media literacy, gender was not included in



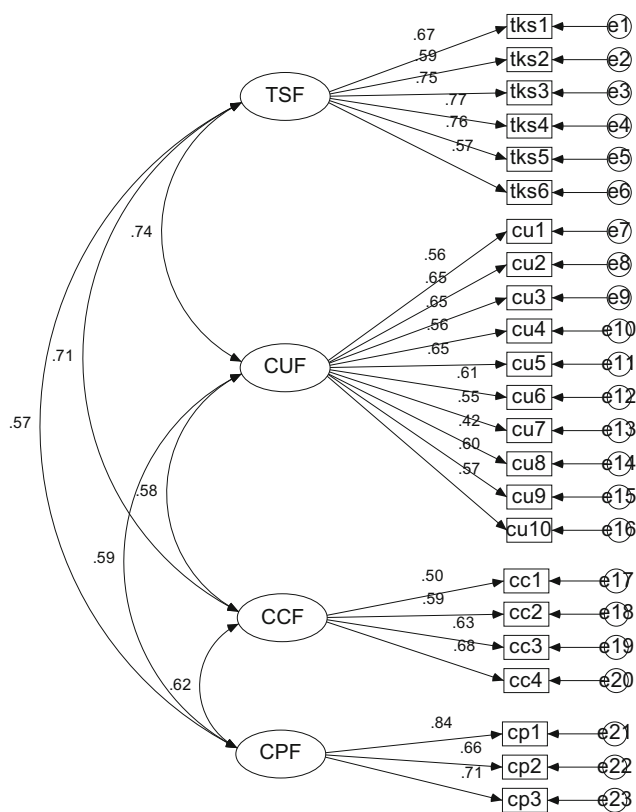


Fig. 2 A four-factor model of digital media literacy

multiple regression analysis. Table 6 summarizes the regression analysis results with regard to predicting digital media literacy in terms of student level and family level variables.

The regression analyses results show that the contribution of Model 1 to students' digital media literacy is .013 (Adjusted  $R^2$ ), the contribution of Model 2 is .127, the contribution of Model 3 is .116 and the contribution of Model 4 is .269 (see Table 5). In Model 4, the students' digital media experience and parental mediation are found as being significant predictors of digital media literacy ( $\beta_{SE} = .305^{***}$ ,  $\beta_{PM} = .383^{***}$ ). With regard to the dimension of *technical skills*, the contribution of Model 1 is .015, that of Model 2 is .091, that of Model 3 is .076 and the contribution of Model 4 is .165. In Model 4, age, students' digital media experience and parental mediation are identified as significant predictors of technical skills ( $\beta_{age} = .071^*$ ,  $\beta_{SE} = .248^{**}$ ,  $\beta_{PM} = .302^{***}$ ). With regard to the dimension of *critical understanding*, the contribution of Model 1 is .010, the contribution of Model 2 is .050, the contribution of Model 3 is .056 and the contribution of Model 4 is .192. In Model 4, age, students' digital media experience, mother's education and parental mediation are considered as significant predictors of *critical understanding* ( $\beta_{age} = .093^{**}$ ,  $\beta_{SE} = .170^{***}$ ,

$\beta_{ME} = .127^{**}$ ,  $\beta_{PM} = .371^{***}$ ). Regarding the dimension of *creation and communication*, the contribution of Model 1 is .003, the contribution of Model 2 is .171, the contribution of Model 3 is .164 and the contribution of Model 4 is .207. In Model 4, students' digital media experience and parental mediation are considered as significant predictors of *creation and communication* ( $\beta_{SE} = .395^{***}$ ,  $\beta_{PM} = .210^{**}$ ). With regard to the dimension of *citizenship participation*, the contribution of Model 1 is .001, the contribution of Model 2 is .061, the contribution of Model 3 is .056 and the contribution of Model 4 is .122. In Model 4, students' digital media experience and parental mediation are considered as significant predictors of *citizenship participation* ( $\beta_{SE} = .226^{***}$ ,  $\beta_{PM} = .260^{**}$ ).

In terms of student variables, age was identified as a significant predictor of technical skills and critical understanding. Students' digital media experience not only has a positive influence on digital media literacy, but also on each aspect of digital media literacy. At the family level, the parents' education level was identified as a significant predictor of critical understanding, and the mother's education level had a positive influence on critical understanding. The results indicate that parental mediation have a significant influence, not only on each dimension of digital media literacy, but also on the whole scale of digital media literacy. The results show that students' digital media experience and parental mediation have the strongest influence on the digital media literacy of primary students (Fig. 5).

## Discussion

### Assessing the Digital Media Literacy of Primary Students

The findings of this research provide an integrated model that not only includes the theoretical structure of digital media literacy, but also the factors related to digital media literacy. In addition, the results reveal that the instrument used for measuring the digital media literacy of primary students has adequate validity and reliability. A previous study showed that the issue of assessing digital media literacy remained a critical challenge for understanding digital media literacy (Arke and Primack 2009). This study has made important theoretical and empirical contributions to the understanding and measurement of digital media literacy. On the one hand, a conceptual model of influencing factors on digital media literacy was built based on the literature. On the other hand, the developed instrument was tested and found to be reliable and valid.

According to Vygotsky (1978), the interaction between teacher and student is central to the learning process, and

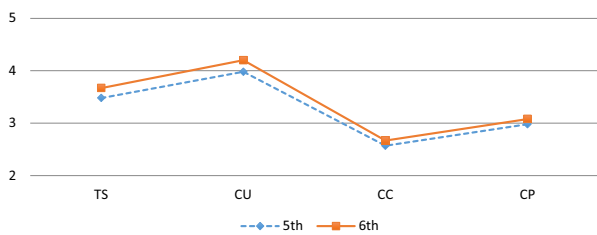
**Table 4** Descriptive statistics for four dimensions of digital media literacy

Scale	Total sample		Sample by gender				Sample by grade			
	M	SD	Female (N = 380)		Male (N = 414)		5th (N = 464)		6th (N = 332)	
			M	SD	M	SD	M	SD	M	SD
TS	3.583	1.117	3.657	1.096	3.523	1.132	3.481	1.173	3.726	1.019
CU	4.072	0.851	4.087	.849	4.062	.851	3.982	.899	4.196	.762
CC	2.616	1.049	2.650	1.069	2.587	1.030	2.574	1.080	2.674	1.003
CP	3.021	1.214	2.992	1.180	3.052	1.246	2.982	1.225	3.076	1.198

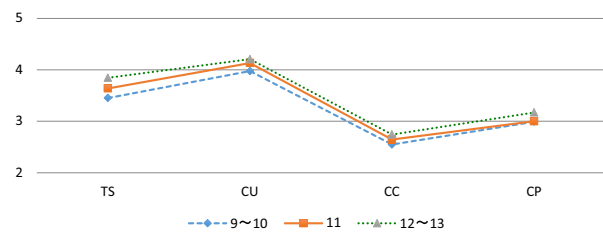
  

Scale	Sample by age group					
	9–10 (N = 360)		11 (N = 309)		12–13 (N = 125)	
	M	SD	M	SD	M	SD
TS	3.451	1.181	3.638	1.054	3.845	1.008
CU	3.974	.885	4.132	.827	4.206	.783
CC	2.547	1.075	2.645	1.039	2.743	.984
CP	2.991	1.227	3.000	1.176	3.171	1.272

TS technical skills, CU critical understanding, CC Creation and communication, CP citizenship participation



**Fig. 3** Digital media literacy of primary students of the 5th and 6th grades. TS technical skills, CU critical understanding, CC creation and communication, CP citizenship participation



**Fig. 4** Digital media literacy of different age group. TS technical skills, CU critical understanding, CC creation and communication, CP citizenship participation

that teachers should be working in “the zone of proximal development”. In order to integrate digital media literacy into education effectively, it is necessary to understand students’ prior levels and factors related to digital media literacy (Li and Ranieri 2010; Martens 2009). The present study found that primary students reported lowest in terms of communication and creation. The results indicated that teachers should provide more guidance for primary students on how to create digital media and communicate with others in an appropriated way. In addition, students’ digital media literacy experience and parental mediation were identified as significant influencing variables on students’ digital media literacy. The results indicate that in order to improve students’ digital media literacy, cooperation between school and home is necessary.

### Digital Media Literacy of Primary Students

In the present study, we found that the 5th and 6th grade primary students had a rather high level of reported critical

understanding and technical skills. The results showed that there were no significant gender differences in terms of digital media literacy. This finding challenges previous studies. Chang and Liu (2011) found that female students in Taiwanese primary schools were more competent than male students regarding digital media literacy. More specifically, female students reported higher on media application skills, attitude towards media and learning with media. Other studies regarding gender differences with regard to ICT-related literacy or skills showed different results. In the present study, gender was not a significant influencing factor when it comes to digital media literacy. Therefore, the gender issue should be reconsidered in future research. With regard to the digital media literacy associated with different ages and grades, the 6th grade students reported higher than the 5th grade in terms of their technical skills and critical understanding. This finding supports previous studies. For example, Appel (2012) found that higher grade students presented better computer knowledge than younger students did.

**Table 5** Correlations between each dimension of digital media literacy

	TS	CU	CC	CP
TS		.580**	.485**	.479**
CU			.404**	.476**
CC				.474**

TS technical skills, CU critical understanding, CC Creation and communication, CP citizenship participation

\*\*  $p < .01$

**The Effect of Parental Mediation and Other Influencing Variables on the Digital Media Literacy of Primary Students**

In the present study, parental mediation and students' digital media experience were found to be significant influencing factors for each dimension of digital media literacy. The results are consistent with previous studies (Aesaert et al. 2015a; Claro et al. 2012). For example, Claro et al. (2012) found that frequency of ICT use at home on the part of students had a positive relationship on ICT literacy. The results of the present study indicate that critical understanding and analysis can be influenced by age, students' digital media experience, parents' educational background and parental mediation. Previous

research also identified age as a variable affecting the cognitive aspect of digital competence on the part of students, which consisted of interpreting and evaluating the reliability and relevance of information (Li and Ranieri 2010). Moreover, creation and communication and citizenship participation could be affected by students' digital media experience and parental mediation. The results of the present research indicate that students' digital media experience is considered as a predictor of communication and of citizenship participation. This adds new insights into the understanding of this issue, which indicates that the higher the level of digital media use, the more positively it is related to student communication and citizen participation using digital media.

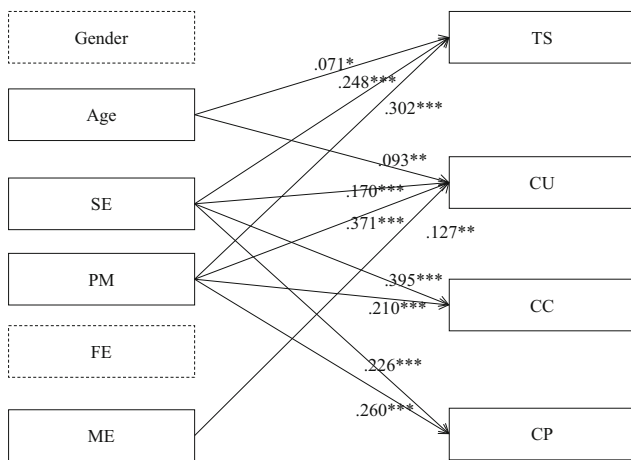
The results regarding the influence of parental mediation on students' creation and communication and citizenship participation, were consistent with the findings of previous studies. For example, Sasson and Mesch (2014) found that children who made frequent use of platforms to facilitate communication with strangers, were the children of parents exercising little control. The findings of the present study support that parental mediation plays a significant role in children's digital media literacy education. Therefore, further attention and research on the role of parental mediation (e.g. active mediation or restrictive mediation) (Nikken and Jansz 2014) will be

**Table 6** Multiple regression analysis on digital media literacy

	DML				TS				CU			
	M1 $\beta$	M2 $\beta$	M3 $\beta$	M4 $\beta$	M1 $\beta$	M2 $\beta$	M3 $\beta$	M4 $\beta$	M1 $\beta$	M2 $\beta$	M3 $\beta$	M4 $\beta$
Age	.120	.069*	.058	.064*	.127***	.085*	.067	.071*	.107**	.076*	.088*	.093**
SE		.342***	.332***	.305***		.281***	.270***	.248***		.206***	.197***	.170***
FE			.014	-.028			.032	-.001			.016	-.025
ME			.062	.078			.008	.005			.112*	.127**
PM				.382***				.302***				.371***
$R^2_{adjusted}$	.013	.127	.116	.260	.015	.091	.076	.165	.010	.050	.056	.192
F	11.482***	58.484***	25.485***	53.298***	12.927***	40.616***	16.301***	30.506***	9.103**	22.074***	12.111***	36.406***
	CC				CP							
	M1 $\beta$	M2 $\beta$	M3 $\beta$	M4 $\beta$	M1 $\beta$	M2 $\beta$	M3 $\beta$	M4 $\beta$				
Age	.068	.006	-.031	-.027	.043	.006	.003	.007				
SE		.415***	.410***	.395***		.250***	.244***	.226***				
FE			-.055	-.078			.040	.011				
ME			.043	.051			.017	.028				
PM				.210***				.260***				
$R^2_{adjusted}$	.003	.171	.164	.207	.001	.061	.056	.122				
F	3.631	82.913***	37.596***	39.918***	1.476	26.696***	12.110***	21.715***				

DML digital media literacy, TS technical skills, CU critical understanding, CC creation and communication, CP citizenship participation, SE Students' digital media experience, FE father education level, ME mother education level, PM parental mediation, M1 Model 1, M2 Model 2, M3 Model 3, M4 Model 4

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$



**Fig. 5** Regression result of internal and external variables' impact on digital media literacy. *TS* technical skills, *CU* critical understanding, *CC* creation and communication, *CP* citizenship participation, *BU* students' digital media experience, *FE* father education level, *ME* mother education level, *PM* parental mediation. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

beneficial to understand better the development of children's digital media literacy.

**Limitations and Implications**

It should be noted that this study has a number of limitations. Firstly, it is a quantitative study that is mainly based on self-reporting in terms of digital media literacy. The self-reporting approach as an indirect measure is not always accurate with regard to representing the actual performance level of students (Merritt et al. 2005). Future studies could build on multiple methods, such as performance-based methods to assess digital media literacy. Secondly, the data on which this study was based was collected in Beijing. The sample can only be presentative of primary students in Beijing and, since the sample size was relatively limited, the statistical results cannot be generalized to the entire body of primary students in China. Thirdly, although the reliability and validity of the instrument developed for this study was confirmed, further testing with other samples such as students in other grades would be useful to further verify the validity of the instrument. Furthermore, parental mediation as one of the most effective factors influencing digital media literacy was measured by student-reported "parental mediation". In order to further understand the impact of parental mediation on digital media literacy, future research could extend the measurement of this factor and elaborate on the relationship between this factor and students' digital media

literacy. To understand variables associated with students' digital media literacy comprehensively, other variables such as digital environment and educational system should be analysed in the future.

Regardless of these limitations, this research makes important contributions to enriching our understanding of, and research into, digital media literacy. Firstly, this study provides a comprehensive conceptual structure which could contribute to our understanding of digital media literacy. Secondly, on the basis of the conceptual framework, a new instrument has been developed. As a self-perceived assessment, the instrument can be adopted in future studies in order to measure the digital media literacy of primary students within large samples. The current study also provides a deeper understanding of the digital media literacy of primary students, which would contribute to the integration of digital media literacy in school-based initiatives, such as the design of the curriculum and instructional material that promotes digital media literacy. Moreover, the present study examined the relationship between each dimension of digital media literacy and student level and family level variables, given that an understanding the characteristics of students in terms of digital media literacy is considered as the premise for the successful integration of digital media literacy education (Lau and Yuen 2014).

In conclusion, the present study contributed to the research on digital media literacy as it validated an instrument that can be used to assess students' four specific dimensions of digital media literacy, and identified critical internal and external variables that affect the digital media literacy of primary students. Li and Ranieri (2010) states that improving digital media education in the Chinese K-12 curriculum is urgently needed. The results of this study provide empirical findings regarding the characteristics of the digital media literacy of the 5th and 6th grade students in Beijing. Regarding the four dimensions of digital media literacy, students reported higher in technical skills and in critical understanding than in creation and communication, and in citizenship participation. The findings of the study indicate that, in order to balance students' development of digital media literacy in China, students should be provided with more opportunities and support to communicate with each other and with society, and to develop their creative skills in the digital context.

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## Appendix

### Digital Media Literacy

#### Technical skills

- Item 1 I am able to send or receive e-mails
- Item 2 I am able to shop online
- Item 3 I am able to watch or download TV, movies or films
- Item 4 I am able to listen to, or download music
- Item 5 I am able to read or download online news/newspapers/news magazines
- Item 6 I am able to search for information or materials related to my homework

#### Critical understanding

- Item 7 I am able to detect differences in the information I receive from different search engines
- Item 8 I am able to judge the reliability of the information and news on television and radio
- Item 9 I am able to judge the reliability of the information and news on the Internet
- Item 11 I am able to protect my computer from being infecting by viruses (such as, installing a virus scan program)
- Item 12 I know how to prevent receiving obscene or otherwise unwanted e-mails (such as installing filters or blocking senders)
- Item 13 I am able to protect my personal information online (such as by not telling strangers my phone number)
- Item 14 I know what advertisements are about
- Item 15 I know when and where advertisements can be placed
- Item 16 I know how to identify the type of content that can be shown (such as, violent content or sexually explicit content)

#### Creation and communication

- Item 17 I am able to create a simple flash file
- Item 18 I am able to upload text, photos, flash file or music
- Item 19 I am able to write a blog or manage a QQ space
- Item 20 I am able to communicate with my family, friends, or classmates

#### Citizenship participation

- Item 21 I am able to post my opinions or texts about social news to websites
- Item 22 I am able to participate in discussion about civic or political issued online
- Item 23 I am able to pay attention to the social focus on television or on any other kinds of media

### Students' Digital Media Experience

- Item 1 I watch television
- Item 2 I go to the cinema
- Item 3 I listen to radio broadcasts
- Item 4 I play computer games
- Item 5 I use a mobile phone
- Item 6 I use a computer
- Item 7 I use my mobile phone to access the Internet
- Item 8 I use other devices (such as an iPad) to access the Internet

### Parental Mediation

- Item 1 My parents set rules about the time spent online or on other digital media
- Item 2 My parents discuss with me when I encounter difficulty online or with other digital media
- Item 3 My parents help when I use the Internet or other digital media
- Item 4 My parents talk to me about what we watch on the Internet, television or other digital media

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