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Mapping the Potential Use of ICT for Distance Learning During Covid-19: Demand and Supply-Side Approach

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Abstract:

Global education systems are facing the biggest disruption in history during the Covid-19 pandemic. The schools are closed preventing spread of the outbreak while the learning method switched to online distance learning. Unfortunately, the implementation of this new method is significantly constrained by socio-economic conditions of the household on the demand-side and the availability of Information Communication and Technology (ICT) infrastructures on the supply-side. This research attempts to depict the potential use of ICT for distance learning during Covid-19 for 34 provinces in Indonesia. Factor Analysis is performed to construct the composite index for demand-side (based on National Socio-economic Survey-Susenas 2020) and supply-side (based on Village Potential Data Collection-Podes 2019). The finding shows that most of the provinces already have a balanced index of demand and supply-side even DKI Jakarta, DI Yogyakarta and Bali have a higher potential use of ICT on the demand-side which indicates having a better ICT readiness of the student. On the contrary, Papua and West Papua have the lowest potential use of ICT on both sides, implicating to be prioritized in ICT readiness of the students and infrastructures improvement. These results can have an important role in supporting the mitigation and intervention programs from the Indonesian government to improve the student participation in distance learning.

Keywords:

Education, Composite Index, Internet, Factor Analysis

1. Introduction:

Global education systems are facing the biggest disruption in history during the Covid-19 pandemic (United Nations, 2020). As first reported in December 2019 as an unknown cause of severe pneumonia in Wuhan, China (Cucinotta & Vanelli, 2020), the World Health Organization (WHO) has declared Covid-19 as global pandemic in March, 11 2020. At that time, this outbreak has affected 114 countries with more than 118.000 cases (WHO, 2020). In Indonesia, the first two cases of Covid-19 were announced in March, 2 2020 and has increased more than 1.500 cases at the end of March. To prevent the spread of the outbreak, since mid-March 2020, schools have been closed to prevent the spread of the outbreak while the learning method switched to online distance learning.

In this new learning method, parents play an important role in providing facilities and access to distance learning for their children like smartphones, tablets, laptops/PCs, and also internet access. That is very challenging and exacerbates the socioeconomic condition during the outbreak, especially for poor households. It was going viral that three high school students attempted a robbery to buy a smartphone and a father stole a smartphone for his son only for the sake of being able to participate in distance learning (Alifia, 2020). A lot of children experienced violence from their parents during distance learning and were obliged to drop out from school to help their parents by working.

The implementation of distance learning also highly relied on the availability of Information Communication and Technology (ICT) facilities and infrastructures. According to BPS (2018), most of the villages in the eastern part of Indonesia still have no internet signal, especially Maluku (36.86%), Papua (22.63%), Kalimantan (16.12%), and Nusa Tenggara (14.08%). While in other areas the number

of villages with no internet signal is relatively small, even in Bali all villages already have internet signals. These inequalities in socioeconomic conditions of households in providing facilities and access to distance learning for their children and availability of ICT facilities and infrastructures are widening the education gap and further hamper the achievement of Sustainable Development Goal 4: Quality Education.

Several previous studies discussed the use of ICT such as ICT use, e.g. Chinn & Fairlie (2010) and the internet for students, e.g. Pramana (2018), Gillwald & Mothobi (2019) and Das, Roy, & Salam (2020). However, the availability of research that discusses the potential use of ICT in Indonesian students is still very limited. Thus, this research conducted for mapping the composite index of potential use of ICT for school students (elementary school to high school) in all provinces in Indonesia during the Covid-19 pandemic, which includes aspects of demand and supply. The findings of this research are expected as a consideration for the government to determine the policies related to the improvement of student participation in distance learning during the Covid-19 pandemic.

2. Methodology:

There are eight socioeconomic variables and six variables were used to construct the composite index of demand-side (I_D) and supply-side (I_S), respectively (**Table 1**). The analytical procedures to construct composite index using factor analysis are adopted from Siagian, Purnadi, Suhartono, & Ritonga (2014) that constructed the social vulnerability index (SoVI) in case of natural hazard in Indonesia.

Table 1. Variables Used in The Study

Index	Variable		Source
Demand side	$X_{D,1}$	proportion of students with female household head	Susenas 2020
	$X_{D,2}$	proportion of students with household head who did not work or work in the agricultural sector a week ago	
	$X_{D,3}$	proportion of students whose household head has the highest education only up to junior high school	
	$X_{D,4}$	proportion of students who did not use cellphones in the past 3 months	
	$X_{D,5}$	proportion of students who did not use a PC/laptop/tablet in the past 3 months	
	$X_{D,6}$	proportion of students who did not use the internet in the past 3 months	
	$X_{D,7}$	proportion of students who do not use the internet for the learning process	
	$X_{D,8}$	proportion of students living in 40 th lowest expenditure group of households	
Supply Side	$X_{S,1}$	proportion of villages without internet for internet stall, online games, etc.	Podes 2019
	$X_{S,2}$	proportion of villages without Base Transceiver Station (BTS)	
	$X_{S,3}$	proportion of villages without telephone communication service operators	
	$X_{S,4}$	proportion of villages without cellular telephone signal	
	$X_{S,5}$	proportion of villages without internet signal	
	$X_{S,6}$	proportion of villages without internet facilities at the village office	

3. Result:

In factor analysis, the composite index of demand-side has two extracted factors with the total of variation explained is 75.62%. The first factor consists of $X_{D,2}, X_{D,4}, X_{D,5}, X_{D,6}$, and $X_{D,7}$ and the second factor consists of $X_{D,1}, X_{D,3}$, and $X_{D,8}$ with the 56.48% and 19.14% variation explained, respectively. The composite index of supply-side also has two extracted factors that explain 92.21% of the variation. The first factor including $X_{S,3}, X_{S,4}$, and $X_{S,5}$ and the second factor including $X_{S,1}, X_{S,2}$, and $X_{S,6}$ with the 75.80% and 16.41% variation explained, respectively. The composite indexes are constructed by weighting each extracted factor by its contribution to the total variation explained. Then the composite indexes are calculated using formulas: $I_D = (0.7469 \times Factor_D 1) + (0.2531 \times Factor_D 2)$ for demand-side and $I_S = (0.8221 \times Factor_S 1) + (0.1779 \times Factor_S 2)$ for supply-side. The results show that for demand-side the indexes range from -1.8152 (most ready to access distance learning) to 1.8109 (least ready to access distance learning) and for supply-side the indexes range from -0.6006 (most ready on infrastructure) to 3.4700 (least ready on infrastructure). Next, these indexes would be categorized and mapped based on its standard deviation (**Figure 1**).

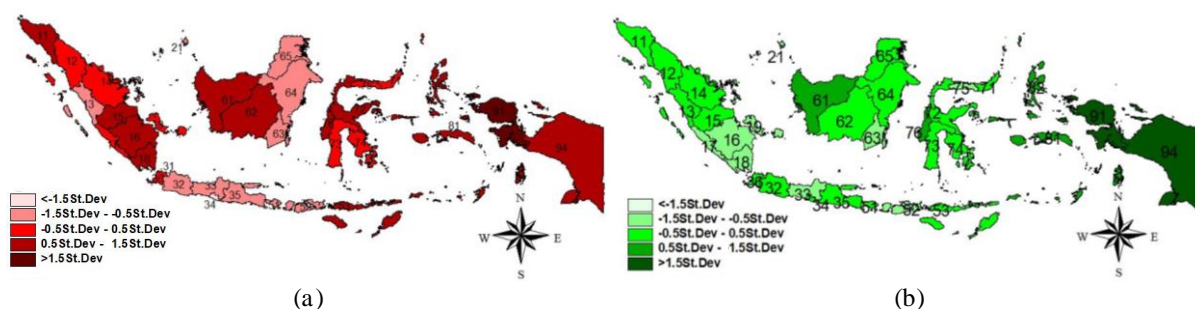


Figure 1. Mapping the Index of Potential Use of ICT on the Demand (a) and Supply (b) Side

Based on demand-side, three provinces that have the lowest potential use of ICT are Papua, Maluku Utara and Nusa Tenggara Timur. Looking deeper on the supply-side, three provinces that have the lowest potential use of ICT are Papua, Papua Barat and Sulawesi Barat.

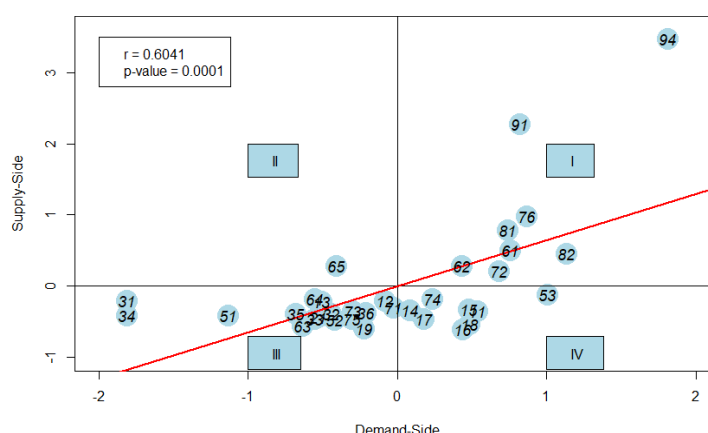


Figure 2. Index of Potential Use of ICT on the Demand vs. Supply-Side

Most of the provinces are clustered in the middle indicates that they have a balanced index of demand and supply-side (**Figure 2**). Provinces on the first quadrant are provinces that have poor potential ICT use, either on demand or supply-side. Otherwise on the third quadrant, they are provinces that have fairly good potential ICT use on the demand and supply-side. The positive correlation between demand and supply-side indexes indicates that the higher the ability of students to access ICT, the higher the availability of ICT infrastructure in a province, vice versa.

4. Discussion and Conclusion:

Educational investment is one of the long-term investments (Becker, 1962). Especially in the pandemic, not only on people's health, education should be improved for quality of human life. Since the ICT is an important element for social economic growth and development, it also has a main role in this situation. Availability of ICT facilities, infrastructures, and sources to get should be concerned by the government. Different characteristics of the community in regions are considered important for conducting this research on a macro basis. According to the results, the government can determine priority regions to increase ICT use from the supply and demand-side. Regions with high indexes or areas mapped in dark colors can be prioritized for development. While developing the use of ICT on the supply side, the Provinces of Papua, Papua Barat and Sulawesi Barat are being targeted. The barriers to people online connectivity are lack of coverage, absence of internet-enabled devices, cost of the internet in terms of connection, services and digital literacy (Gillwald & Mothobi, 2019). In addition, the availability of ICT infrastructure is one of the factors that influence ICT for having an impact on society (Azadnia, Zahedi, Majjedin, & Pourabedy, 2017; UNCTAD, 2014). Thus, suggested policies are extending internet coverage and strengthening the internet network.

Moreover, increasing the use of ICT on demand-side could be targeted to Provinces of Papua, Maluku Utara and Nusa Tenggara Timur. Access to and use of ICT by households and individuals also impacts on the economy, society, and the environment (UNCTAD, 2014). Suggested policies are

educating parents about the importance of education during the pandemic, continuing internet quota assistance to both students and teachers and maintaining the stability of the price of ICT tools. Another recommended policy is providing subsidized ICT tools for students from low-income households. Furthermore, increasing the use of ICT on demand and supply at the same time, the Provinces of Papua and Papua Barat are the targets. Interesting findings in this research are highlighted in the provinces of DKI Jakarta, DI Yogyakarta and Bali. The three provinces have a fairly good potential use of ICT on the demand and supply-side. This condition indicates that they are better on ICT readiness of the student and well supported by the ICT facilities and infrastructures. To address regional disparities in the use of ICT for students, looking deeper on the individual level would be considered for future research.

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Appendix 1. Codes and Provinces in Indonesia

Code	Province	Code	Province	Code	Province
11	Aceh	33	Jawa Tengah	71	Sulawesi Utara
12	Sumatera Utara	34	DI Yogyakarta	72	Sulawesi Tengah
13	Sumatera Barat	35	Jawa Timur	73	Sulawesi Selatan
14	Riau	36	Banten	74	Sulawesi Tenggara
15	Jambi	51	Bali	75	Gorontalo
16	Sumatera Selatan	52	Nusa Tenggara Barat	76	Sulawesi Barat
17	Bengkulu	53	Nusa Tenggara Timur	81	Maluku
18	Lampung	61	Kalimantan Barat	82	Maluku Utara
19	Kep. Bangka Belitung	62	Kalimantan Tengah	91	Papua Barat
21	Kepulauan Riau	63	Kalimantan Selatan	94	Papua
31	DKI Jakarta	64	Kalimantan Timur		
32	Jawa Barat	65	Kalimantan Utara		