DIGITAL DIVIDE IN ONLINE EDUCATION DURING THE COVID-19 PANDEMIC AND EDUCATIONAL OUTCOMES: FINDINGS FROM A COMMUNITY-BASED SURVEY IN THAILAND'S IMPOVERISHED DEEP SOUTH

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Abstract

Data about the extent to which digital divides in online schooling during the COVID-19 pandemic were associated with dropouts from the education system are scarce. This study aims to assess the extent to which digital divides during the pandemic were associated with 1) School drop-out and 2) the Outlook of secondary education completion. We interviewed school-going adolescents aged 13-18 years (n = 643) and caregivers of school-going children aged 7-12 years (n = 663), categorized patterns of the digital divide. We analyzed the study data using descriptive statistics and multivariate logistic regression. We also conducted focus group discussions with education stakeholders. We found significant associations between experience of severe (vs. low) levels of digital divide and dropouts among the children (81% vs. 46%) and among adolescents (14% vs. 2%). Still, we found no significant association with the outlook of secondary education completion. The study findings provide potentially helpful basic information for stakeholders. However, caveats regarding the study design, potential information biases, and discrepancies in selecting quantitative and qualitative study participants should be considered caveats in interpreting the study findings.

Keywords: Education, Dropout, Digital Divide, Latent Class Analysis, COVID-19

Introduction

In sociology, the term "digital divide" refers to unequal access to communication and information technology based on social, cultural, economic, and political factors (Ragnedda & Muschert, 2013). The digital divide can be categorized into three levels: 1) lack of ability to access the internet, 2) usage patterns and digital skills, and 3) inequities in offline benefits from online activities (Guo & Wan, 2022). We hypothesize that during the COVID-19 pandemic when students were required to study online, students who cannot switch from in-person to online learning and/or students who attend schools that do not have online learning capacity will not be able to benefit from the educational system fully. We further hypothesize that these students will be more likely to drop out and auto-impose a self-fulfilling prophecy that limits future academic attainment.

Thailand's Deep South is a region marked by high levels of poverty (The Nation, 2023). A prolonged armed insurgency (Wichaidit, 2018), and an underperforming education system (Uddin & Sarntisart, 2023), making the region prone to experience a digital divide in education during the COVID-19 lockdown. In this study, we tested these hypotheses using data from a community-based survey. The objectives of this study are: 1) To describe the extent to which digital divides in online education were associated with school drop-out during the COVID-19 pandemic among primary and secondary school-aged children in Thailand's Deep South region, and 2) To describe the extent to which digital divides during the COVID-19 pandemic were associated with perceived prospect of completing secondary education.

Literature Review

Generally, people of higher socioeconomic status are less likely to experience the digital divide and more likely to benefit from online activities than those of lower socioeconomic status. (IEEE, 2023).

Humanity is currently in the post-digital era, where digital connections are increasingly ubiquitous (Alexenberg, 2008; Khan & Khan, 2021). Digital connections, or lack thereof, can mutate into a force determining social and economic development, including educational attainment. (Kuhn et al., 2023). Hybrid and online learning are expected to play increasingly prominent roles in education. During the COVID-19 pandemic, school systems worldwide resorted to offering classes online instead of in-person education to comply with disease control measures, despite the lack of response capability in the education sector to ensure continued enrolment of all students (Conto et al., 2021). Analyses of data on the digital divide and educational attainment during the pandemic period can offer insights into the current post-pandemic world and be of interest to stakeholders in education and economic and social development.

Previous studies found decreased enrolment and increased dropout during the pandemic, both in the short and long terms (Azubuike et al., 2021; Chatterji & Li, 2021; Khan & Ahmed, 2021; Kidman et al., 2022; Lichand et al., 2022; Zulaika et al., 2022), but the reasons and consequences of such dropout are not clear.

Research Methods

Study Design and Setting

We conducted a cross-sectional study (survey) among residents of the Deep South region of Thailand, designated by the Royal Thai Government as a special security area. The region covers the provinces of Pattani, Narathiwat, and Yala Provinces and four districts in Songkhla Province (Chana, Thepa, Na Thawi, and Saba Yoi). The region covers an area of approximately 14,000 sq.km. The region is also impoverished, with lower educational achievements compared to the rest of Thailand (Uddin & Sarntisart, 2023).

Study Participants and Sample Size Calculation

Our study participants included resident adolescents aged 13-18 and caregivers of schoolchildren aged 13-18. Inclusion criteria were: 1) having a name either in the household registry or the registry of the local health-promoting hospital (for adolescents aged 13-18 years) or being the parent or guardian of a child aged 0-12 years who fit the same criterion, and; 2) being able to communicate either in Thai or Malay language. We excluded those with physical or cognitive issues that hindered participation in the study, e.g., if they had a hearing impairment or lacked the mental capacity to communicate.

The sample size calculation for the broader study assumed that 50% of the children in the local area experience at least one issue with their well-being (p = 0.50), with a 5% margin of error and 95% confidence level. Thus, we required a sample size of 384 adolescents and caregivers per province. Based on an assumed 305 probability of refusal, we adjusted our sample size to 500 persons per province, thus 2000 persons. In each province, we intended to sample an approximately equal number of adolescents aged 13-18 years (i.e., secondary school-aged), caregivers of children aged 7-12 years (i.e., primary school-aged), and caregivers of children aged 0-6 years (i.e., preschool). As we wished to focus on the digital divide in the formal education system, we did not include data from caregivers of preschool children in this study.

Study Instrument

Our study instruments included a structured interview questionnaire. We designed the quantitative structured interview questionnaire based on a literature review. We either developed the questions anew or performed human translation of existing standard instruments from English to Thai. For the translated instrument, we also used a machine translation tool to back-translate the Thai questions into English, identified discrepancies between the original and back-translated versions, and corrected the Thai questions accordingly. The final version of the structured interview questionnaire included four sections: Section A: Characteristics of the respondents and households; Section B: Direct impacts of Coronavirus disease on children; Section C: Indirect effects of Coronavirus disease on children; Section D: Aids provided by related agencies. We modified the study instrument to suit the context of each participant group. Due to time and resource constraints, we did not fully assess the validity and reliability of the complete questionnaires.

Exposure: Digital Divide

Based on a previous study among school students in China (Guo & Wan, 2022)We categorized experiences of the digital divide into three levels: Level 1) available vs. unavailable internet access, Level 2) patterns of internet use and digital skills, and Level 3) offline benefits drawn from internet use. We developed digital divide measurement questions based on findings from focus group discussions conducted in the broader mixed-methods study.

Among children aged 7-12 years, we measured such digital divide using two questions that allowed multiple responses: "C2.4) If [the school announced a switch to online learning], what were the issues in learning that your child experienced?" and; "C2.7) In your opinion, did the child aged 7-12 years under your care experience the following impacts of staying home instead of attending school?" Among adolescents aged 13-18 years, we measured the digital divide using two questions that allowed multiple responses: "C2.3) If [the school announced a switch to online learning], did you experience the following issues in online learning?" and; "C2.6) In your opinion, which of the following impacts of staying home instead of attending school did you experience?" Details regarding the answer choices and categorizations are available from the corresponding author.

Outcome: School Dropout during the Pandemic

Among adolescents aged 13-18 years, we asked the participants "C2_1) Since the start of the COVID-19 pandemic until now, has your school closed during the school year according to an order from relevant agencies?" and "C2_2, If yes, has your school announced that there would

be a switch to online education?". Among those who answered "Yes" to both questions, we asked, "C2_7) Since the start of the COVID-19 pandemic, have you stopped attending school?". Participants who answered "Yes" to question C2_7 were those who had dropped out of school during the pandemic; otherwise, they were those who did not fall out of school. We excluded those whose schools did not close, those who did not switch to online education, and those who answered "Don't know" or "Refuse to answer" from the analyses.

Among caregivers of children aged 7-12 years, we asked, "C2_2) Since the start of the COVID-19 pandemic until now, has the school of a child aged 7-12 years under your care closed according to an order of relevant agencies?" and "C2_3) If yes, has the school ever announced that there would be online classes?". Among those who answered "Yes" to both questions, we asked, "C2_6) Has a child aged 7-12 years under your care ever missed class during online sessions?". Participants who answered "Yes" to question C2_6 were those who had dropped out of school during the pandemic; otherwise, they were those who did not fall out of school. We excluded those whose schools did not close, those who did not switch to online education, and those who answered "Don't know" or "Refuse to answer" from the analyses.

Outcome: Outlook on Secondary Education Completion

Among guardians of children aged 7-12 years, we asked, "C2_13) Do you think that a child aged 7-12 years under your care tends to not complete Matthayom 6 / Vocational Certificate 3 [Year 12]?" with the possible answers: 0) No; 1) Yes; 8) Don't know / Not sure; 9) Refuse to answer. Among adolescents aged 13-18 years, we asked, "C2_12) Do you think that you tend to not complete Matthayom 6 / Vocational Certificate 3 [Year 12]?" with the possible answers: 0) No; 1) Yes; 8) Don't know / Not sure; 9) Refuse to answer. We excluded those who answered "Don't know" or "Refuse to answer" from the analyses.

Data Collection

We collected data during August 2022. We reached our study participants by multi-stage clustered sampling. We randomly sampled five districts and randomly sampled five sub-districts in each district (thus, 25 sub-districts per province). In each sub-district, we contacted a local health-promoting hospital, informed them about the study, and requested help from village health volunteers in contacting adolescents aged 13-18 years or caregivers of children aged 7-12 years in the households under their care. From each sub-district in Pattani, Yala, and Narathiwat, we aimed to sample 20 participants. From each sub-district in Songkhla Province, we aimed to sample 25 participants. Thus, our target sample size was 500 participants per province or 2000 participants.

We recruited enumerators from previous experience in field surveys in the study region. We trained our enumerators for 2 days, and the training included an overview of the study design, the study instrument, and tabletop exercise sessions. We then asked our enumerators to visit the sampled sub-districts and contact the sub-district health-promoting hospitals and village health volunteers based at the health-promoting hospital. Our enumerators then requested the village health volunteers to bring the enumerators to approximately 20 households under the volunteers' care. The selection of the volunteers and the households was based entirely on convenience.

At each household, our enumerators approached the study participants with the assistance of the village health volunteers. The enumerators introduced themselves and provided information about the study according to the approved participant information sheet. Enumerators then asked the participants to provide written or verbal informed consent. The Human Research Ethics Committee that approved the protocols for this study also approved the waiver of written informed consent. Enumerators then asked the participants to identify a location with adequate privacy to conduct the study interview. We instructed enumerators to follow the texts written on the questionnaire.

Data Management
Our enumerators entered survey data into the KoboToolbox online data entry platform. A research team member functioned as the data manager, receiving feedback from the supervisor of the data collection team to update or note issues with data collection and cleaning the data accordingly.

Data Analyses
We used descriptive statistics to describe the overall characteristics of the study participants. To classify patterns of digital divide, we divided participants into a given number of latent classes based on our subjective opinion on what seemed to be the most distinct manner to classify the occurrence of digital divide. In both age groups, we identified three latent classes. We used descriptive statistics and multivariate logistic regression analyses to assess the association between the digital divide and the study outcomes. In multivariate analyses, we adjusted for the sex of the child, the caregiver's level of education, and the caregiver's monthly income as confounders, as per predictors of school non-disciplinary suspension and drop-out according to the literature (Chatterji & Li, 2021; Khan & Ahmed, 2021; Kidman et al., 2022; Lichand et al., 2022; Zulaika et al., 2022).

Ethical Considerations
This study has received ethical approval from the Human Research Ethics Committee, Sirindhorn College of Public Health Yala Province (Registration No.SCPHYLIRB-019/2565).

Research Findings

Six hundred sixty-three caregivers of children aged 7-12 and 643 adolescents aged 13-18 participated in our study interviews (n = 1306 respondents of the target 1381 persons, response = 94.6%). Most caregivers of children aged 7-12 identified as the child's mother (Table 1). Common problems in online learning included concerns about the child being unable to keep up with schools, not having enough phones to support online education, and not having an internet connection. Among adolescents aged 13-18 years, most participants were female, and the most common problems in online learning included not being able to keep up with school, unstable internet connection, and not having an internet connection.

Table 1 Characteristics of the study participants (n = 1306 respondents)

Characteristic	Children aged 7-12	Adolescents aged 13-18
Sex of participant		
Male	90 (13.7%)	273 (42.6%)
Female	569 (86.3%)	368 (57.4%)
Age of participant in years; median (Q1, Q3)	39 (34, 45)	16 (14, 17)
Relationship between participant and child		
Child's Mother	533 (80.6%)	N/A
Child's Father	76 (11.5%)	N/A
Child's Grandmother	36 (5.4%)	N/A
Others	16 (2.4%)	N/A
Caregiver's highest level of education completed		
Primary school (Year 6) or less	159 (24.8%)	N/A
Lower secondary school (Year 9)	106 (16.5%)	N/A
Upper secondary school or equivalent (Year 12)	195 (30.4%)	N/A
Associate's degree or higher	181 (28.2%)	N/A
Caregiver's personal monthly income		
Less than 3,000 THB	75 (12.1%)	55 (9.0%)
3,000 THB to 5,000 THB	197 (31.8%)	166 (27.1%)

5,001 THB to 10,000 THB	177 (28.5%)	183 (29.9%)
10,001 THB to 20,000 THB	70 (11.3%)	57 (9.3%)
20,001 THB to 30,000 THB	16 (2.6%)	9 (1.5%)
30,001 THB to 40,000 THB	6 (1.0%)	1 (0.2%)
40,001 THB to 50,000 THB	2 (0.3%)	5 (0.8%)
More than 50,000 THB	1 (0.2%)	2 (0.3%)
Not sure	76 (12.3%)	135 (22.0%)
Sex of child under participant's care		
Male	354 (53.5%)	N/A
Female	308 (46.5%)	N/A
Problems encountered in online education among children aged 7-12	(n = 615)	
Level 1: There was no internet connection	140 (22.5%)	N/A
Level 1: There was no mobile phone with internet connection	93 (14.9%)	N/A
Level 1: There were many children and not enough phones for children to study	160 (25.7%)	N/A
Level 1: Day care / school could not provide online education	11 (1.8%)	N/A
Level 2: Teacher only played YouTube videos	4 (0.6%)	N/A
Level 2: Child only studied for 5 minutes, then went out to play	130 (20.9%)	N/A
Level 2: Child accessed porn websites	0 (0.0%)	N/A
Level 2: Child became addicted to games	84 (13.7%)	N/A
Level 3: Child could not keep up with school	437 (71.1%)	N/A
Level 3: Child could not write own name	38 (6.2%)	N/A
Level 3: Child could not count	27 (4.4%)	N/A
Problems encountered in online education among adolescents aged 13-18		
Level 1: There was no internet connection	N/A	64 (12.3%)
Level 1: There was no mobile phone with internet connection	N/A	46 (8.9%)
Level 1: Unstable internet connection	N/A	183 (35.3%)
Level 1: School could not provide online education	N/A	13 (2.5%)
Level 2: Teacher did not come to class on the designated date and time	N/A	47 (9.1%)
Level 2: Teacher did not teach according to plan	N/A	43 (8.3%)
Level 2: I accessed porn websites	N/A	0 (0%)
Level 2: I became addicted to games	N/A	23 (4.5%)
Level 3: Could not keep up with school	N/A	329 (64.3%)
Child stopped attending school during the pandemic	(n = 617 caregivers)	(n = 526 participants)
No	253 (41.0%)	506 (96.2%)
Yes	364 (59.0%)	20 (3.8%)
Has the child returned to school since the end of lockdown?	(n = 644 caregivers)	(n = 526 participants)
Returned to school as usual	640 (99.4%)	522 (99.2%)
Returned to school to a limited extent	3 (0.5%)	1 (0.2%)
Did not return to school	1 (0.2%)	3 (0.6%)

Child has tendency to drop out before finishing Year 12	(n = 613 caregivers)	(n = 605 participants)
No	532 (86.8%)	515 (85.1%)
Yes	81 (13.2%)	90 (14.9%)

* "Don't know" and "Refuse to answer" were excluded from the findings

Latent class analysis among caregivers of children aged 7-12 years showed 3 distinct groups of participants (Table 2). Participants in Latent Class 1 had a low to zero prevalence of issues with online learning behavior or lack of offline benefits (except for concerns about the child being unable to keep up with school). In contrast, those in Latent Class 2 reported issues with internet connection but no issues with online learning or lack of offline benefits (except for concerns about a child being unable to keep up with school). Those in Latent Class 3 reported issues with an internet connection, issues in online learning behaviors, and a lack of offline benefits. Thus, we decided to call those in Latent Class 1 those with a "Low [Level of] Digital Divide," those in Latent Class 2 those with a "Moderate Digital Divide," and those in Latent Class 3 those with "Severe Digital Divide." Similarly, among adolescents aged 13-18 years, there were 3 distinct groups. Those in Latent Class 1 had a low prevalence of issues (except for concerns about being unable to keep up with school. Those in Latent Class 2 had issues with internet connection and online game addiction but no issues with online teaching. Those in Latent Class 3 had issues with internet connection, as well as issues with online teaching. We similarly classified those in Latent Class 1 through 3 as those with "Low," "Moderate," and "Severe" levels of the digital divide, respectively. Compared to those with a "Low" digital divide, those with a "Severe" digital divide were slightly more likely to come from low-income households but did not differ in other demographic or socioeconomic characteristics (Table 3).

Table 2 Prevalence of digital divide problems in online education by identified latent classes, stratified by age groups

Among children aged 7-12	Latent Class 1	Latent Class 2	Latent Class 3
Level 1: There was no internet connection	56 (15.1%)	55 (41.4%)	29 (18.1%)
Level 1: There was no mobile phone with internet connection	0 (0%)	88 (66.2%)	5 (3.1%)
Level 1: There were many children and not enough phones for children to study	9 (2.4%)	81 (60.9%)	70 (43.8%)
Level 1: Day care / school could not provide online education	0 (0%)	11 (8.3%)	0 (0%)
Level 2: Teacher only played YouTube videos	3 (0.8%)	0 (0%)	1 (0.6%)
Level 2: Child only studied for 5 minutes, then went out to play	7 (1.9%)	6 (4.5%)	117 (73.1%)
Level 2: Child became addicted to games	6 (1.6%)	8 (6.0%)	70 (43.8%)
Level 3: Child could not keep up with school	180 (48.6%)	115 (86.5%)	142 (88.8%)
Level 3: Child could not write own name	1 (0.3%)	0 (0%)	37 (23.1%)
Level 3: Child could not count	0 (0%)	0 (0%)	27 (16.9%)

Among adolescents aged 13-18	Latent Class 1	Latent Class 2	Latent Class 3
Level 1: There was no internet connection	6 (1.4%)	52 (33.3%)	6 (10%)
Level 1: There was no mobile phone with internet connection	0 (0%)	41 (26.3%)	5 (8.3%)
Level 1: Unstable internet connection	43 (10.1%)	116 (74.4%)	24 (40%)
Level 1: School could not provide online education	5 (1.2%)	6 (3.8%)	2 (3.3%)
Level 2: Teacher did not come to class on the designated date and time	5 (1.2%)	0 (0%)	42 (70%)
Level 2: Teacher did not teach according to plan	0 (0%)	2 (1.3%)	41 (68.3%)
Level 2: I became addicted to games	2 (0.5%)	21 (13.5%)	0 (0%)
Level 3: Could not keep up with school	134 (31.4%)	146 (93.6%)	49 (81.7%)

Table 3 Socioeconomic characteristics of participants in different latent classes of digital divide, stratified by age groups

Among children aged 7-12	Latent Class 1	Latent Class 2	Latent Class 3
Sex of child under participant's care			
Male	197 (53.2%)	71 (53.4%)	86 (54.1%)
Female	173 (46.8%)	62 (46.6%)	73 (45.9%)
Caregiver's highest level of education completed			
Primary school (Year 6) or less	84 (23.5%)	53 (39.8%)	22 (14.7%)
Lower secondary school (Year 9)	57 (15.9%)	20 (15.0%)	29 (19.3%)
Upper secondary school or equivalent (Year 12)	103 (28.8%)	29 (21.8%)	63 (42.0%)
Associate's degree or higher	114 (31.8%)	31 (23.3%)	36 (24.0%)
Caregiver's personal monthly income			
Less than 3,000 THB	31 (8.7%)	28 (21.5%)	16 (11.9%)
3,000 THB to 5,000 THB	98 (27.5%)	45 (34.6%)	54 (40.3%)
5,001 THB to 10,000 THB	96 (27.0%)	39 (30.0%)	42 (31.3%)
10,001 THB to 20,000 THB	50 (14.0%)	10 (7.7%)	10 (7.5%)
More than 20,000 THB	22 (6.2%)	0 (0.0%)	3 (2.2%)
Not sure	59 (16.6%)	8 (6.2%)	9 (6.7%)
Among adolescents aged 13-18	**Latent Class 1**	**Latent Class 2**	**Latent Class 3**
Sex of participant			
Male	194 (45.6%)	64 (41.0%)	15 (25.0%)
Female	231 (54.4%)	92 (59.0%)	45 (75.0%)
Caregiver's personal monthly income			
Less than 3,000 THB	35 (8.6%)	18 (11.8%)	2 (3.7%)
3,000 THB to 5,000 THB	100 (24.6%)	53 (34.9%)	13 (24.1%)
5,001 THB to 10,000 THB	128 (31.4%)	42 (27.6%)	13 (24.1%)
10,001 THB to 20,000 THB	39 (9.6%)	12 (7.9%)	6 (11.1%)
More than 20,000 THB	10 (2.5%)	3 (2.0%)	4 (7.4%)
Not sure	95 (23.3%)	24 (15.8%)	16 (29.6%)

Among children aged 7-12 years, compared to those with a "Low" level of digital divide, those with "Moderate" and "Severe" levels of digital divide had 2-3 times higher odds of dropping out (Table 4). Among adolescents aged 13-18, those with a "Severe" digital divide had more than 8 times higher odds of dropping out than those with a "Low" digital divide. However, no such associations existed about the outlook or the prospect of completing secondary education (Table 5).

Table 4 Association between latent classes of digital divide patterns and history of educational interruption during the COVID-19 pandemic

Patterns	No interruption	Interrupted	Unadjusted OR (95% CI)	Adjusted OR (95% CI)*
Among children aged 7-12				
Latent Class 1	181 (54.0%)	154 (46.0%)	1 (*Reference*)	1 (*Reference*)
Latent Class 2	42 (33.1%)	85 (66.9%)	**2.38 (1.55, 3.65)**	**2.19 (1.39, 3.46)**
Latent Class 3	30 (19.4%)	125 (80.6%)	**4.90 (3.11, 7.70)**	**3.69 (2.29, 5.94)**
Among adolescents aged 13-18				
Latent Class 1	306 (97.8%)	7 (2.2%)	1 (*Reference*)	1 (*Reference*)
Latent Class 2	151 (96.8%)	5 (3.2%)	1.45 (0.45, 4.64)	1.30 (0.40, 4.21)
Latent Class 3	49 (86.0%)	8 (14.0%)	**7.14 (2.48, 20.56)**	**8.64 (2.83, 26.31)**

*Among children aged 7-12 years, adjusted for sex of the child, caregiver's level of education, and caregiver's monthly income. Among adolescents aged 13-18 years, adjusted for sex of the adolescent and caregiver's monthly income.

Table 5 Association between patterns of digital divide and outlook of secondary education completion

Patterns	Deemed able to complete secondary education	Deemed unable to complete secondary education	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Among children aged 7-12				
Latent Class 1	302 (87.0%)	45 (13.0%)	1 (*Reference*)	1 (*Reference*)
Latent Class 2	99 (82.5%)	21 (17.5%)	1.42 (0.81, 2.51)	1.34 (0.73, 2.48)
Latent Class 3	131 (89.7%)	15 (10.3%)	0.77 (0.41, 1.43)	0.90 (0.47, 1.73)
Among adolescents aged 13-18				
Latent Class 1	345 (86.0%)	56 (14.0%)	1 (*Reference*)	1 (*Reference*)
Latent Class 2	125 (83.3%)	25 (16.7%)	1.23 (0.74, 2.06)	1.23 (0.74, 2.06)
Latent Class 3	45 (83.3%)	9 (16.7%)	1.23 (0.57, 2.66)	1.23 (0.57, 2.66)

*Among children aged 7-12 years, adjusted for sex of the child, caregiver's level of education, and caregiver's monthly income. Among adolescents aged 13-18 years, adjusted for sex of the adolescent and caregiver's monthly income.

Conclusion and Discussion

In this cross-sectional study, we assessed how digital divides in online education were associated with school drop-out and the perceived prospect of completing secondary education among primary and secondary school-aged children in Thailand's Deep South region. We found that parents and students commonly reported an inability to access the internet via mobile phones or other devices and to keep up with class materials. The digital divide was associated with drop-out among primary and secondary school students, but there was no significant

association with the perceived prospect of secondary education completion. The findings of this study should be of interest to stakeholders in education and economic-social development. Our study contributed to the literature by measuring the three levels of the digital divide (Guo & Wan, 2022) and performing latent class analysis, which showed that digital divide issues existed at multiple levels simultaneously, albeit at varying degrees. Although mobile phones and internet connections were widely available in Thailand at the time of the survey (National Statistical Office, 2017), the sudden upfront costs of purchasing additional phones with an internet connection might have precluded all household members from accessing the internet simultaneously, further exacerbated by the need to prioritize food and other basic needs during an economic crisis (IEEE, 2023). However, although we measured issues at the first level (divide in the ability to access the internet) and second level (divide in online behavior) of the digital divide objectively, our measurement of the third level of the digital divide (i.e., whether the child could keep up with school) was based on each participant's subjective interpretation of the ability to follow the curriculum. If the participants tended to over-report the ability to follow the curriculum due to social desirability (to avoid admission of academic difficulty of self or the child), then the prevalence of the third-level digital divide could have been over-reported. In other words, the study could have been subjected to social desirability bias.

The association between the digital divide and school dropout during the pandemic concurred with the findings of previous studies (Chatterji & Li, 2021; Khan & Ahmed, 2021; Lichand et al., 2022). However, the lack of association with the perceived prospect of completing secondary education suggested that either the effect of dropout from education was temporary or the response regarding the prospect of secondary school completion was influenced by either social desirability or response acquiescence. The issue of dropout from the education system may be part of a broader picture of educational attainment in Thailand, in which drop-outs are common during secondary education (Chiangkul, 2015; Chitviriyakul, 2023). However, the study region does not only face issues with school management and inefficient public resource allocation like in other parts of Thailand (Durongkaveroj, 2023), but also faces inequality in dropouts, with a higher likelihood among Malay Muslim students, particularly boys (Uddin & Sarntisart, 2023). Residents of the Deep South generally view the centralized national education framework with either negativity, skepticism, or apathy (Pherali, 2023). The digital divide in this study may create an additional self-fulfilling prophecy in education but imposed by the students themselves rather than the teachers or other components of the education system (Gentrup et al., 2020). Education may be deemed by students who dropped out as a futile effort, considering the lack of resources to access online classes and the lack of means to obtain access otherwise, creating a self-stereotype that further undermines self-efficacy in education and potentially contributes to inter-generational poverty (Fell & Hewstone, 2015). Furthermore, considering that schools in the Deep South receive a budget to provide lunch on the days that schools are open, school closures and dropouts might have had additional effects on students' nutrition, which could also affect health and academic performance (Delbiso et al., 2021).

The primary strength of our study was the relatively large sample size, which enabled us to perform more complex analyses. However, several considerations should be taken into account in the interpretation of our study findings. Firstly, the cross-sectional study design did not enable us to ascertain the temporality of the observed associations. We did not know when the issue of the digital divide occurred and the extent to which each issue persisted for our participants. Secondly, our measurements were potentially affected by subjective interpretations of the study questions and social desirability and response acquiescence, all of which could have introduced bias to the study findings. Thirdly, we conducted this survey only in a region in the Deep South of Thailand, which limited the generalizability of the study findings (i.e., to an impoverished region with a prolonged armed conflict where the majority

of the population are Muslims who spoke a local dialect of the Malay language as the mother tongue).

In conclusion, we described the extent to which the digital divide in online education was associated with school dropout during the COVID-19 pandemic and the perceived prospect of completing secondary education in an impoverished region in Thailand. We found an association between the digital divide and school dropout during the pandemic, but there was no association with the perceived prospect of completing secondary education. These results contribute to the literature and should interest stakeholders in education and economic and social developments. However, the study design, potential information biases, and limited generalizability should be considered caveats in interpreting the study findings. Future studies should consider further improvement on this study's measurement questions and instruments to reduce potential social desirability bias.

Recommendations

1) Introduce a systematic assessment of the digital divide in education at various levels to obtain basic information for future education program planning while being mindful of the cultural contexts and infrastructure limitations in the Deep South region of Thailand.

2) Conduct a follow-up assessment of students in the Deep South region of Thailand who completely withdraw from the formal educational system to plan for non-traditional education.

Recommendations for Future Research

1) Assess the temporality of the digital divide and school drop-out.

2) Consider measures less likely to introduce social desirability bias, such as mining open access information, to yield potentially accurate insights regarding the association between the digital divide and educational attainment.

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