Key Determinants of the Digital Skills Gap: A Comprehensive Analysis

Yubo Yan *

Zhengzhou Foreign Language School-New Fengyang Campus, Zhengzhou, China

* Corresponding Author Email: zufeng@Idy.edu.rs

Abstract. In contemporary society, digital technology has emerged as an indispensable tool for communication, work, study and entertainment, exerting a profound impact on our daily life. On one hand, the widespread adoption of digital technology has significantly facilitated the ease of accessing and processing information. On the other hand, it has become the only medium for us to deal with problems, which forces us to learn and utilize digital technology without any second choice. Consequently, the digital divide has been exacerbated, and its impact on individuals is intensifying over time. Therefore, narrowing the digital skills gap has become a critical task that must be urgently addressed. This study aims to deeply analyze the various factors that affect the digital skills gap and strives to find solutions to these factors. This research mainly studies the relationship between digital skills gap and the factors of local economy, internet accessibility, people's education, and government support. Through correlation coefficient analysis and regression equation, we find that increasing local internet penetration rates, extending the duration of education, government support, and local economic development all contribute to improving digital skills and alleviating the digital divide.

Keywords: Digital skills gap; Regional difference; Digital divide.

1. Introduction

1.1. Background

1.1.1 The coming digital age

As early as 1999, a report named ‘FALLING THROUGH THE NET: DEFINING THE DIGITAL DIVIDE’, National Telecommunications and Information Administration (NITA) had first defined ‘digital divide’ as a gap between the people who can access devices which connect themselves to the digital society in a digital age and the people who cannot access those devices [1]. This definition, established at the start of the internet revolution and the digital era, has accurately predicted the realities of today’s world: a vast digital divide and a considerable digital skills gap.

1.1.2 The importance of digital skills

People have to use the Internet or whatever they are doing for entertainment, work issues, or learning in their daily lives in modern society. “Digital skills gap” is described as the gap between the supply of employees who have enough digital skills and requirement from employers [2]. People's competitive strength in their job opportunities may decline due to their digital skills gap, and then they will lose their opportunities, which negatively affects their career development. In this period, digital transformation of economic activities is flourishing in most industries. This will exacerbate the impact of the digital skills gap on individuals. 85% of jobs in the EU's job market require at least a basic level of digital skills. In the United Kingdom, more than 75% of jobs in the market require digital skills, and more than half of employment in the United States and Singapore are in digital occupations [3].

1.1.3 Digital skills gap in contemporary society

Nowadays, in most area of the world, digital divides between regions still exist, even in some developed countries or some rapidly developing countries, where network infrastructure and facilities are well-equipped and complete. Digital divides in other developing countries or those least

developed countries (LCDS)is much more common and widespread. According to the World Bank Open Group, the percentage of people who use the Internet in upper middle-income countries, middle-income countries and least developed countries are 73.74%, 60.19% and 29.75% [4].

1.2. Research questions and goals

The research aims to explore how various factors influence the digital skills gap and to identify potential solutions to mitigate the impact of these factors. By examining the changing effects of these influences, the study seeks to contribute to reducing the digital skills gap and its associated challenges.

2. Literature review

Some research focuses on the change in learning opportunities of different student groups under the development of digital education, especially those Disadvantaged student groups. They also discuss the difficulties of Diverse student groups and the challenges those who make the rules and policies have to deal with [5].

Some research tried to find out the influence of the digital divide on individuals under the wave of digital education development (especially during or after the pandemic of COVID-19). Students learning in public schools will face more difficulties in accessing internet devices and connections than those who learn in private schools [6]. Also, students with more financial support from their families have a higher rate of using electronic devices than others [7].

Some research discovers how digital skills differ in different countries or regions. For instance, WILEY made a report named 'Digital Skills Gap Index 2021'[2]. The report quantifies the digital skills gap's performance in 134 countries or regions around the world as an index through calculating 6 main indicators (Digital Skills Institutions; Digital Responsiveness; Government Support; Supply, Demand & Competitiveness; Data Ethics & Integrity; Research Intensity).

Some studies find out how to solve or at least decline the digital skills gap among the students at secondary level. For example, the DQ Institute published a white paper in 2015 [8]. This white paper aimed at enhancing the basic digital skills of teenagers and children in more than 80 countries around the world. According to the #DQEveryChild plan in the white paper, one billion people will be empowered with digital skills, including teachers, parents, and students. This will be done through building a global network of partners, developing a certification system, developing a micro badge credits system, and building an online assessment platform within a decade. This plan has the potential to change so many people's lives in the future, but still more efforts are needed [9].

3. Method

3.1. Data

In the research, All the data are collected from the Digital Skills Gap Index (DSGI) 2021 by Wiley and the World Bank Open Group. There are 12 types of data that are collected. Overall Digital Skills Gap Index (ODSGI), Digital Skills among Population (DSP), Digital Skills upon Graduation (DSG), the Size of the STEM Gender Gap (SSGG), Gender Gap of STEM Graduates (GGSG), Years of Schooling (YS) and Government Support (GS) came from the Digital Skills Gap Index 2021 [10]. Individuals Using the Internet (% of population) (IUI), School Enrollment Tertiary (% gross) (SET), Government Expenditure on Education Total (% of government expenditure) (GEET), GDP per capita (current US$) and GNI per capita (constant 2015 US$) from World Bank Open Group [4]. All the data used in the research came from 2021 and they all focus on about 70 countries or regions.

3.2. Variables

3.2.1 Explained variables

Dependent variables considerded in this research are specific indexes of regional digital skills gap, which are ODSGI, DSP, DSG, SSGG, and GGSG. These 5 weighted indexes range from 0 to 10.

3.2.2 Explanatory variables

Independent variables are the factors that affect the digital skills gap among individuals in 4 aspects. The first aspect is the local economy, which is shown by the index of GNI per capita (constant 2015 US$) and GDP per capita (current US$). The second aspect is the accessibility to the Internet in different countries, represented by IUI. The third aspect is the difference in education accessibility in different countries or regions, reflected by SET, GEET, and YS. The last one is the government support, shown by the GS index from Wiley.

3.3. Methods

3.3.1 Method one

This research studies the correlation between the explanatory variables and the explained variables by comparing the correlation coefficient (C_{xy}) obtained by calculating the equation of covariance ($\mathrm{cov}(X, Y)$). The formula for the correlation coefficient is as follows equation (1) to (4):

$$\mathrm{cov}(X, Y) = \frac{\sum_{i=1}^{n}(X - \overline{X})(Y - \overline{Y})}{n - 1} \tag{1}$$

$$C_x = \frac{\sqrt{\sum(X_{i-\bar{x}})^2}}{n - 1} \tag{2}$$

$$C_y = \frac{\sqrt{\sum\left(X_{i-\bar{y}}\right)^2}}{n - 1} \tag{3}$$

$$C_{xy} = \frac{\mathrm{cov}(X, Y)}{S_x S_y} \tag{4}$$

The correlation coefficient is graded as follows. See Table 1. All the correlation coefficients are positive unless otherwise indicated.

Table 1: Correlation coefficient grades

Correlation coefficient	Grade (positive)	Grade (negative)
$0.00 \leq \lvert r \rvert < 0.25$	no correlation	no correlation
$0.25 \leq \lvert r \rvert < 0.50$	low (positive) correlation	low negative correlation
$0.50 \leq \lvert r \rvert < 1.00$	high (positive) correlation	high negative correlation

3.3.2 Method two

This research uses a regression equation to calculate the P value, which reflects the statistical significance. $P \leq 0.10$ means the result is statistically significant. Multiple R and R squares are also calculated through regression equations in Excel.4 Result

4. Result

4.1. Overall situation

The correlation coefficients and regression model results of factors and the ODSGI show that GDP per capita, GNI per capita, IUI, YS, and GS have a big influence on the regional overall digital skills gap situation. See Table 2. SET has a small influence on the regional overall overall situation. Besides,

GEET has a small negative influence on the regional overall situation. Among them, GNI per capita, and YS have a significant impact on the regional overall situation. See Table 3.

Table 2: Coralation of regional overall digital skills gap

Item	Covariance	Correlation coefficient
GNI per capita (constant 2015 US$)	23033.25	0.77
GDP per capita (current US$)	28069.51	0.74
IUI	22.17	0.75
SET	25.68	0.62
GEET	-1.37	-0.27
YS	2.47	0.76
GS	1.72	0.68

Table 3: Regression equation of regional overall digital skills gap

Result Of Regression				Regression Statistics	
Item	Coefficients	Standard Error	P-value	Multiple R	0.93
Intercept	1.42	0.41	0	R Square	0.87
GNI per capita (constant 2015 US$)	0	0	0.07	Adjusted R Square	0.85
GDP per capita (current US$)	0	0	0.41	Standard Error	0.53
IUI	0.01	0.01	0.39	Observations	69
SET	0.01	0	0.11		
GEET	0	0.02	0.92		
YS	0.18	0.05	0		
GS	0.32	0.04	0		

4.2. The situation of digital skills among population

The correlation coefficients and regression model results of factors and the DSP show that GDP per capita, GNI per capita, YS, and GS all have a big influence on the regional digital skills gap among the population. See Table 3 and Table 4. SET also has a small influence on the regional digital skills gap among the population. Among them, GNI per capita, YS, and GS have significant impact on the regional digital skills gap situation among the population. See Table 5.

Table 4: Coralation of digital skills among population

Item	Covariance	Correlation coefficient
GNI per capita (constant 2015 US$)	29594.63	0.72
GDP per capita (current US$)	35943.93	0.69
IUI	25.7	0.64
SET	29.06	0.51
GEET	-1.07	-0.15
YS	2.89	0.65
GS	2.27	0.66

Table 5: Regression equation of digital skills among population

Result Of Regression				Regression Statistics	
Item	Coefficients	Standard Error	P-value	Multiple R	0.86
Intercept	0.83	0.79	0.3	R Square	0.74
GNI per capita (constant 2015 US$)	0	0	0.1	Adjusted R Square	0.71
GDP per capita (current US$)	0	0	0.43	Standard Error	1.01
IUI	0	0.01	0.81	Observations	69
SET	0.01	0.01	0.31		
GEET	0.05	0.04	0.22		
YS	0.25	0.1	0.01		
GS	0.43	0.08	0		

4.3. The situation of digital skills between graduations

The results of the research and DSG show that IUI, GEET, and YS have a small influence on the regional digital skills gap between graduations. See Table 6.

Table 6: Coralation of digital skills between graduation

Item	Covariance	Correlation coefficient
GNI per capita (constant 2015 US$)	1223.86	0.12
GDP per capita (current US$)	1865.78	0.17
IUI	3.28	0.43
SET	0.84	0.07
GEET	0.73	0.43
YS	0.32	0.38
GS	0.14	0.21

4.4. Gender gap

GGSG and the results of correlation coefficients and regression model reflect that GDP per capita and GNI per capita have no influence on regional digital skills gender gap of STEM graduates. See Table 7 and 8. When the research data just focus on APEC countries, it is discovered that YS and GS have small influence on the size of the regional STEM gender gap. Also, what have changed is, GS have big influence on the size of the regional STEM gender gap. See Table 9.

Table 7: Coralation of gender gap of STEM graduates

Item	Covariance	Correlation coefficient
GNI per capita (constant 2015 US$)	23033.25	-0.29
GDP per capita (current US$)	28069.51	-0.3
IUI	22.17	0.13
SET	25.68	0.13
GEET	-1.37	0.06
YS	2.47	0.05
GS	1.72	-0.09

Table 8: Regression equation of gender gap of STEM graduates

Result Of Regression				Regression Statistics	
Item	Coefficients	Standard Error	P-value	Multiple R	0.51
Intercept	2.16	1.52	0.16	R Square	0.26
GNI per capita (constant 2015 US$)	0	0	0.21	Adjusted R Square	0.17
GDP per capita (current US$)	0	0	0.93	Standard Error	1.97
IUI	0.03	0.02	0.15	Observations	69
SET	0.01	0.02	0.36		
GEET	0.04	0.07	0.59		
YS	0.05	0.19	0.81		
GS	0.08	0.16	0.61		

Table 9: Coralation of the size of the regional STEM gender gap

Item	Covariance	Correlation coefficient
GNI per capita (constant 2015 US$)	-11830.25	-0.49
GDP per capita (current US$)	-13158.73	-0.51
IUI	-1.48	-0.08
SET	-9.87	-0.32
GEET	2.13	0.52
YS	-0.63	-0.31
GS	1.03	0.67

5. Suggestion

Based on the research findings, it is evident that there is a strong correlation between regional economic conditions and the local digital skills gap. In areas where is economically prosperous, the digital skills gap tends to be narrower. On the contrary, economically disadvantaged areas often struggle with a digital skills gap. Given this dynamic, national and local governments must continue to prioritize the investment in the development of the local economy. By promoting economic growth, these governments can help create an environment conducive to the development of people's digital skills.

The research also indicates that the network infrastructure construction, which affects network accessibility, has a strong correlation with the regional digital skills gap. It shows that in areas with higher network accessibility, the quality skills gap is often smaller, while regions with poorer network accessibility often have a bigger digital skills gap. Therefore, national and local governments should focus on the construction of network infrastructure, while also paying attention to addressing the inequality in network infrastructure between regions.

For individuals, particularly those seeking to advance in their careers or provide better opportunities for their children, relocating to a more economically developed and prosperous area is a strategic decision. Moving to such areas can enhance personal development and ensure that the next generation has access to high-quality educational resources, including those necessary for acquiring essential digital skills.

From an educational perspective, it is crucial that all stakeholders—including government agencies, educational institutions, and parents—focus on children's basic education. Efforts should be made to ensure that children receive long-term and high-quality education, as this is the groundwork for future digital capabilities. In addition to a strong general education, it is equally important to add specific digital skills training into the curriculum.

6. Conclusion

The research finds that increasing local internet penetration rates, extending the duration of education, government support, and local economic development all contribute to improving digital skills and reducing the digital divide. Gender factors were found to have a relatively minor impact on the issue of the digital divide.

The research has certain limitations. The data used in this study is limited, primarily drawn from reports by two institutions, and only from the year 2021, which falls within the pandemic period and may lead to overall biases. Additionally, some of the data may be outdated. The methodology used, particularly the reliance on correlation analysis, is somewhat limited in scope.

For future research, data that came from different years can be studied and compared to discover the impact of different factors on the digital skills gap between people over time. Also, other factors that may influence the digital skills gap can be explored, such as different classes and different age or income groups. The research reflects that in the future, the regional digital skills gap may be reduced because of the further development of society, the progress of technology, and the continuous construction of internet infrastructure. However, the possible intensification of regional economic development imbalances may strengthen the digital divide.

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