

# The Learning Preferences of Digital Learners in K-12 Schools in China

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Students grown up with digital technology and Internet are called digital natives or net generation. All others, who grew up without so much immersion with digital technologies are called digital immigrants. Researchers held different ideas on whether a new generation of learners existed. One of the foci of the debate is on the appropriateness of using age as the criteria to divide “digital native” and “digital immigrants”. In order to reconcile the debate, the term “digital learner” was used in this paper, with the hypothesis that the time length for using technology could be used as the criteria for dividing digital learners. It is also noticed that there were few studies focused on the learning preferences of today’s learners in Chinese context. In order to understand learners’ learning preference and test our hypothesis, a large-scale survey with 44470 participants and 7 focus group interviews were conducted with 28 participants. Results showed NetizenYears that indicated the number of years passed since he/she first time got online could be used as the criteria of digital learners. Digital learners could be labeled as 1-NetizenYear digital learners, 2-NetizenYears digital learners, and so on, and non-digital learners are those with 0 NetizenYear. Results revealed that non-digital learners and digital learners had significantly different Internet use patterns. More positive attitudes to Internet, more active participation online and more tendency to Internet addiction were found for digital learners with increasing NetizenYears. The gap between digital learner’s preferred learning approach and teaching methods in classroom was discussed. The paper concludes with a discussion on using the time length of using technology as the criteria for digital learners.

*Keywords:* digital native; digital immigrants; K-12 class; digital learner, learning preference

## INTRODUCTION

Because students’ lives today were saturated with digital media at a time when their brains were still developing, several researchers suggested that media use had profoundly affected students’ abilities, preferences, and attitudes related to learning

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(Thompson, 2013). Many researchers, such as Tapscott (1998), Howe and Strauss (2000), Prensky (2001) and Gasser and Palfrey (2009) argued that today's generation of learners behaved differently than the previous generation, because they had been immersed in a world infused with digital technologies. It was claimed that they learned differently, they exhibited different social characteristics and had different expectations about life and learning. These researchers believed that this digital generation of learners preferred active rather than passive learning, preferred using digital technologies and collaborating to finish work. However, researchers like Bennett, Maton, and Kervin (2008), Selwyn (2009), Jones, Ramanau, Cross, and Healing (2010) and Romero, Guitert, Sangrà, and Bullen (2013) had argued that although digital technologies were associated with significant changes in the lives of young people, there was no evidence of a serious break between young people and the rest of society.

The debate started by Bennett et al. (2008), continued drawing attentions from lots of researchers till now (Bennett and Maton, 2010; Jones and Czerniewicz, 2010; Demirbilek, 2014). The current debate about the digital native could be interpreted in two aspects. The first aspect was on whether to admit there was a generation of digital learners entering schools, with different behavioral characteristics and learning preferences from previous generation of learners; authors such as Prensky (2008) and Wilson (2010) believed that digital natives had been entering school, and their behavior or thinking habits were quite different from their parents "digital immigrants"; while researchers like Bennett et al. (2008) and Jones (2013) believed that students varied widely in gender, socio-economic backgrounds, countries and regions considering the technology use and learning preferences.

The second aspect was about whether taking age as the main symbol of the digital learners to divide "digital native" and "digital immigrants". Tapscott (1998) presented that "net generation" was born between 1977 to 1997; Prensky (2001) took 1980s as a dividing line, people before that were regarded as "digital immigrants" and after as "digital natives." While authors like Bennett and Maton (2010) believed that taking age as a division mark was too arbitrary and prone to cause panic, because digital immigrants will never become digital natives so that a teacher would never be able to meet the needs of digital native students

The above debate, seemingly contradictory views, was in fact only two perspectives to describe a problem; one was from a macro perspective to enable readers to grasp the general direction, and the other was from the microscopic point of view to enable readers to understand the topic discussed precisely and deeply. Both of the macro and micro perspective were critical for understanding new generation of learners. Wang, Myers, and Sundaram (2013) suggested that there was a continuum rather than a rigid dichotomy between digital natives and digital immigrants, which was conceptualized as digital fluency. Accordingly, we used term

### **State of the literature**

- It was claimed by some researchers that digital natives grown up with digital devices and Internet had developed different learning preferences compared with digital immigrants.
- Debates existed, and one of the foci of the debate centers around the argument is whether age is an appropriate factor to divide "digital native" and "digital immigrants".
- More and more empirical research was conducted to identify the characters of young generation's experience with technology in education, however failed to ease the debate.

### **Contribution of this paper to the literature**

- The term "digital learner" was used in this paper, with the hypothesis that the time length for using technology could be used as the criteria for dividing digital learners.
- A large-scale survey with 44470 participants and 7 focus group interviews were conducted, which proved NetizenYears that indicated the number of years passed since he/she first time got online could be used as the criteria of digital learners.
- Non-digital learners and digital learners had significantly different Internet use patterns, and more positive attitudes to Internet and more active participation online were found for digital learners with increasing NetizenYears.

“digital learner” to reconcile the above debate. Age is not the division mark of digital learners, rather time length of using technology is considered as the division criteria of digital learners, and this hypothesis is then tested in this paper.

Some researchers argued beyond the debate for empirical research on the impact of technology on today’s learner (Bennett and Maton, 2010; Thomas, 2011; Gros, Garcia, and Escofet, 2012). A growing body of theoretical and empirical research aimed to identify characters of young people’s experience with technology and the factors influenced the habits in ICT use (Romero et al., 2013; Corrin, Bennett, and Lockyer, 2013; Varela-Candamio, Novo-Corti, and Barreiro-Gen, 2014; Demirbilek, 2014). Considering the Chinese new generation of learners, Li and Ranieri (2010) provided some evidence on the digital competence status of a group of Chinese teenagers (ninth grade students) from Zhejiang Province, China. Gu, Zhu, and Guo (2013) presented the comparison of ICT usage between students and teachers in Shanghai. However, little attention has been paid to the overall learning preference of the digital learners regarding different academic grades in technology-rich environment.

The purpose of this study is to validate the hypothesis of taking time length of using technology as criteria for determining digital learners and to identify the learning preferences of digital learners regarding different academic grades in technology-rich environment through a large-scale survey in China. The specific objectives of the present study are to: (1) test whether time length of using technology could be used as the division criteria of digital learners; (2) discover the learning preferences of digital learners in different academic grades in China; (3) investigate habits of using Internet for digital learners.

## RELATED WORK

### Criteria of digital learner

In order to reconcile the debate on digital natives, “digital learner” were used in this paper to represent students who were born and grown up with digital technologies and Internet. The time length of using technology was hypothesized as the criteria of digital learner. Technology refers to any digital technological tools employed for communication or information gathering (e.g., tablet PC mobile devices, smart phones, personal computers, laptops, or the Internet) (Ono and Zavodny, 2007). Internet has been the most influential technology that has had tremendous impact on all aspects of society (Wang, Luo, Gao, and Kong, 2012). It is difficult to calculate the time length of using all different types of technologies, therefore, the time length of using the Internet was taken as a typical representative of technology use in this study. NetizenYears stand for the number of years passed since he/she first time got online, which are used as the criteria of digital learners in this study. Noticing there is a continuum rather than a rigid dichotomy between digital natives and digital immigrants (Wang, et al., 2013), digital learners could be labeled as 1-NetizenYear digital learners, 2-NetizenYears digital learners, and so on, and non-digital learners are those with 0 NetizenYear. The core of this hypotheses is whether the group of students with the same NetizenYears have the similar attitudes and technology using patterns, from a population statistically perspective.

### Internet use framework

Whilst there is a clear need to remain mindful of the changing information and technological needs of children and young people it is clear that we should concentrate on enhancing our understandings of the realities of technology use in contemporary society (Selwyn, 2009). Internet is one of the most influential

technologies, and young people have increasingly adopted the Internet, using it as means of entertainment, socialization and information retrieval (Sinkkonen, Puhakka, and Meriläinen, 2014). In this paper, Internet participation is investigated to show digital natives' technology involvement from the perspective of Internet usage.

This study tries to provide evidence-based understanding about the extent and nature of technology use of young students, to classify the differences of technology use in different age groups or NetizenYear groups. After reviewing the studies of technology use, four dimensions are included in the research framework (Table 1.).

**Table 1.** Internet use framework

Dimension	Description	Details
Grown up with Internet	Internet use experience	<ul style="list-style-type: none"> <li>– How many years has he/she used Internet?</li> <li>– Time length surfing on Internet everyday</li> </ul>
Attitudes toward the Internet	Attitudes toward the use of digital devices and Internet	<ul style="list-style-type: none"> <li>– Using digital devices</li> <li>– Curiosity in new online software or games</li> <li>– Self-confidence in using Internet</li> <li>– Collaboration online</li> </ul>
Internet Participation	Involvement in online activities	<ul style="list-style-type: none"> <li>– Sharing online</li> <li>– Expression online</li> <li>– Want more and more Internet</li> </ul>
Negative effects	The tendency to Internet addiction	<ul style="list-style-type: none"> <li>– Restless without Internet</li> <li>– Dependent on Internet</li> </ul>

Digital natives have grown up with digital technology and Internet (Tapscott, 2008). *Grown up with Internet, attitudes to Internet, participation Online and negative effects* are investigated in this research. *Grown up with Internet* intends to investigate students' experience of Internet use, including their NetizenYears, everyday Internet use time, and self-confidence in using Internet. *Attitudes to Internet* intends to investigate students' perceptions of Internet use, including their interests to digital devices, newly published Internet software or games, and their perception of skills to use Internet. *Participation Online* intends to investigate student's involvement in Internet use, including discussion, sharing, and expression on Internet. In regard to Internet use, the dilemma is that the more students partook in online activities, the more they are exposed to risks (Lee and Chae, 2012). When we discuss the use of Internet for digital students, the negative effects are always included. *Negative effects* intend to investigate the tendency to Internet addiction, including more and more time online, restless without Internet, etc.

### Learning preference

Awareness of learning preferences can have useful learning and teaching implications (Sinha, Bhardwaj, Singh, and Abas, 2013). In regarding to classroom learning, it is useful to understand what kind of learning approaches students preferred. A number of authors refer to the favoring of one method of teaching over another (such as group work over independent-study) as learning preferences (Cassidy, 2004). It was argued that team work and reliant on graphics as the typical learning preferences of digital natives (Prensky, 2001; Tapscott, 2008; Toe, 2013). This study intends to investigate the preference of learning for digital learners in classroom and their preference of cognition in learning process.

## RESEARCH METHOD

### Participants

Stratified sampling was used in this survey. First we decided to cover both the developed provinces and developing provinces in China, and Beijing, Chongqing,

**Table 2.** Sample characteristics

Measure	Category	Frequency (n)	%	Cumulative (%)
Gender	Female	22488	50.6	50.6
	Male	21982	49.4	100
Province	Beijing	12659	28.5	28.5
	Chongqing	8841	19.9	48.3
	Guangdong	1997	4.5	52.8
	Liaoning	6162	13.9	66.7
	Gansu	7258	16.3	83
	Jiangxi	7553	17	100
	Grade	3	8713	19.6
	5	8749	19.7	39.3
	8	14486	32.6	71.8
	11	12522	28.2	100

Guangdong province, Liaoning province, Gansu province and Jiangxi province were selected; then schools covering leading schools and normal schools (in terms of documented academic performance) in each province were selected; then students from Year 3, Year 5, Year 8, and Year 11 were selected as participants. Finally, 44,470 questionnaires were collected. Students from Year 3 (8-9 years) accounted for 19.6%; students from Year 5 (10-11 years) accounted for 19.7%; students from Year 8 (13-14 years) accounted for 32.6%; students from Year 11 (16-17 years) accounted for 28.2%, as shown in Table 2.

In order to delve more deeply into the understanding of digital learner's learning preferences, focus group interviews were conducted after the large-scale survey. The sample comprised of seven mixed gender focus groups that took part in a conversation around the theme of new technology use at home and in school. Four schools were selected for their reputation as innovative in digital technology to be the representative of urban schools, and three schools were selected to be the representative of suburb schools. In each school, teacher convened groups of students from Year 3 and Year 5, or Year 8 and Year 11, who self-reported being either low users of technology, average users or high users. Groups varied in size from three to six students. Twenty-eight students took part in the interview, and twelve of them were female students.

### Instrument and data collection

Digital Learning Preference Questionnaire (DLPQ) exploring the Internet use patterns and learning preferences were developed based on the Internet use framework and learning preference indicators discussed in section 2, as shown in Table 3.

The questionnaire consisted of two parts. The first part was used to collect demographic and learning preference information, which consisted of blank and single choice questions; the second part was used to discover Internet use patterns, which consisted of five-point likert-type responses (see questionnaire in Appendix).

A total of 30 items questionnaire were created. Some of the seven questions for learning preference was adapted from Visual, Aural, Read/Write, and Kinesthetic (VARK) Questionnaire (Fleming and Mills, 1992). The 17 questions for Internet use was adapted from media literacy questionnaire and Internet addiction questionnaire (Huang and Yang, 2014). The items were evaluated with the options of "not measuring", "somewhat measuring", and "not measuring" by six professors from learning technology and at the end 25 items labeled "total measuring" were selected. A key step for developing this questionnaire was to ensure that the

**Table 3.** Questionnaire framework

Dimension	Description	Details
<b>Learning Preference</b>	Preference of learning methods and preference for cognition in learning process	<ul style="list-style-type: none"> <li>- Preference of learning methods</li> <li>- Visual, aural or kinesthetic cognitive preference</li> <li>- Self-perceived learning achievement</li> </ul>
<b>Grown up with Internet</b>	Internet use experience	<ul style="list-style-type: none"> <li>- How many years has he/she used Internet?</li> <li>- Time length surfing on Internet everyday</li> </ul>
<b>Attitudes to Internet</b>	Attitudes to use digital devices and Internet	<ul style="list-style-type: none"> <li>- Using digital devices</li> <li>- Curiosity in new online software or games</li> <li>- Self-confidence in using Internet</li> </ul>
<b>Internet Participation</b>	Involvement in online activities	<ul style="list-style-type: none"> <li>- Collaboration online</li> <li>- Sharing online</li> <li>- Expression online</li> </ul>
<b>Negative effects</b>	The tendency to Internet addiction	<ul style="list-style-type: none"> <li>- Want more and more Internet</li> <li>- Restless without Internet</li> <li>- Dependent on Internet</li> </ul>

potential respondents could understand the items. For this purpose, the list of 25 items was presented to a group of ten junior middle school (aged 12–14) students for their feedback. Specifically, these students explained what they thought each statement meant to them. Thereafter, the items were revised for clarity and parsimony in sentence. Finally, the Digital Learning Preference Questionnaire (DLPQ) was developed with 25 items, with seven questions for learning preference and 12 five-point likert-type questions for Internet use (see Appendix).

The focus group questions consisted of three dimensions from Internet use, learning preference, and attitudes to technology. The focus group interview conversations were held in quiet rooms and lasted between 30 and 55 minutes. The interviews were conducted by three researchers and one assistant who help researchers to plan the interview, such as arranging for interview, recording the interview, transcribing the recording. Researchers framed the conversation in a spirit of the participants being ‘informants’ or voices of their peer group rather than only presenting their own perspective.

**Data analysis**

Questionnaire data were analyzed in SPSS 20.0. An exploratory factor analysis using principal components analysis with varimax rotation was conducted on the 12 five-point likert-type questions for Internet use to explore the underlying structure and reliability. Focus group interview recordings were transcribed and content analysis was used for analyze these transcripts.

**RESULTS**

**Testing the hypothesis**

Internet use section contains 12 items that were answered by means of a likert-type scale with five response choices, including “1=strong disagree” “2=disagree,” “3=moderate,” “4=agree,” and “5=strong agree”. Exploratory factor analysis (EFA) and principle component analysis with varimax rotation were employed to verify whether the survey items for each subscale successfully measure each variable. Table 4 schematically listed the final results.

The three factors accounted for 56.7% of the total variance explained, with an overall Cronbach Alpha=0.84, indicating that the internal consistency of the responses was acceptable for evaluating Internet use in three constructs. Table 5 outlined and summarized the average student scores for all of the scales, with the percentage of variance explained.

The average score indicated that students' attitudes to Internet were not that positive as argued by Prensky (2001). Different age students show different attitudes to technology (see Table 6), and significant difference existed among different ages after applying ANOVA ( $F=56.41$ ,  $d.f.=11$ ,  $p=.00$ ). The same results were found to participation online ( $F=165.62$ ,  $d.f.=11$ ,  $p=.00$ ) and negative effects of tendency to Internet addiction ( $F=263.96$ ,  $d.f.=11$ ,  $p=.00$ ). But younger students did not hold much more positive attitudes to Internet than older students did, and they did not actively participate in online activities.

There was no linear relationship between age and the three scales, which revealed that students' Internet use patterns didn't show any significant trends with age increasing. However, we found the relationship between NetizenYears and the three scales from a statistic perspective, as shown in Table 7. NetizenYears stand for the number of years passed since he/she first time got online.

As shown in Figure 1, the score of each scale went higher when the NetizenYears increased, which indicated students' attitudes to technology become more positive and they participate in online activities more actively with NetizenYears increasing. However, negative effects of tendency to Internet addiction also went higher with NetizenYears increasing. Linear regression confirmed that all the three scales have

**Table 4.** Factor loadings for the Internet use questionnaire

Items	Factors		
	Negative effects	Participation online	Attitudes to Internet
(1) I felt I should get online more and more	.812		
(2) I felt restless if I don't get online	.792		
(3) I still think about things happened online when I get offline	.740		
(4) I pretend to parents and friends that I did not always want to get online	.712		
(5) I try to get rid of trouble through surfing the Internet	.677		
(6) I always surfing online longer than planed	.600		
(7) I will discuss with others on the hot topics		.804	
(8) I will forward or share the interesting news\blogs\videos		.796	
(9) I will publish my views online actively		.705	
(10) I am good at using Internet			-.804
(11) I like to use digital devices			-.803
(12) I am interested in the newly published software or games			-.690

Notes: 1. Factor loadings smaller than 0.40 have been omitted.

**Table 5.** Average score on each scale

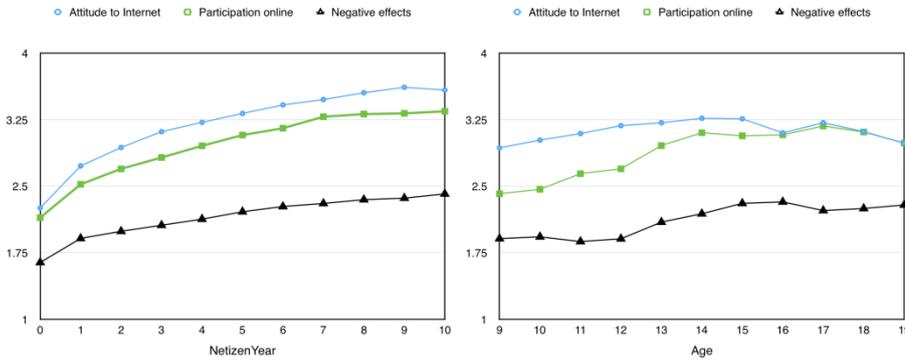
Scale	Mean	SD	Percentage of variance explained
Attitudes to Internet	3.21	1.05	9.14%
Participation online	2.84	1.12	14.60%
Negative effects	2.23	0.99	32.98%

**Table 6.** Average score for each scale with different age students

Age	9	10	11	12	13	14	15	16	17	18	19	
<b>n (students)</b>	3999	3374	5008	2205	2934	7504	3259	3061	5262	3332	595	
<b>Attitudes to technology</b>	<b>Mean</b>	3.02	3.16	3.16	3.24	3.43	3.33	3.28	3.36	3.27	3.09	2.98
	<b>SD</b>	1.20	1.13	1.07	1.10	1.02	1.01	1.03	0.95	0.92	0.89	0.87
<b>Participation online</b>	<b>Mean</b>	2.40	2.46	2.57	2.67	3.10	3.01	2.96	3.18	3.11	3.07	2.93
	<b>SD</b>	1.14	1.13	1.12	1.15	1.13	1.11	1.07	1.00	1.00	0.95	0.93
<b>Negative effects</b>	<b>Mean</b>	1.98	1.97	1.96	2.07	2.26	2.33	2.46	2.45	2.39	2.40	2.44
	<b>SD</b>	1.00	0.99	0.95	1.00	1.00	1.01	1.02	0.95	0.91	0.89	0.92

**Table 7.** Average score for each scale with different NetizenYear students

NetizenYears		0	1	2	3	4	5	6	7	8	9	10
<b>n (students)</b>		2518	5120	5561	6933	5704	7099	4372	2478	1983	780	1141
<b>Attitudes to technology</b>	<b>Mean</b>	2.23	2.72	2.97	3.18	3.32	3.41	3.54	3.62	0.92	3.79	3.72
	<b>SD</b>	1.06	1.04	0.98	0.99	0.95	0.95	0.93	0.93	0.92	0.91	0.99
<b>Participation online</b>	<b>Mean</b>	2.12	2.46	2.62	2.75	2.89	1.07	3.08	3.23	3.25	3.25	3.31
	<b>SD</b>	1.08	1.08	1.07	1.08	1.09	1.07	1.08	1.08	1.07	1.12	1.10
<b>Negative effects</b>	<b>Mean</b>	1.68	1.97	0.94	0.94	2.25	2.35	2.43	2.46	2.49	2.54	2.57
	<b>SD</b>	0.92	0.96	0.94	0.94	0.97	0.97	0.99	0.98	1.00	1.05	1.04



**Figure 1.** Score trends on each scale with NetizenYears (left) and Age (right)

**Table 8.** Linear model between NetizenYear and three scales after linear regression analysis

Dependent Variable	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square
		B	Std. Error	Beta			
<b>Attitudes to Internet</b>	(Constant)	2.630	.009		287.662	.000	.114
	NetizenYear	.146	.002	.338	74.225	.000	
<b>Participation online</b>	(Constant)	2.361	.010		232.291	.000	.066
	NetizenYear	.119	.002	.256	54.535	.000	
<b>Negative effects</b>	(Constant)	1.888	.009		206.556	.000	.042
	NetizenYear	.084	.002	.204	42.638	.000	

linear relationship with NetizenYears, as shown in Table 8. But the scores of these scales did not show much linear trends with increasing age.

This result shows that students' attitudes to Internet, behaviors in participation online, and tendencies to Internet addiction will change in a linear model with NetizenYears increasing, which test that NetizenYears could be used as criteria for determining digital learners from the perspective of population statistics. The next key step is to understand what are the technology use patterns of different NetizenYears digital learner, including the non-digital learners with no experience of Internet.

Post hoc of ANOVA test revealed significant differences existed between non-digital learners and all NetizenYears digital learners in the three scales, as shown in Table 9. Non-digital learners show significant lower scores in all the three scales, indicating the less positive attitudes to Internet, less active participation online, and less tendency for Internet addiction.

**Table 9.** Post hoc ANOVA on the difference between non-digital learners and digital learners

Scales	(I) Netizen Year	(J) NetizenYear	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
<b>Attitudes to Internet</b>	<b>.00</b>	1.00	-.48818*	.02405	.000	-.5353	-.4410
		2.00	-.73635*	.02372	.000	-.7828	-.6899
		3.00	-.94438*	.02297	.000	-.9894	-.8994
		4.00	-1.08732*	.02359	.000	-1.1336	-1.0411
		5.00	-1.18382*	.02288	.000	-1.2287	-1.1390
		6.00	-1.30959*	.02466	.000	-1.3579	-1.2613
		7.00	-1.38551*	.02786	.000	-1.4401	-1.3309
		8.00	-1.45728*	.02953	.000	-1.5152	-1.3994
		9.00	-1.55458*	.04021	.000	-1.6334	-1.4758
		10.00	-1.48974*	.03502	.000	-1.5584	-1.4211
<b>Participa tion online</b>	<b>.00</b>	1.00	-.34101*	.02697	.000	-.3939	-.2881
		2.00	-.49939*	.02661	.000	-.5516	-.4472
		3.00	-.62819*	.02575	.000	-.6787	-.5777
		4.00	-.77017*	.02646	.000	-.8220	-.7183
		5.00	-.89153*	.02565	.000	-.9418	-.8413
		6.00	-.96128*	.02762	.000	-1.0154	-.9071
		7.00	-1.10308*	.03117	.000	-1.1642	-1.0420
		8.00	-1.13126*	.03303	.000	-1.1960	-1.0665
		9.00	-1.12740*	.04487	.000	-1.2154	-1.0395
		10.00	-1.18830*	.03920	.000	-1.2651	-1.1115
<b>Negative effects</b>	<b>.00</b>	1.00	-.28983*	.02425	.000	-.3374	-.2423
		2.00	-.40266*	.02393	.000	-.4496	-.3558
		3.00	-.47679*	.02315	.000	-.5222	-.4314
		4.00	-.56721*	.02378	.000	-.6138	-.5206
		5.00	-.66579*	.02306	.000	-.7110	-.6206
		6.00	-.74222*	.02482	.000	-.7909	-.6936
		7.00	-.77241*	.02798	.000	-.8273	-.7176
		8.00	-.80540*	.02969	.000	-.8636	-.7472
		9.00	-.85544*	.04054	.000	-.9349	-.7760
		10.00	-.88909*	.03527	.000	-.9582	-.8200

### Internet use patterns

The median for first time getting online for Grader 3, Grader 5, Grader 8 and Grader 11 were 7 years, 8 years, 10 years and 12 years separately, which indicated that younger students got online earlier than elder students. In focus group interview, the majority of students said that they had mobile phone that was used for surfing on the Internet after school, but it was forbidden to use mobile phones at school.

The average NetizenYears for Grader 3, Grader 5, Grader 8 and Grader 11 were 2.26 (Standard Deviation=1.86), 3.15 (Standard Deviation=1.90), 4.46 (Standard Deviation=2.34), 5.49 (Standard Deviation=2.67). The NetizenYears in different grades were shown in Table 10.

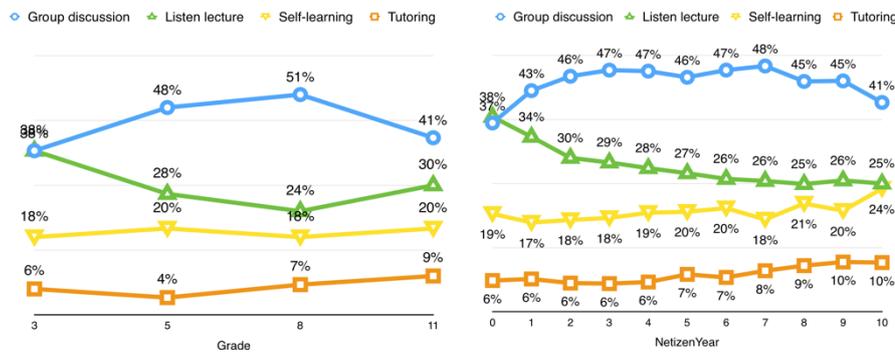
The average time for getting online every day was 1.31 hours (Standard Deviation=1.31) for all the participants. The average time getting online everyday for different NetizenYears digital learners was shown in Table 11, indicating digital learners used more time online with NetizenYears increasing. The standard deviation exceeding the mean indicates the online time for different NetizenYear digital learners vary a lot. The online time length for different NetizenYear digital learners may vary a lot.

**Table 10.** Grade \* Netizenyear crosstabulation

Grade \ Netizen Year	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	Total
	<b>Grader3(n &amp; %)</b>	2134 24.7%	1481 17.1%	1668 19.3%	867 10.0%	572 6.6%	225 2.6%	87 1.0%	51 0.6%	36 0.4%	25 0.3%
<b>Grader5(n &amp; %)</b>	1394 16.0%	1581 18.2%	1762 20.3%	1287 14.8%	1266 14.6%	530 6.1%	215 2.5%	97 1.1%	31 0.4%	21 0.2%	8184 94.2%
<b>Grader8(n &amp; %)</b>	1092 7.6%	1549 10.7%	2146 14.9%	2252 15.6%	2723 18.9%	1800 12.5%	985 6.8%	826 5.7%	285 2.0%	264 1.8%	13922 96.5%
<b>Grader11(n &amp; %)</b>	500 4.0%	950 7.6%	1357 10.9%	1298 10.4%	2538 20.4%	1817 14.6%	1191 9.6%	1009 8.1%	428 3.4%	831 6.7%	11919 95.7%

**Table 11.** Online time everyday for different NetizenYear students

Hours/day \ Netizen Year	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	<b>Hours</b>	0.94	1.16	1.28	1.37	1.49	1.52	1.64	1.74	1.75
<b>S.D.</b>	1.09	1.28	1.39	1.43	1.58	1.56	1.69	1.82	1.99	2.20
<b>N</b>	5120	5561	6933	5704	7099	4372	2478	1983	780	1141



**Figure 2.** Preferred ways of learning for different graders (Left) and different NetizenYear digital learners (right)

The average time for Grader 3, Grader 5, Grader 8 and Grader 11 were 1.01 hours, 1.11 hours, 1.53 hours and 1.39 hours separately. With students getting elder, they spend more time online each day, except for Grade 11 students as they faced the pressure of college entrance examination. In focus group interview, almost every student said that they often used Internet to chat with others by using QQ, and sometimes to find answers for questions. *“About 1/4-1/3 of the online time was used for learning schoolwork, and about half of the time was used for interests rather than schoolwork” (f, yr10).* (“f” stands for female, “yr 10” means he/she was 10 years old)

**Learning preference**

With regard to the preferred ways of learning for Q9 in the questionnaire (see the Appendix), 45% selected “group discussion”, 29% “listen lecture”, 19% “self-learning”, and 7% “tutoring”. Different graders and different NetizenYear digital learners had different preferences, as shown in Figure 2. Generally, group discussion was the most favorable ways of learning for students from different grades. Focus group interview showed the same results. Students expressed their needs in discussing with peers in a rational way. *“Discussion is needed in some classes, but not suitable for all subjects” (m, yr13).* We concluded that group discussion was the most

preferred ways of learning for digital learners in classroom, although some differences existed in different grades.

With regard to the preferred way of teaching for Q10, 65% preferred “field trips, labs, practical sessions” used by teachers in classroom, 19% “textbook, handouts, readings”, 11% “discussion, guest speakers”, and 5% “flow diagrams, charts, graphs”. No significant differences existed among different grades. Post hoc ANOVA test revealed that significant difference existed among non-digital learners and 2-9 NetizenYears digital learners for preferred ways of teaching, while there were no significant differences between non-digital learners and 1 NetizenYear digital learners, as shown in Table 12. Regarding the preferred ways to learn a new program on computer for Q11, 45% sit down at the keyboard and begin to experiment, 37% read the manual that comes with the program, and 18% telephone a friend and ask questions about it. Post hoc ANOVA test revealed that that significant difference existed among non-digital learners and all NetizenYears digital learners (see Table 13).

Q10 and Q11 were adapted from VARK Questionnaire (Fleming and Mills, 1992), according to which, the selection of “field trips, labs, practical sessions” and “sit down at the keyboard and begin to experiment” mean Kinesthetic, the selection of “flow diagrams, charts, graphs” mean Visual, the selection of “discussion, guest speakers” and “telephone a friend” mean Aural, and the selection of “textbook, handouts, readings” and “read the manual” mean Read. With NetizenYears growing, digital students have shown significant differences in learning a new program, with a more Kinesthetic way and less Aural or Read ways, as shown in Figure 3.

Regarding the time for discussion and self-regulated learning in a class, 56% had less than 10 minutes, and 31% had 10 to 20 minutes. Post hoc ANOVA test revealed

**Table 12.** Post hoc ANOVA on differences of preferred way of teaching between non-digital learners and digital learners

(I) NetizenYear	(J) NetizenYear	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
.00	1.00	.00	.035	.968	-.07	.07
	2.00	-.07*	.035	.034	-.14	-.01
	3.00	-.14*	.033	.000	-.20	-.07
	4.00	-.12*	.034	.000	-.19	-.06
	5.00	-.12*	.033	.000	-.19	-.06
	6.00	-.19*	.036	.000	-.26	-.12
	7.00	-.16*	.041	.000	-.24	-.08
	8.00	-.17*	.043	.000	-.26	-.09
	9.00	-.17*	.059	.003	-.29	-.06
	10.00	-.03	.051	.520	-.13	.07

**Table 13.** Post hoc ANOVA on differences of preferred way to learn a new program between non-digital learners and digital learners

(I) NetizenYear	(J) NetizenYear	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
.00	1.00	.178*	.031	.000	.12	.24
	2.00	.220*	.031	.000	.16	.28
	3.00	.344*	.030	.000	.29	.40
	4.00	.393*	.030	.000	.33	.45
	5.00	.471*	.030	.000	.41	.53
	6.00	.549*	.032	.000	.49	.61
	7.00	.614*	.036	.000	.54	.68
	8.00	.641*	.038	.000	.57	.72
	9.00	.487*	.052	.000	.38	.59
	10.00	.689*	.045	.000	.60	.78

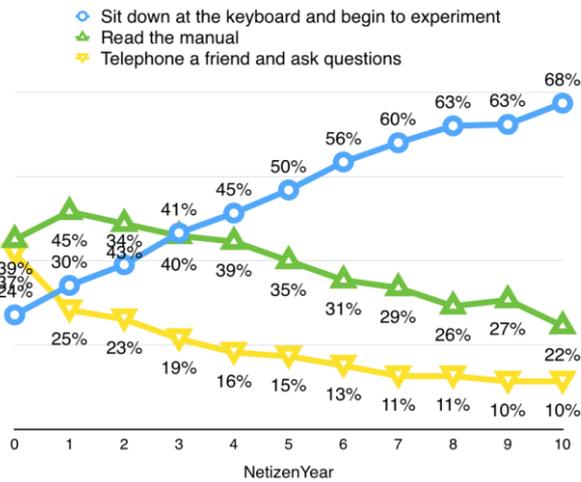


Figure 3. Preferred ways to learn a new program for different NetizenYear students

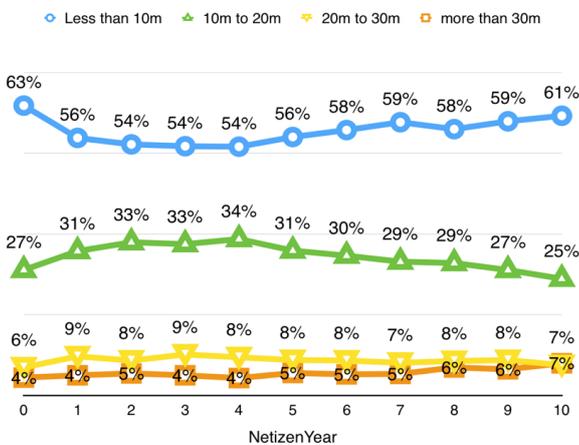


Figure 4. Time for discussion and self-regulated learning in classroom for different NetizenYears students

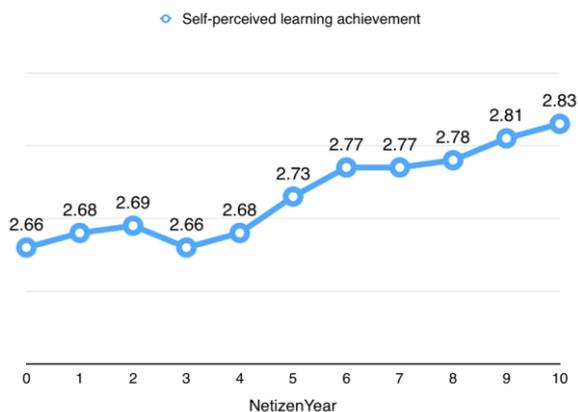
that significant differences existed between non-digital learners and all NetizenYears digital learners ( $F=5.444, p<.001$ ), and the differences were shown in Figure 4. This result indicated that a large number of digital learners have less than 10 minutes for discussion and self-regulated learning in a 45-minutes class, which was quite different from the ways digital learners preferred to learn. However, focus group interview indicated most students understood teaching methods should be associated with teaching contents, and they believed that the methods their teachers used in class was suitable for delivering knowledge. The reason was that students generally tested their learning through quizzes, and if they could figure out the problem in the quiz, they felt they did not master the knowledge point. Therefore, they believed “*teachers should deliver all the knowledge points to them as quickly as possible, and discussion could happen after that*” (f, yr 14).

In regard to self-perceived learning achievement, no significant differences were found in non-digital learners and 1-4 NetizenYears digital learners, however significant differences existed between non-digital learners and 5-10 NetizenYears digital learners, as shown in Table 13. With NetizenYears increasing (after 5), student self-perceived learning achievement get worse (1=very good, 5=very bad), as shown in Figure 5.

In terms of “The difficulties for using the Internet to learn”, 27% indicated that they found the learning resources were dull and 27% said they were easily distracted because of weak self-discipline; 20% didn’t know where to get technical

**Table 13.** Post hoc ANOVA on differences of perceived learning achievement between non-digital learners and digital learners

(I) NetizenYear	(J) NetizenYear	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
.00	1.00	-.014	.022	.519	-.06	.03
	2.00	-.027	.021	.203	-.07	.01
	3.00	.007	.021	.737	-.03	.05
	4.00	-.020	.021	.345	-.06	.02
	5.00	-.065*	.021	.002	-.11	-.02
	6.00	-.110*	.022	.000	-.15	-.07
	7.00	-.103*	.025	.000	-.15	-.05
	8.00	-.112*	.027	.000	-.16	-.06
	9.00	-.148*	.036	.000	-.22	-.08
	10.00	-.167*	.032	.000	-.23	-.11



**Figure 5.** Self-perceived learning achievement with increasing NetizenYears

help when they experienced problems, 14% expressed the lack of Internet skills, and also 12% indicated they lost Internet connection. We concluded that dull learning resources and weak self-discipline were the main obstacles for student’s using Internet for learning.

### DISCUSSION AND CONCLUSION

Age could not be the criteria to divide “digital native” and “digital immigrants”, as the technology use patterns show no linear trends with age growing, which has been shown by the results of this study from the perspective of Internet use. Age as the criteria will also cause moral panic that “digital immigrants” will never become “digital native” (Bennett et al., 2008). In stead of using age as the criteria, we proposed the hypothesis that time length of using technology could be used as the criteria for determining digital learners. The results tested that NetizenYears could be used as the criteria of digital learners, as the Internet use patterns show significant linear trends with NetizenYears increasing. The criteria of digital learner based on this large scale survey might stop the debate of digital natives from the researcher like Tapscott (1998), Howe and Strauss (2000), Prensky (2001) and Gasser and Palfrey (2009) and researchers like Bennett, Maton, and Kervin (2008), Selwyn (2009), Jones, Ramanau, Cross, and Healing (2010) and Romero, Guitert, Sangrà, and Bullen (2013).

In educational research, we should concentrate on enhancing our understandings of the realities of technology use in contemporary society (Selwyn, 2009) and the learning preferences in the technology-rich environments. The study uses NetizenYears as the criteria for digital learners to investigate the Internet use patterns and learning preferences through a large scale survey in China. Students with 0 NetizenYear was regarded as non-digital learner, and others were regarded digital learners labeled as 1-NetizenYear digital learners, 2-NetizenYears digital learners, and so on.

The results indicated that non-digital learners and digital learners had significant different Internet use patterns, and more positive attitudes to Internet and more active participation online were found for digital learners with increasing NetizenYears. However, with the increasing of NetizenYears, more negative effects of tendency to Internet addiction were also found in digital learner and the self-perceived learning achievement got worse for digital learners (after 5 NetizenYears). The results confirmed the delimita that the more students partook in online activities, the more they are exposed to risks (Lee and Chae, 2012). More research need to be done to understand the relationship between self-perceived learning achievement and NetizenYears for digital learners in K-12 school.

The lower-grade students got online earlier than higher-grade students did, while the higher-grade students got online longer in daily use than the lower grade students did, except for the grader 11 with the pressure of entrance examination for college. With digital devices and Internet becoming more and more accessible, kids had more chance to get online earlier. Digital learners used more time to surf online with NetizenYears increasing. Dull learning resources and weak self-discipline were the two main obstacles for using Internet to learn from student's view. Therefore, providing high quality digital learning resources and guidance for using Internet were the major task for K-12 schools.

Group discussion was the most favorable learning approach in classroom for digital learners from different grades in China, but a large number of digital learners expressed the time for discussion and self-regulated learning was less than 10 minutes in a 45-minutes class. There was a gap between digital learner's preferred approach for learning and teaching methods in classroom. Part of the reason for the gap was teacher's notion and part of the gap was the test-based assessment methods. Students could understand their teacher's teaching methods as they got used to the test-based assessment methods.

It is urgent for teachers to recognize the gap between teaching methods and digital learner's preference, as learner's needs should be considered to train their 21<sup>st</sup> century skills. Chinese Ministry of Education (MOE) has launched the "Curriculum Reform Outline in Basic Education (Pilot)" in 2001 (MOE, 2001), which emphasized the self-regulated learning, inquiry learning and collaborative learning in classroom. However, after all these years, the learning pattern in classroom is still teacher-centered (Huang and Yang, 2014), which doesn't fit the aim of training students' 21<sup>st</sup> century skills. Future research should be done on developing suitable teaching and learning models in technology-rich classrooms according to digital learner's preference.

Digital learner is gradually becoming a research area that focuses on the criteria of digital learners and their learning preferences in association with the influence from digital devices and Internet. The questionnaire used in the present research should be improved in the future, and future research could be done to enhance the items of attitudes to technology and participation for the Internet use part. For the learning preference part, the other characters of digital natives, such as "multitasking, teamwork and reliant on graphics", could be included to test the influence of technology on these learning characters.

This study tested that NetizenYears could be used as the criteria of digital learners from the perspective of Internet use as the representative of technology use, with the aim to test the hypothesis of time length of using technology as the criteria of digital learner. However, as the Internet use time for the same NetizenYears digital students vary a lot, it could not be concluded that time length of using technology could be used as the criteria. But this research revealed that time length of using technology could be the direction in the criteria of determining digital learner, which should be tested in the future study with more sophisticated research design.

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## APPENDIX: Digital Learning Preference Questionnaire

### Part 1: demographic information and learning preference

1. I am now in \_\_\_\_\_;  
a. Grade 3; b. Grade 5; c. Grade 8; d. Grade 11
2. Your gender:  
a. female b. male
3. Your province:  
a. Beijing, b. Chongqing, c. Guangdong province, d. Liaoning province, e. Gansu province, f. Jiangxi province
4. The year you were born: \_\_\_\_\_;
5. I normally have \_\_\_\_\_ minutes to do discussion or self-directed learning in classroom.
6. How many years have you been online? \_\_\_\_\_
7. How long do you spend online each day? \_\_\_\_\_ (hours)
8. How often do you prepare for new class? \_\_\_\_\_ %
9. The way I prefer to learn most is:  
  
a. discussion in groups; b. listen to teacher c. self-directed learning; d. 1-1 tutoring;
10. Do you prefer a lecturer or teacher who likes to use:?  
  
a. a textbook, handouts, readings.  
b. flow diagrams, charts, graphs.  
c. field trips, labs, practical sessions.  
d. discussion, guest speakers.
11. You are about to learn to use a new program on a computer. I would:  
  
a. sit down at the keyboard and begin to experiment with the program's features.  
b. read the manual which comes with the program.  
c. telephone a friend and ask questions about it.
12. I think my learning achievement is:  
  
a. very good; b. good; c. normal; d. bad; e. very bad
13. What are the main difficulties by using Internet for learning?  
  
a. Dull learning resources  
b. Weak self-discipline  
c. No technical help/assistant  
d. Lack of Internet skills  
e. Lost connection

**Part 2:** Interent use

No	Items	Answers				
		Strong Disagree	Disagree	Moderate	Agree	Strong Agree
		1	2	3	4	5
14	I am good at using Internet					
15	I like to use digital devices					
16	I am interested in the newly published software or games					
17	I will discuss with others on the hot topics					
18	I will forward or share the interesting news\blogs\videos					
19	I will publish my views online actively					
20	I felt I should get online more and more					
21	I felt restless if I don't get online					
22	I still think about things happened online when I get offline					
23	I pretend to parents and friends that I did not always want to get online					
24	I try to get rid of trouble through surfing Interent					
25	I always surfing online longer than planed					