THE DIGITAL TALENT INDEX:

Measuring Digital Skills for the Workforce

Presented by Chris McGovern and David Nunnally,
Connected Nation, Inc.
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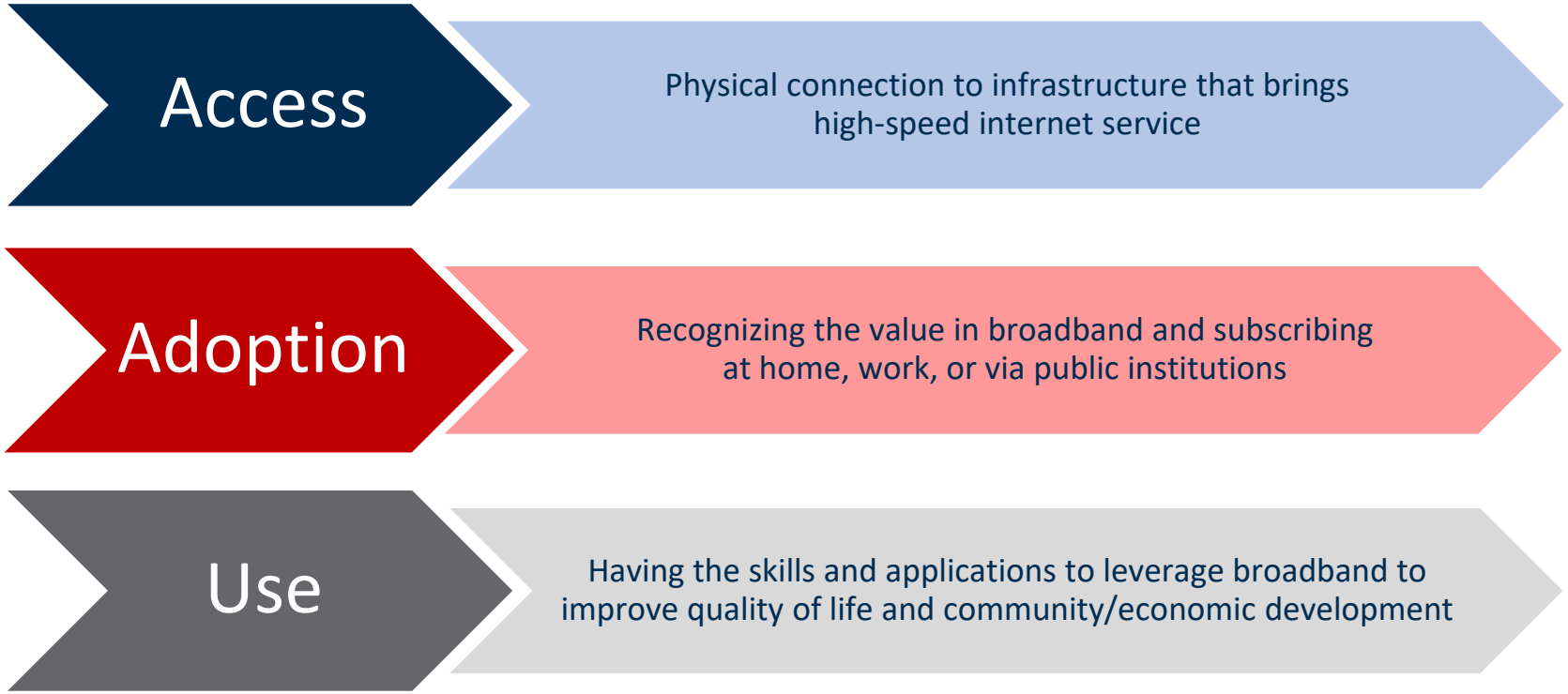
CONNECTED NATION™

Connected Nation

who we are

"Our mission is to improve lives by providing innovative solutions that expand the access, adoption, and use of high-speed internet and its related technologies to all people.
Everyone belongs in a Connected Nation."



Research Questions
and data description

RESEARCH QUESTIONS:

1) How do individuals rate their ability to use the digital skills that employers need?

2) How can those self-reported skills be measured empirically and how can those findings be used by employers and policymakers?

DATA SOURCE:

- Connected Nation surveyed 32,591 households across 163 counties in Texas between September 2019 and December 2022 through the Connected Community Engagement Program.
- Connected Nation collected data through online and paper surveys filled out by self-selected respondents.

Digital Skills
and why they matter

Digital skills = abilities that relate to digital technologies

- Hardware devices
- Software applications
- Communication tools
- Online activities

Why they matter:

- Allow individuals and businesses to work more efficiently
- Companies can take on additional projects and maximize revenue
- Individuals with digital skills have a comparative advantage in the job market and an increased ability to work from home to maximize their quality of life
- Localities where this work takes place see increased tax revenue, which can foster economic development

Data Collection
considerations

Online and paper surveys filled out by self-selected respondents.

Benefits to this approach:

- Efficient and cost-effective
- Anonymous and private

Drawbacks to this approach:

- Response bias
- Nonresponse bias (Skilled individuals might be overrepresented)
- Scale assumptions
- *Temporal variability*

The Digital Talent Index

design and purpose

The Digital Talent Index (DTI) is based on responses to the following question:

Rate your skill level related to each activity (ordinal scale)

- Not interested = NA
- I need to learn = 0
- I know a little = 1
- I'm comfortable with it = 2
- I could teach this = 3

Composite score

- Sum of item scores divided by the number of items
- Each item carries equal weight in the index
- Benefits: simple, easy to use and interpret, efficient, cost-effective
- Drawbacks: response/nonresponse biases, subjectivity, temporal variability

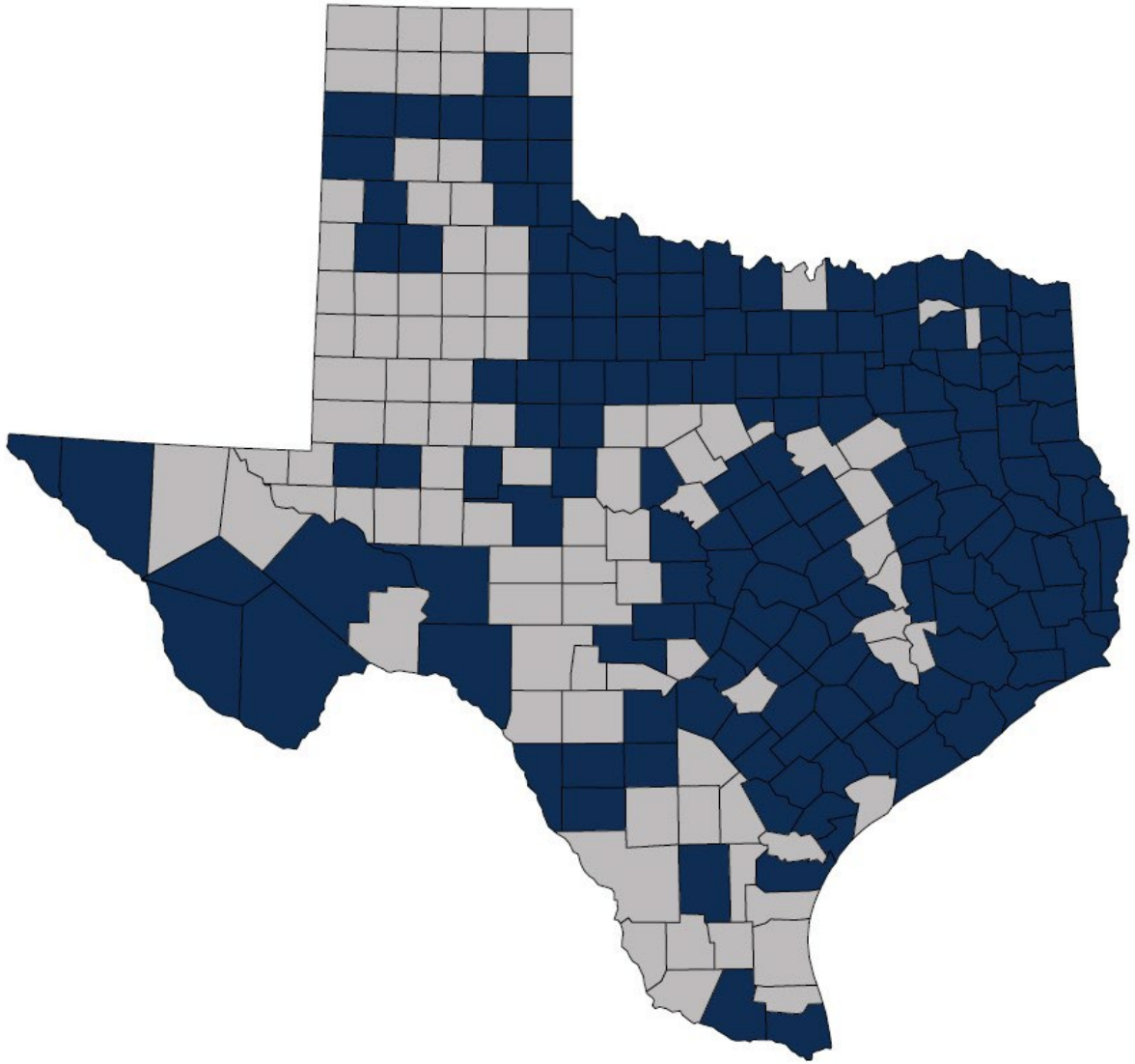
Alternative Measurement
model

An alternative formulation of the DTI relaxes the assumption that each item carries equal weight.

Latent variable

- Graded response model
  - Item response theory model that relies on ordered polytomous categories
- Items do not carry equal weight
  - Model calculates a probability based on item difficulty and discrimination parameters
- Benefits: precise measurement
- Drawbacks: difficult to explain

Spatial Domain

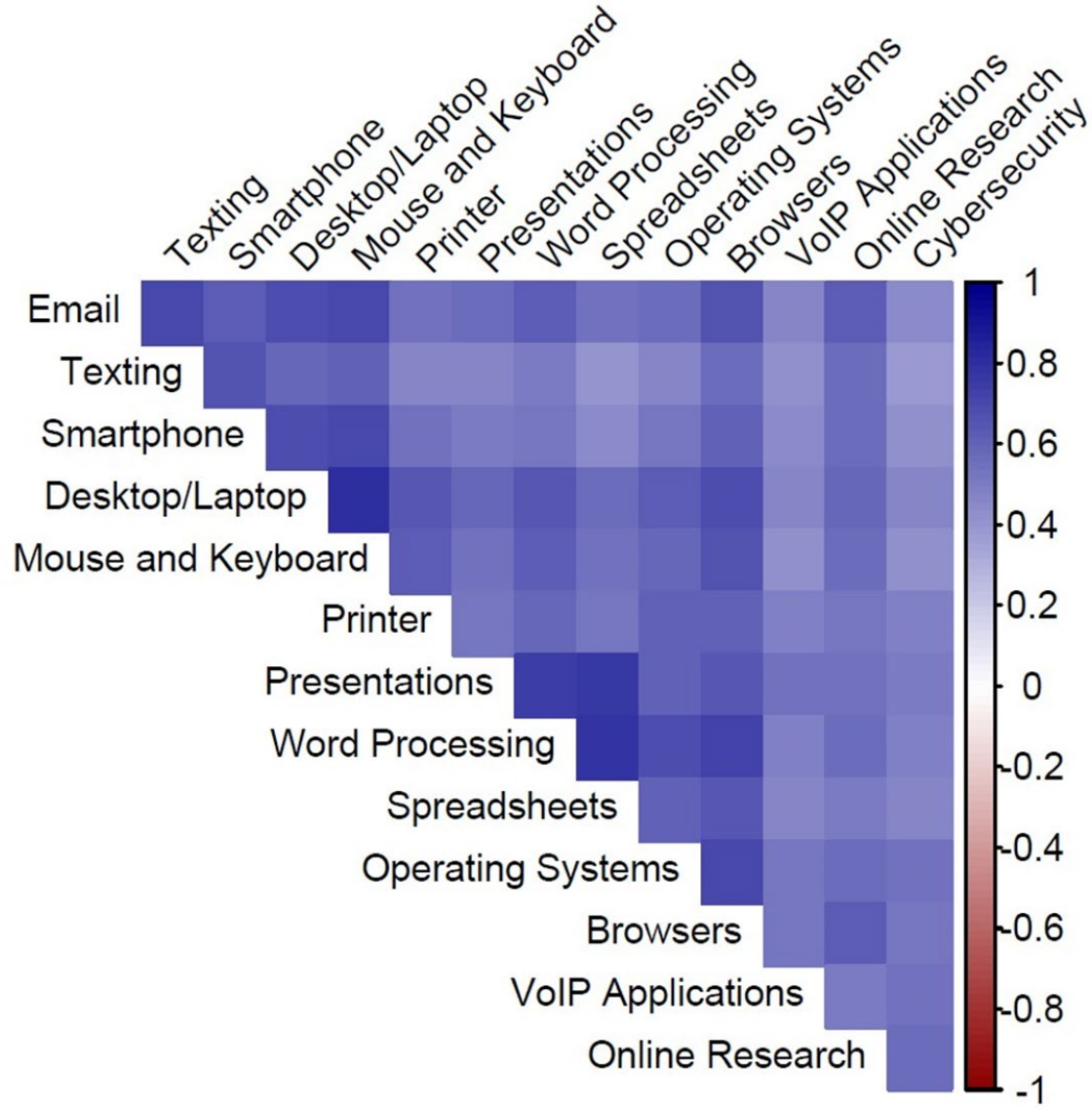


The Digital Talent Index

self-reported skills

Hardware devices	Software applications	Communication tools	Online activities
Desktop/laptop	Operating systems	Email	Cybersecurity
Smartphone	Word processing	VoIP applications	Online research
Mouse and keyboard	Spreadsheets	Texting	
Printer	Presentations		
	Internet browsers		

How Survey Items Correlate



Incorporating Measurement Uncertainty

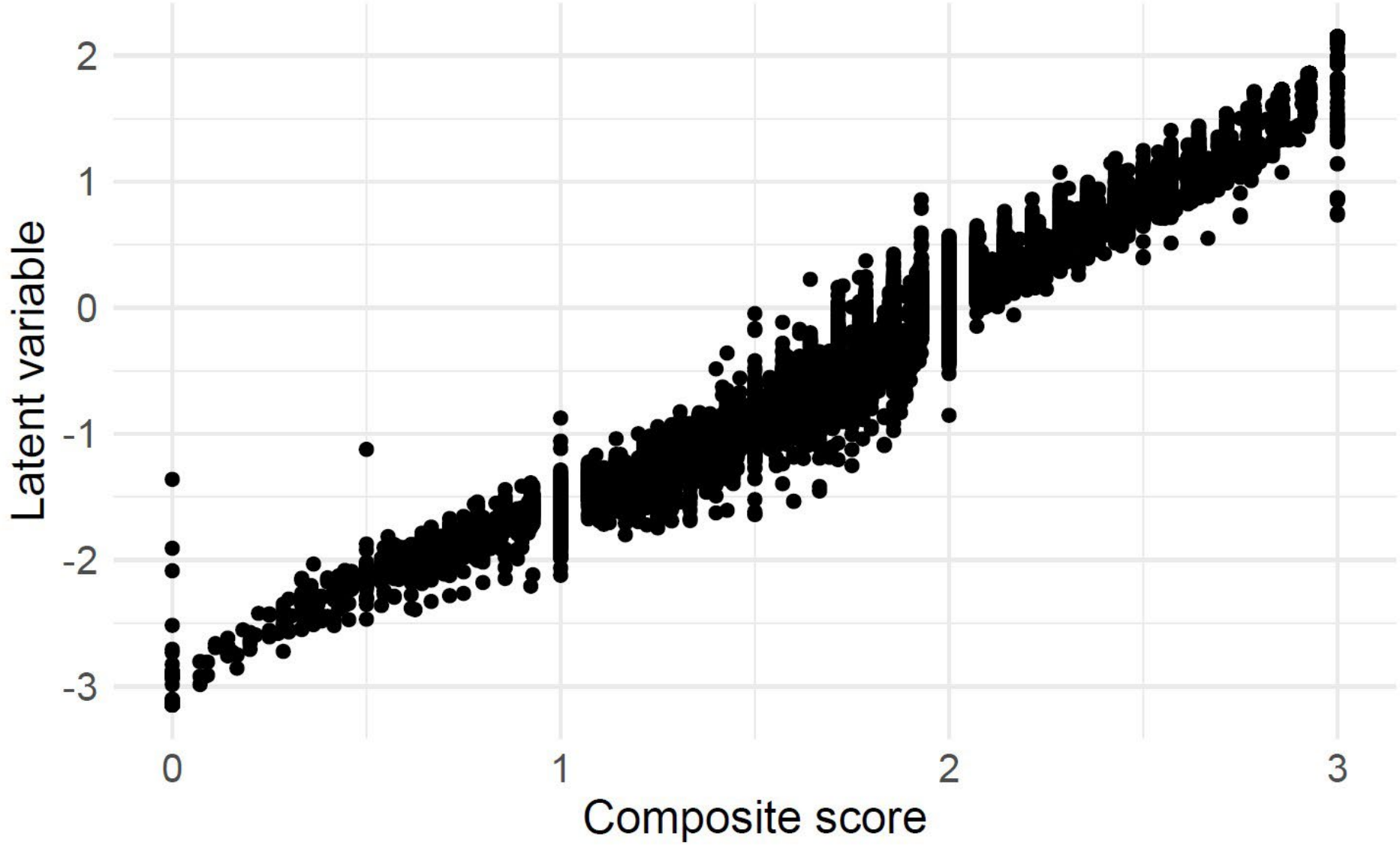
Composite score:

- The number of unanswered survey items serves as a crude measure of uncertainty
- Less survey items answered = less certainty that the score reflects someone's digital skills

Latent variable:

- Model calculates a point estimate of the posterior distribution and the standard error of the posterior distribution
- Standard error provides an estimate of how much uncertainty is associated with each calculated score
- High standard error = less certainty that the point estimate reflects someone's digital skills

Comparing Measures



Correlation coefficient = 0.987

Plausibility Probes

Individual-level hypotheses:

- Education level → score
- Score → skill conducting an online job search
- Score → use internet for work

County-level hypotheses:

- County score → county unemployment rate
- County score → county economic output
- County score → county personal income
- County score → county poverty rate

Summary Statistics

Table 1: Descriptive Statistics

Variable	N	Mean	SD	Min	Max	Range	SE
Composite Score	24,996	2.01	0.56	0.00	3.00	3.00	0.00
Latent Variable	32,587	0.06	0.85	-3.15	2.15	5.29	0.00
Bachelor's Degree or Higher	22,800	0.23	0.42	0.00	1.00	1.00	0.00
Respondent Uses Internet at Work	15,771	0.96	0.19	0.00	1.00	1.00	0.00
Job Search Skills	20,107	1.99	0.75	0.00	3.00	3.00	0.01

Modeling Measurement Uncertainty

Composite score:

- Ordinary least squares regression models when score is the DV
- Weighted least squares regression models when score is the IV
  - Weight = uncertainty measure / max (uncertainty measure)
  - Observations with less uncertainty are given more weight in the model

Latent variable:

- Ordinary least squares regression models when variable is the DV
- Weighted least squares regression models when variable is the IV
  - Weight = 1 / (uncertainty measure)^2
  - Observations with less uncertainty are given more weight in the model

Individual-Level Analyses

Table 2: Ordinary Least Squares Regression Results

	Composite Score	Latent Variable
Bachelor's Degree or Higher	0.175***	0.314***
Constant	1.976***	0.017*
N	22,639	22,800
R^2	0.017	0.019
Residual Std. Error	0.553 (df = 22637)	0.962 (df = 22798)
F Statistic	402.341*** (df = 1; 22637)	433.479*** (df = 1; 22798)

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

Individual-Level Analyses

Table 3: Weighted Least Squares Regression Results

	Respondent Uses Internet for Work	
Composite Score	0.056***	
Latent Variable		0.040***
Constant	0.845***	0.954***
N	15,637	15,771
R^2	0.024	0.031
Residual Std. Error	0.184 (df = 15635)	0.880 (df = 15769)
F Statistic	391.428*** (df = 1; 15635)	496.103*** (df = 1; 15769)

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

Individual-Level Analyses

Table 4: Weighted Least Squares Regression Results

	Job Search Skills	
Composite Score	0.935***	
Latent Variable		0.535***
Constant	0.047**	1.877***
N	20,107	20,107
R^2	0.463	0.397
Residual Std. Error (df = 20105)	0.544	2.649
F Statistic (df = 1; 20105)	17,320.320***	13,264.260***

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

County-Level Aggregation

and measurement uncertainty

County-level weighted averages based on uncertainty measures

- Composite score weight = uncertainty measure / max(uncertainty measure)
- Latent variable weight = 1 / (uncertainty measure)^2

Drop counties with fewer than 100 observations

Additional County-Level Measures

Log of GDP:

Regional Economic Accounts data from the US Bureau of Economic Analysis, 2021

Log of Per Capita Personal Income:

Regional Economic Accounts data from the US Bureau of Economic Analysis, 2021

Poverty Rate:

Census Bureau, Small Area Income and Poverty Estimates, 2021

Unemployment Rate:

Census Bureau, Small Area Income and Poverty Estimates, 2021

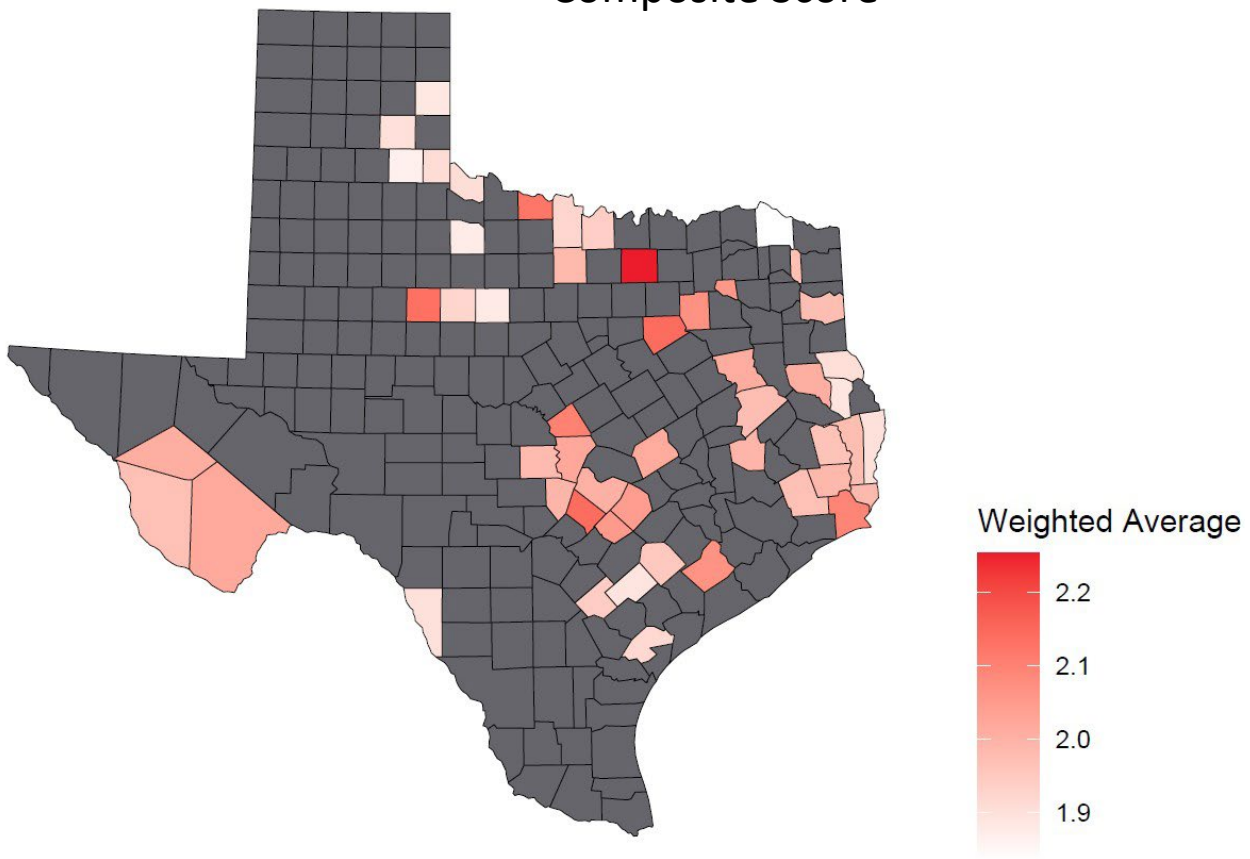
Summary Statistics

Table 5: Descriptive Statistics

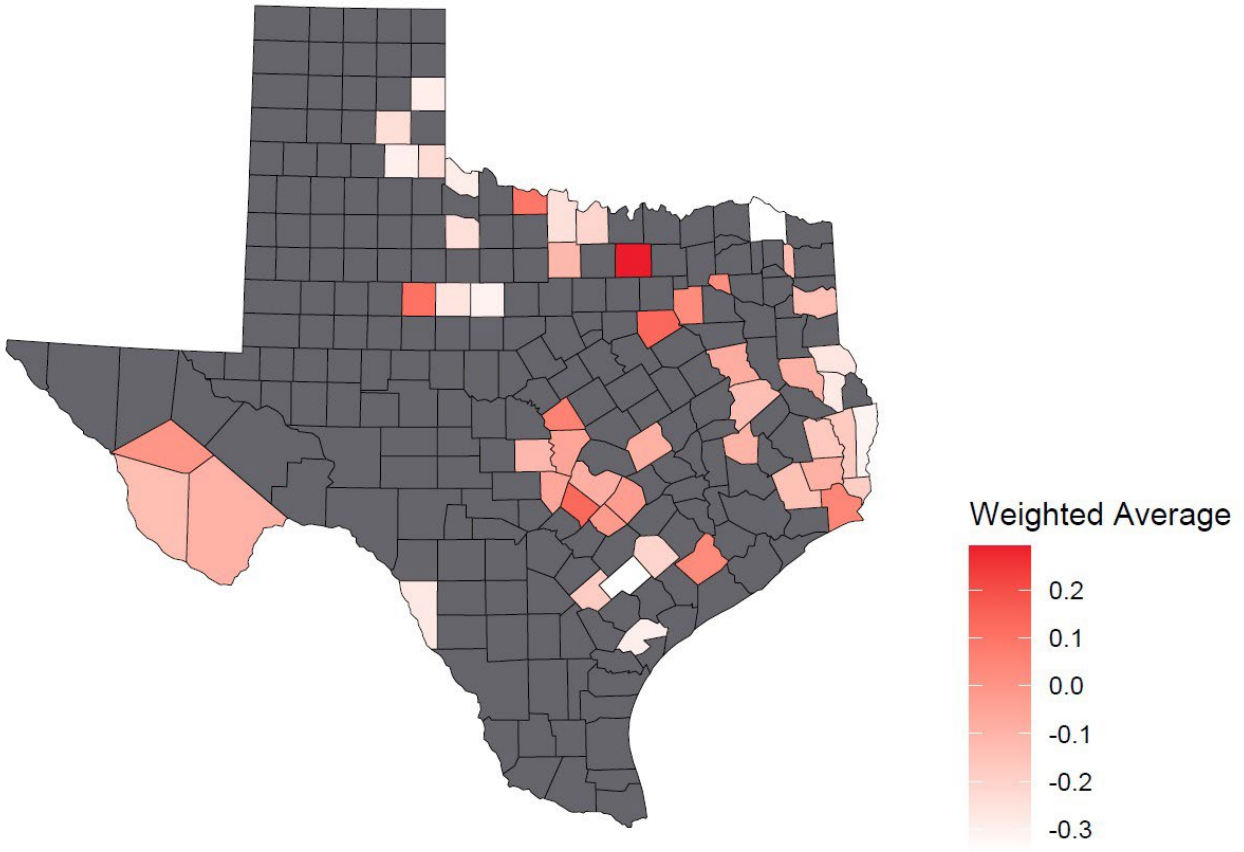
Variable	N	Mean	SD	Min	Max	Range	SE
Composite Score	51	1.98	0.09	1.83	2.25	0.42	0.01
Latent Variable	51	-0.13	0.14	-0.35	0.29	0.64	0.02
Log of GDP	51	14.00	1.50	11.51	18.83	7.32	0.21
Log of Per Capita Personal Income	51	10.85	0.19	10.41	11.44	1.03	0.03
Poverty Rate	51	15.95	4.47	7.40	24.10	16.70	0.63
Unemployment Rate	51	4.21	1.21	2.70	7.90	5.20	0.17

County-Level Data Visualization

Composite Score



Latent Variable



County-Level Analyses

Table 6: Weighted Least Squares Regression Results

	Log of GDP	
Composite Score	10.288***	
Latent Variable		5.682***
Constant	-6.073	15.117***
N	51	51
R^2	0.468	0.412
Residual Std. Error (df = 49)	0.394	0.414
F Statistic (df = 1; 49)	43.053***	34.287***

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

County-Level Analyses

Table 7: Weighted Least Squares Regression Results

	Log of Per Capita Personal Income	
Composite Score	0.479	
Latent Variable		0.259
Constant	9.842***	10.829***
N	51	51
R^2	0.064	0.054
Residual Std. Error (df = 49)	0.066	0.066
F Statistic (df = 1; 49)	3.350	2.794

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

County-Level Analyses

Table 8: Weighted Least Squares Regression Results

	Poverty Rate	
Composite Score	-29.417***	
Latent Variable		-17.370***
Constant	74.546***	13.871***
N	51	51
R^2	0.267	0.268
Residual Std. Error (df = 49)	1.750	1.748
F Statistic (df = 1; 49)	17.837***	17.982***

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

County-Level Analyses

Table 9: Weighted Least Squares Regression Results

	Unemployment Rate	
Composite Score	-5.388**	
Latent Variable		-3.518**
Constant	15.098***	3.959***
N	51	51
R^2	0.139	0.172
Residual Std. Error (df = 49)	0.480	0.471
F Statistic (df = 1; 49)	7.941**	10.145**

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

Recommendations

for future research

What can additional plausibility probes show about the economic and community impacts of improving digital skills?

What can cost/benefit analyses show about the optimal spending level for communities to maximize the benefit of digital skills training programs?

How best to visualize the data and their impacts in real time?

Questions may be directed to

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