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Understanding the Effects of Non-Cognitive Skills and Gender Beliefs on Digital Skills:

A Longitudinal and Comparative Study Across Four Developing Countries

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Abstract. Recognizing the multitude of barriers to digital inclusion in developing countries, this study contributes fresh evidence on predictors of digital skills. Specifically, we examine the effects of non-cognitive skills, which in this paper consists of motivation and grit and socio-emotional competence, and gender beliefs on computer skills and internet skills. We use panel data from the Young Lives (YL) survey, collected over a 15-year period in Ethiopia, India, Peru, and Vietnam. With a sample of 2,654 individuals born in 1994/95, we run ordinary least squares (OLS) regressions to establish potential correlations. This study suggests that the impact of motivation and grit, socio-emotional competence, and gender beliefs differ by country and these factors have different effects on computer skills and internet skills. Our findings provide important insights into what factors influence digital inclusion in low- and middle-income countries.

Keywords: computer skills, internet skills, motivation and grit, socio-emotional competence, gender beliefs

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1. Introduction

The rate of global technology adoption is increasing rapidly, contributing to a boost in productivity, improvement of services and expansion of job opportunities. People benefit from digital skills when studying, working, accessing online public services, communicating, and finding trustworthy information. Yet the aggregate impact of digital technologies is unevenly distributed, and digital inequality is one of the most important issues we face today, according to the World Bank (2016). The digital divide has been defined as “the gap between people who do and do not have access to forms of information and communication technology (ICT)”, and that is primarily the internet and computers (Van Dijk, 2017).

However, as many researchers have concluded, increasing physical access will not be enough. The World Bank (2016) argues that there is a need for “analogue complements” to greater digital access, such as improving people’s digital skills so that they can take full advantage of opportunities of the new, digital economy. Furthermore, they argue that the many components of ICTs and their widespread use in all sectors of society have made digital skills and digital literacy increasingly important, and automation in an increasing number of sectors puts a premium on skills that it complements rather than replaces. For this reason, several authors have discussed inequalities in skills needed to effectively use ICTs and refer to this as the “second-level divide” (Hargittai, 2002; Van Dijk, 2017).

Unfortunately, many studies are still limited to study the effects of individual characteristics and socioeconomic factors, such as gender and educational level (Hargittai, 2002; Cueto et al., 2018), and do not take the effects of norms and non-cognitive factors such as personality traits and attitudes into account. Therefore, to address the various barriers to digital inclusion for young adults in low- and middle-income countries, this study seeks to examine the effects of non-cognitive skills and gender beliefs on digital skills, in the context of developing countries. Specifically, the following question is addressed:

*Does motivation and grit, socio-emotional competence, and gender beliefs
have an effect on computer skills and internet skills?*

This study contributes to the literature on digital inclusion in several ways. Firstly, we look at factors affecting young people’s computer and internet skills. Thus, our findings provide important insights into what factors influence digital inclusion or exclusion. Secondly, this

study further contributes to research seeking to find predictors of digital skills in the context of developing countries. Determining country specific relevance of certain non-cognitive skills and gender beliefs variables can aid in future policy making that aims to enhance digital skills.

The data used in this study comes from the Young Lives (YL) surveys. YL is a longitudinal study which has followed individuals in Ethiopia, India, Peru, and Vietnam, over a 15-year period. The data is extensive and provides relevant information on the individual, household, and cluster level. Although the YL study consists of two different cohorts, our study will only be based on the older cohort, who were around 22 years old when the data from Round 5 was collected. This is because we wish to capture the skills of young adults who are in the late years of, or have finished, their education. The sample size decreases from a total of 3,722 observations in Round 1, to 2,654 observations in the final regressions. We examine the relationship between our independent variables: socio-emotional competence, grit and motivation, and gender beliefs, and our dependent variables: computer and internet skills, through ordinary least squares (OLS) regressions. To address the problem of heterogeneity we employ control variables and control for cluster level fixed effects.

The remainder of this paper is organized as follows. Section 2 provides a background on the countries studied by looking at economic factors and trends in access and usage of computers and the internet. Section 3 provides an overview of the relevant academic literature and theory. Section 4 presents our conceptual framework and hypotheses. Section 5 provides further information regarding the YL data sample, the econometric model, descriptive statistics, and our relevant variables. Section 6 presents the empirical results. Section 7 discusses the results, limitations of the study, and the contribution of this study's findings, and provides suggestions on future research. Finally, section 8 presents the conclusion.

2. Background

In this section, an overview of factors is provided that are relevant in the context of digital inclusion and the later cross-country analysis, by looking at an economic overview of the four countries studied as well as trends in digital access and usage. The countries studied exhibit a variety of characteristics which distinguishes them from each other and therefore important to address.

2.1 Economic Overview

Ethiopia is classified as a low-income economy (The World Bank, 2020), and has experienced the highest growth of the four countries with an average annual economic growth rate above ten percent since 2003. Vietnam and India are both classified as lower-middle-income economies and have experienced an average annual growth rate of about six to seven percent. Peru is classified as an upper-middle-income economy and has sustained an average annual growth rate of about five percent.

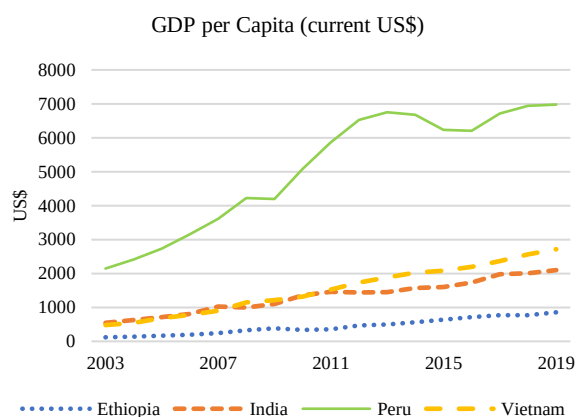


Figure 1

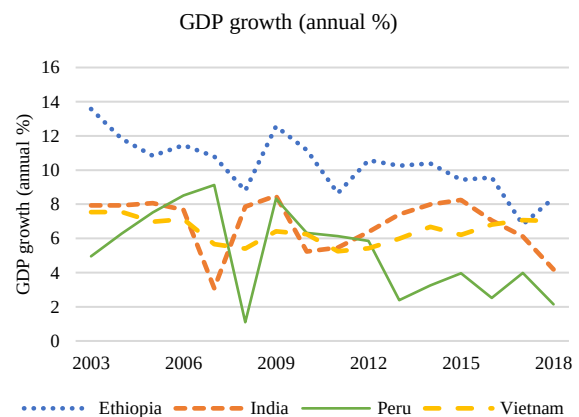


Figure 2

Note: Figure 1: The World Bank (2019a). Figure 2: The World Bank (2018).

Table 1 shows that the rural population decreases in all four countries between 2002 and 2016. However, the share sizes greatly differ. In Ethiopia, India and Vietnam, a much larger share of the population lives in rural residences, while in Peru this share is only about one fifth of the population. The primary school completion rate also varies greatly between the countries. By 2015, three out of four countries almost had a 100% completion rate, while in Ethiopia, the completion rate is only about half that. Lastly, the Gini coefficient indicates a much greater income inequality in Peru than in the other countries.

Table 1: Country Characteristics

Country	Rural Population (%)		Poverty Rate (%)			Primary Completion		Gini
			USD 1.90 per day, PPP 2011			Rate (%)		Coefficient
	2002	2016	2004	2010 - 2011	2015 - 2016	2002	2015	2010 - 2011
Ethiopia	85	80	36	34	27	31	54	33
India	72	67	38	21	-	76	98	35
Peru	26	21	14	6	4	97	99	46
Vietnam	74	66	27	4	3	101	104	39

Note: The World Bank (2019d; 2017; 2019c; 2011).

2.2 Trends in Computer and Internet Access

There is a great disparity in internet usage across the four countries. Despite Peru having the highest GDP per capita (see Figure 1), Vietnam has higher internet usage as they surpassed Peru around 2014 (see Figure 3). This is followed by India with the third highest percentage of internet users, which is lastly followed by Ethiopia. Looking at Figure 3, it is evident that Peru and Vietnam adopted the internet much earlier than the other two. Ethiopia and India, which started their digital journey much later, are far behind. Ethiopia, for instance, has around the same percentage of their population using the internet as Peru did around 14 years ago. Although Figure 4 illustrates a relatively short time frame, it communicates a difference in access to personal computers per country and corresponds with the differences in GDP per capita. Figure 3 illustrates that Vietnam has a higher percentage of internet users than Peru, however, these roles are switched when it comes to households with computers, in which an additional ten percent of the population in Peru have computers in their household. It is visible that all countries are moving in an upward trajectory, with the greatest development being made by Peru and India. Ethiopia has the lowest increase in real terms, but the second highest increase in relative terms.

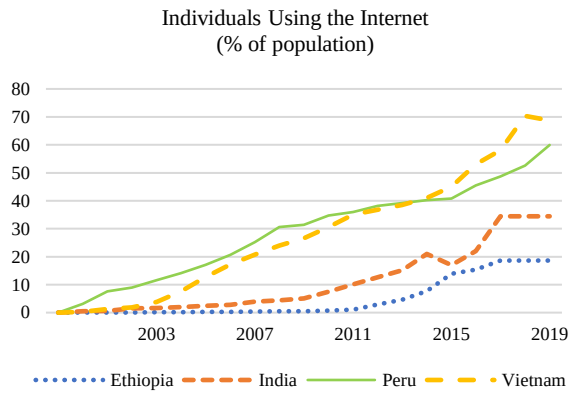


Figure 3

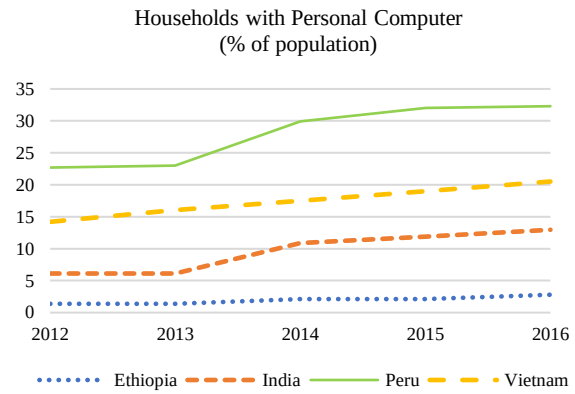


Figure 4

Note: Figure 3: The World Bank (2019b). Figure 4: Baller et al. (2016).

2.3 Computer and Internet Usage

Table 2 presents information regarding digital usage and presence in the countries studied for individuals around 22 years of age, from the YL dataset. For the first two variables in the table, a larger share of male respondents than female respondents have used computers or the internet, with the exception of Vietnam, where a larger share of females have used the internet. In absolute terms, the gender gap is widest in India, while both variables show similar shares for men and women in Peru and Vietnam. Neither males nor females seem to use computers or the internet to a great extent in India, and in Ethiopia the percentage is even lower.

Furthermore, Table 2 shows that the largest share of frequent computer users can be found in Peru, where 43% of males and 39% of females use a computer on a daily basis. 85% of females in both Ethiopia and India reply that they never use a computer, and the same reply for males is 82% and 73%, respectively. Regarding the internet, the largest share of users can be found in Vietnam, where 70% of males and 77% of females use the internet on a daily basis. Again, the largest share of people replying “never” to both questions can be found among the female population in Ethiopia, 87%, and India, 88%.

Table 2: Digital Usage Amongst YL Children

		Ethiopia		India		Peru		Vietnam	
		M	F	M	F	M	F	M	F
<i>Have you ever used the following</i>									
- Computer	S	.180	.160	.275	.156	.725	.674	.635	.592
	N	427	387	448	474	320	288	447	463
- internet	S	.218	.134	.353	.131	.759	.712	.834	.862
	N	427	387	448	474	320	288	447	463
<i>How often have you used the following in the last 12 months</i>									
<u>Computer</u>									
- Never	S	.820	.845	.725	.846	.281	.338	.380	.421
	N	427	387	448	474	320	287	447	463
- Less than Monthly	S	.009	.010	.004	.004	.016	.031	.051	.069
	N	427	387	448	474	320	287	447	463
- Monthly	S	.042	.023	.036	.034	.044	.035	.069	.065
	N	427	387	448	474	320	287	447	463
- Weekly	S	.061	.052	.098	.038	.228	.206	.159	.112
	N	427	387	448	474	320	287	447	463
- Daily	S	.068	.070	.136	.078	.431	.390	.340	.333
	N	427	387	448	474	320	287	447	463
<u>Internet</u>									
- Never	S	.785	.868	.647	.876	.244	.293	.170	.145
	N	427	387	448	474	320	287	447	463
- Less than Monthly	S	.009	.010	0.00	0.00	.013	.017	.004	.004
	N	427	387	448	474	320	287	447	463
- Monthly	S	.023	.013	.033	.019	.025	.028	.022	.022
	N	427	387	448	474	320	287	447	463
- Weekly	S	.084	.049	.136	.032	.181	.125	.101	.063
	N	427	387	448	474	320	287	447	463
- Daily	S	.098	.059	.183	.074	.538	.537	.702	.767
	N	427	387	448	474	320	287	447	463
<i>How old were you the first time you used the following (if ever used)</i>									
- Computer	m	16.763	17.823	16.309	17.514	12.142	12.338	13.708	14.496
	N	76	62	123	74	232	195	284	274
- Internet	m	16.387	17.808	17.709	18.387	13.144	13.675	14.973	16.018
	N	93	52	158	62	243	206	373	399
<i>Do you have the following</i>									
- Email	S	.150	.083	.498	.156	.603	.573	.613	.622
	N	427	387	448	474	320	288	447	463
- Social Network Account	S	.211	.124	.529	.165	.738	.670	.848	.864
	N	427	387	448	474	320	288	447	463

Note: Data from the YL survey Round 5.¹ M and F stand for male and female. S, N, and m stand for share, number of observations, and mean, respectively.

¹ Social Network Account refers to e.g., Facebook, WhatsApp, etc.

The question “How old were you the first time you used the following” is only asked to those who answered “Yes, many times in my life” to the question “Have you ever used a computer” or “Have you ever used the internet” in the YL questionnaire. Hence, the number of observations for these variables differ from the rest. Out of these respondents, the average age of first using computers and the internet is the lowest in Peru. However, there are more people in the Vietnamese sample for this variable. In the case of Ethiopia and India, the average age for both variables is considerably higher.

Lastly, it is more common to have a social network account than an email account in all four countries for both genders. The share of males having an email and a social network account are considerably higher than those of females in all countries except Vietnam. This gender gap is, again, largest in India, where around 50% of males have an email and a social network account, this share being only around 15% for females.

3. Previous Literature and Our Contribution

This section presents previous research on the first, second, and third level of the digital divide with a focus on the second, as well as gender and non-cognitive skills in relation to technology adoption. We begin by presenting earlier research on the YL data set and conclude the section with how this study contributes to existing literature.

3.1 Young Lives Technical Note

The study closest to our own is a technical note by Cueto et al. (2018), who use the same data set as in our study. In their note, the authors outline the procedure used to develop the digital module in the YL questionnaires. They also present descriptive statistics as well as a multivariate analysis, from which they find evidence of certain predictors of internet and computer skills, usage, and access. Firstly, they find that starting to use computers and the internet at an early age, and using them daily, is associated with higher levels of digital skills for most countries. This indicates that more practice is linked with higher skills. Secondly, they find that a wealth index², maternal education, ethnicity, and mathematics achievement are significant predictors of computer and internet usage for most countries. Lastly, the results concerning digital access are similar to that of usage. They find that certain socioeconomic factors predict access to computers 15 years later, such as wealth, ethnicity, and maternal

² The wealth index is further discussed in section 5.3.2.

education. They also found an association between computer and internet access and tertiary education. The determinants of digital skills versus access and usage greatly differ. This is likely because the analysis of determinants of skills only includes respondents who have used computers or the internet many times in their lives, resulting in a much smaller group of people compared to that of access and usage.

3.2 The Digital Divides

There is a wealth of literature on the first level of the digital divide which assumes a dichotomous view - either you have access to computers and the internet, or you do not have access (Ferro et al., 2011). Scholars initially aimed to understand access to technology, not the complexity of individual use, and scholars framed the problem solely as a delay in the diffusion of technology among different social groups and geographic areas (Becchetti and Leonardo, 2003). Studies on inequalities among various segments of the population paid particular attention to education, race, gender, age, income, and rural residence (Hargittai, 2002). Therefore, this view tends to ignore the influence of various ICT related skills and their impact on access.

Scholars eventually shifted their focus from inequalities in access to inequalities in skills among users. Hargittai (2002) was one of the first researchers to suggest a second-level digital divide and argued that as the new mediums spread within the population it becomes increasingly important to identify different levels of online skills among individuals, as this also constitutes a barrier to digital inclusion. She found that experience with the technology is positively correlated with online skill, age is negatively correlated, and gender does little to explain the variance in skill. Other studies have found similar results (Blank and Groselj, 2014; Van Deursen and Van Dijk, 2010).

The debate has shifted once more to consider the consequences of internet use, not only access and skills. Attewell (2001) defined the third level of the digital divide as “unequal outcomes” that “may stem from differences between affluent and disadvantaged students in what they do with the technology, once they have access” (Attewell, 2001, p. 6). At the time, he claimed that, even if we would be able to provide every child with a computer and internet connection, inequalities would prevail. “Affluent children will leverage their ample resources of social and cultural capital to excel in this new area of skill” (Attewell, 2001, p. 7).

3.3 Gender and Technology Adoption

The multidimensional views on digital inequalities focus on individuals and their use of ICTs and challenge the dichotomous view by conceptualizing the digital divide as something arising from several endogenous and exogenous factors (Ferro et al., 2011). They recognize that history and social context often influence how individuals and communities employ technology but reject the assumption that one group of individuals inherently uses it differently (Nelson et al., 2001). However, some scholars hypothesize that while the gender gap in internet use has narrowed, the issues of “gendered patterns of computer and internet use will emerge and diverge in different cultures and societies based on their particular construction of gender roles” (Dholakia, 2006, p. 239). This suggests that gender norms play a role in the technology adoption in a community, and one of our contributions to the literature is therefore to investigate the effect of progressive gender beliefs on computer and internet skills.

There is a large pool of literature on gender and technology usage (Venkatesh and Morris, 2000; Weiser, 2004), as well as on stereotyping about computers (Hargittai and Shafer, 2006; Whitley, 1997). One study, in which the authors tested how self-perceived abilities are related to actual abilities and how these differ by gender, found that women’s online abilities do not greatly differ from men, but that their self-assessed skills are significantly lower (Hargittai and Shafer, 2006). Whitley (1997) found in his study that male participants demonstrated a greater sex-role stereotyping of computer usage. That is, male participants had the perception that computers are more appropriate for men than for women and that men have more computer-related skills than women. They were also found to report higher self-efficacy than female participants. The fact that men exhibit higher self-efficacy scores is a recurring finding in many studies (Campbell, 1990; Torkzadeh and Van Dyke, 2002). Furthermore, Venkatesh and Morris (2000) found that women are more strongly influenced by subjective norms than men, which relate to the social pressures to pursue or not pursue a certain behavior. This highlights the importance of understanding the impact of gender beliefs on digital skills.

Moreover, most empirical findings concerning these effects on technology adoption processes have been provided by studies carried out in Western cultures (Jaradat and Faqih, 2014). Research regarding gender norms and technology adoption in developing countries is limited and mostly addresses the case of female farmers, in which empirical evidence has revealed that gender norms shape the way men and women behave toward, adopt and benefit from agricultural technologies (Mudege et al., 2016; Twyman et al., 2015). In a study on

women's demand for and adoption of labor-saving technology in maize-based systems in Ethiopia and Kenya, the scholars found that intra-household gender dynamics seems to work against women's demand for mechanization that could reduce labor constraints (Badstue et al., 2020). In conclusion, the research on digital skills in developing countries is limited, but it does show how gender variations and dynamics affect the adoption process in developing countries. Thus, it is important to study the effect of gender beliefs.

3.4 Non-Cognitive Skills and Technology Adoption

Van Dijk and Hacker (2003) discuss the lack of data and research on mental barriers to digital inclusion and claim that “mental access problems become more important when it is claimed that there are not only information have-nots, but also information want-nots. Thus, there also are important motivational problems.” (Van Dijk and Hacker 2003, p. 317). One prominent example of this is the One-Laptop-Per-Child Program. The goal with this program was to give children the chance to access a computer and learn how to use it on their own, but this has later been cited as a failure by many scholars (Keating, 2009; Kraemer et al., 2009). One reason for the failure is said to be the attitude of the recipient nations' citizens, which is to say that they believed the laptops to not be appropriate for them (Shah, 2010). This suggests that the mental outlook of an individual and of a community as a whole play an important role in technology adoption. There are several studies that investigate the effects of perceived self-efficacy on actual use of technology, behavioural intention, and attitude. One example is a study on faculties' attitude towards Learning Management Systems, in which perceived self-efficacy was a significant predictor (Fathema et al., 2015).

Furthermore, there is a small pool of literature on the effects of social support and social skills on digital skills. Stewart (2007) found that the motivation and intention to use new technology are affected by both social norms and social support from one's network. Furthermore, Helsper and Eynon (2013) studied the relationship between sociodemographic factors, digital skills, and different types of engagement with the internet, and found that social capital was positively related to technical and critical types of engagement. That is, people with a rich social network were more likely to engage in technical activities on the computer, as well as to seek information and educate themselves online. Social isolation was found to be negatively related to all skills except social skills and digital self-efficacy. This indicates that socially isolated people are less confident regarding their digital skills and engage in less social networking and instant messaging.

Lastly, a recent study found that grit is positively correlated with students' individual performance using e-learning systems (Aparicio et al., 2017). However, to date and to the best of our knowledge, no study has considered the relevance of grit and motivation for computer and internet skills. We find it particularly important to study this non-cognitive effect in the context of development economies, as computer and internet usage is low, and thus the possibilities to access technical support are few.

3.5 Contribution

Firstly, this study contributes to the literature on factors affecting young people's computer and internet skills. The closest research to ours is the one by Cueto et al. (2018). However, they only consider predictors such as socioeconomic factors, individual characteristics, and digital usage. We wish to extend this discussion by studying the effect of non-cognitive measurements and gender beliefs. Since no studies have, to the best of our knowledge, previously examined these effects on digital skills, our findings provide important insights into what factors influence a person's digital inclusion or exclusion.

Secondly, our study contributes to existing research by addressing determinants of digital skills in the context of developing countries. Specifically, we provide the fresh evidence that motivation and grit, socio-emotional competence and progressive gender beliefs are associated with digital skills and differ between countries. This suggests that economic, social, and cultural factors, among others, differ between countries and that non-cognitive skills and gender beliefs should be evaluated in distinct contexts. By determining the relevance of certain country-specific predictors, we hope to gain a better understanding of digital inclusion in low- and middle-income countries so that future policy makers can be more effective in their means of enhancing digital skills. Further research and understanding of obstacles to digital inclusion can be utilized to empower countries that need it the most and guide their economies out of poverty.

4. Conceptual Framework and Hypotheses

This section describes our conceptual framework which is built on previous literature on the second level of the digital divide, gender beliefs, non-cognitive skills, and technology adoption. We begin with a discussion on different categories and terminology of digital literacy and sets of skills and conclude the section with our suggested hypotheses.

4.1 Digital Skills and Literacy

There is an abundance of research on the set of skills and competencies that are critical to participate fully in the new, digital economy (Van Deursen and Van Dijk, 2010; Eshet-Alkalai and Amichai-Hamburger, 2004). However, the field is difficult to navigate because of different, often overlapping, definitions of skills and literacies (Van Deursen and Van Dijk, 2008). While some authors discuss digital-, new media- or information literacy (Livingstone, 2004), others examine several more specific digital skills, such as informational, operational, formal, and strategic skills (Van Deursen and Van Dijk, 2008), critical, social, creative, and technical skills (Helsper and Eynon, 2013), and photo-visual, reproduction, branching, information and socio-emotional skills (Eshet-Alkalai and Amichai-Hamburger, 2004). A common belief, however, is that internet skills should be considered as distinct from computer skills. This is because internet skills include creating online content, communicating online, and searching for information, thus being more complex than the technical skills required when using a computer (Van Deursen et al., 2016). Therefore, we look at the two skill sets separately in this study. We do not categorize any further because we have not found any previous studies on developing countries that analyses digital skills on a more specific level than general computer and internet skills. Likewise, the dataset used in this study does not distinguish between more specific computer- and internet-related skills.

4.2 Barriers to Digital Inclusion

Many attempts to study barriers to digital inclusion around the world have been made, as is evident from the previous literature section. However, most studies still focus on the effects of individual and socioeconomic characteristics. This prompts us to ask the question whether personality traits and norms influence how well people adopt technology and excel in various digital skills. From the previous literature we distinguish three assumptions from which we develop our conceptual framework:

1. *Motivation and grit are critical factors for one's attitude towards and adoption of digital technologies.*

Grit is defined as a “non-cognitive individual characteristic reflected in the mental capacity and stamina in the pursuit of long-term objectives” (Aparicio et al., 2017, p. 388). Studies show that students with high grit demonstrate higher performances (Duckworth and Gross, 2014; Duckworth et al., 2007) and in a recent study grit was found to have a positive effect on

students' individual performance using e-learning systems (Aparicio et al., 2017). As learning is not a short-term process, it requires significant investments in the form of time and effort over longer periods. One is also demanded to sustain interest and cope with setbacks, and these abilities vary considerably in individuals. Grit entails the ability to sustain both effort and interest, even in the absence of positive feedback (Duckworth et al., 2007), and lack of this ability constitutes a mental barrier to learning. Understanding the effect of grit on digital skills may lead to a better conception of technology adoption in low- and middle-income countries.

2. Social context and social competence affect one's motivation and intention to use new technology.

Social capital theory argues that social relationships are resources that help develop and accumulate human capital (Machalek and Martin, 2015). This is partly because relationships contribute obligations and expectations in the form of social norms and constitute information channels and social support. Studies show that social capital is positively related to technical and critical types of engagement (Helsper and Eynon, 2013). That is, people with a rich social network were more likely to engage in technical activities on the computer, as well as to seek information and educate themselves online.

Social capital is closely related to social and behavioral competence, sometimes referred to as non-cognitive skills or soft skills, which include interpersonal skills, openness to experience, self-confidence, and emotional stability (Helsper and Eynon, 2013). These are considered essential skills in an increasingly digital society, as they are skills that automation complements rather than replaces (The World Bank, 2016).

Another related concept is self-efficacy, which is defined as people's beliefs about their capabilities and resulting performance, and determine how people feel, think, motivate themselves and behave (Bandura, 1994). Self-efficacy, unlike self-confidence, includes both a confirmation of a capability level and the strength of that belief, which is why Bandura (1994) argued that the two concepts should be held separate. Several studies have found that perceived self-efficacy is a critical factor for one's behavioral intention and attitude towards digital devices (Sharma and Chandel, 2013; Fathema et al., 2015). According to Bandura (1994), people who believe in their ability to execute different tasks will see their accomplishments enhanced.

Based on Attewell's (2001) and Hargittai's (2002) claims in the previous section, it is reasonable to assume that children with a higher level of social and behavioral competence and social capital will leverage these skills to excel in digital literacy. As we wish to study non-cognitive barriers to digital inclusion, that is, personality traits and attitudes that may or may not constitute barriers to digital inclusion, we restrict our study to social and behavioral competence, and leave social capital to future studies. Finally, we define our variable socio-emotional competence to include interpersonal skills, openness to experience, self-efficacy, and emotional stability.

3. Gendered patterns of computer and internet usage will differ based on a society's particular construction of gender roles.

Many scholars have concluded that gender norms are shaped by culture and influence behavior (Elam and Terjesen, 2010; Kubíček and Machek, 2018). Although the gender gap in internet usage is rapidly diminishing, several studies have found evidence of clear gender differences in internet use patterns and internet application preferences (Wayan, 2018; Weiser, 2004). Furthermore, the literature on gender and technology usage in developed economies finds that men and women differ significantly in their attitudes toward their technological abilities (Hargittai and Shafer, 2006; Whitley, 1997), as well as toward technology in general (Morris and Venkatesh, 2000). Empirical evidence also points towards differences between men and women concerning sex-role stereotyping, as men seem to have more quickly accepted the stereotype of computers as a male domain (Whitley, 1997).

Lastly, women are found to be more strongly influenced by subjective norms than men, which relate to the social pressures to pursue or not pursue a certain behavior (Venkatesh and Morris, 2000), and several studies in the context of developing economies find that gender norms shape the way men and women behave toward, adopt and benefit from agricultural technologies (Mudege et al., 2016; Twyman et al., 2015). However, the question remains whether these social constructs affect digital skills. Thus, we wish to study the effect of progressive gender beliefs, that is, the rejection of traditional gender role beliefs, on digital skills in four different cultural contexts.

4.3 Hypotheses

Based on the previous literature and our conceptual framework, our hypotheses are specified as follows, where c denotes the country, thus showing four distinct hypotheses for each dependent variable:

Hypothesis 1. Computer skills are either positively or negatively affected by motivation and grit (3), socio-emotional competence (4), and progressive gender beliefs (5).

$$\begin{aligned} H_0: & \text{All } \beta_{ic} = 0 \\ H_1: & \text{At least one } \beta_{ic} \neq 0 \end{aligned} : i \in \{3,4,5\} \wedge c \in \{Ethiopia, India, Peru, Vietnam\}$$

Hypothesis 2. Internet skills are either positively or negatively affected by motivation and grit (3), socio-emotional competence (4), and progressive gender beliefs (5).

$$\begin{aligned} H_0: & \text{All } \pi_{ic} = 0 \\ H_1: & \text{At least one } \pi_{ic} \neq 0 \end{aligned} : i \in \{3,4,5\} \wedge c \in \{Ethiopia, India, Peru, Vietnam\}$$

We refer to the coefficients as 3, 4, and 5, in order to be coherent with the formulation in the upcoming econometric model.

5. Data and Methodology

This section presents the data used in our study, followed by introducing the econometric model, and an outline of the different components. Moreover, descriptive statistics and an overview of the variables are also included.

5.1 Data

The data used in this study comes from surveys collected by YL, a collaborative research project organized by the University of Oxford and commissioned by the Foreign, Commonwealth & Development Office, previously known as the Department for International Development in the United Kingdom. The project originally sought to examine factors affecting childhood poverty in developing countries to design future programs and policies. The four countries studied are Ethiopia, India, Peru and Vietnam. These countries were chosen by YL from a list of 24 possible options, and represent a diversity of inequality, economic circumstances and politics, and a range of geographical, social, and cultural contexts. The

countries also have institutions with the ability to oversee long-term research projects (Young Lives, 2015).

5.1.1 Sample Specification

Across the four countries, data was collected by YL in a longitudinal study on two different cohorts, the older cohort born in 1994/95, and the younger cohort born in 2001/02. The first survey took place in 2002, while the subsequent rounds were collected over a 15-year period with three to four years in between each round. The exact years were 2006/7, 2009/10, 2013/14, and 2016. The data used in this study is a combination of data from all rounds and constitutes the older cohort. The older cohort is used, since this study aims to look at young adults.³ With different rounds focusing on different factors related to the individual and the household, the survey covers an extensive width of information. Data used from Round 1 focuses on both individual and household level characteristics, data used from Round 4 focuses on parental education, data used from Round 3 focuses on the child's test scores, data used from Round 4 focuses on child education, while data used from Round 5 focuses on both individual and household level characteristics.

The employed method of sampling within the four countries followed the same multistage procedure. First, the countries were divided into 20 different clusters which reflect the geographic, ethnic, and socioeconomic diversity of each selected country. Second, from each cluster, approximately 50 households were identified and enrolled, each had at least one child between the age of seven to eight. Peru constitutes the only exception, as only around 25-50 households were identified and enrolled per cluster. The total number of observations in Ethiopia, India, Peru, and Vietnam, is 1000, 1008, 714 and 1000, respectively. Despite the lower number of households in Peru, the sample is still very analogous to the average household in Peru and is suitable for a longitudinal study (Flores and Escobal, 2008).

5.1.2 Attrition Rates

Analysis based on panel datasets can be heavily compromised by sample attrition. Attrition in Round 5 is defined as the ratio of total number of individuals who died, were not located, moved to another country, or did not give consent, relative to the number of individuals in Round 1. As the study has followed children over 15 years, falling sample sizes due to attrition

³ The younger cohort born around seven years after the older cohort, were aged only 15 in Round 5 and were therefore not appropriate to include in this specific study.

is inevitable, and this will weaken any statistical research that uses the sample (Outes-Leon and Dercon, 2008). However, considering the challenges involved in collecting longitudinal data in low-income countries, the attrition rates between the rounds are relatively low (Sánchez and Escobal, 2020). During the 15-year period the attrition rate was 18.6% in Ethiopia, 8.5 percent in India, 14.8% in Peru, and 8.5% in Vietnam. When also accounting for the attrition rates of the younger cohort, these are among the lowest attrition rates found in a longitudinal study focusing on low- and middle-income countries (Sánchez and Escobal, 2020).

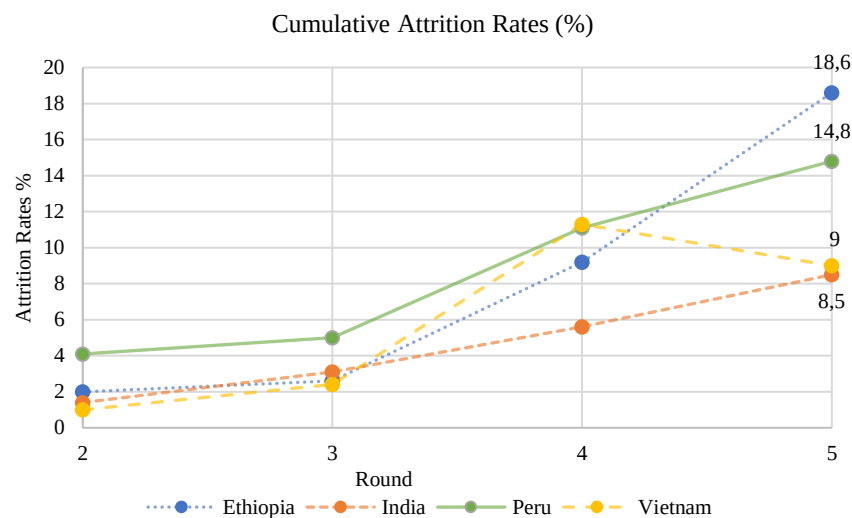


Figure 5

Note: Data retrieved from the YL survey.

Cumulative attrition rates have increased over time, with the only exception of Vietnam between Round 4 and 5.⁴ The distinct increase between Round 3 and 4 in all countries is likely associated with the age of the respondents who reached adulthood in Round 4, according to Sánchez and Escobal (2020). Furthermore, they theorize that as becoming adults, respondents might have felt empowered to leave the study. They may also have formed new families, which required them to answer the household questionnaire in addition to the individual questionnaire, which likely contributed to increased refusal rates. Furthermore, the probability of migration likely increased due to the transition to adulthood, which makes it more difficult to locate the respondent.

⁴ For the sample from Vietnam, a decrease in the communicative attrition is observed between Round 4 and 5, which implies that some respondents not interviewed in Round 4 reentered the sample in Round 5.

Addressing attrition rates over time for respondents who were in the top-tercile relative to those who were in the bottom-tercile in the first, Peru stands out (see appendix Figure A1).⁵ While the attrition rates for the top-tercile are higher than for the bottom-tercile in India and Vietnam, it is the opposite in Peru. In Ethiopia, the two rates are consistent in the first three rounds, while in the fifth round the attrition rate for the top-tercile increases significantly. In Round 5, the gaps between the two groups are largest in all countries except Vietnam, in which the rates converge. The, on average, higher attrition rates for the top-tercile could result from those who are better off are more likely to migrate (Sánchez and Escobal, 2020).

When distinguishing between attrition rates for urban and rural respondents, Ethiopia, India and Vietnam show a higher attrition rate for urban than rural respondents (see appendix Figure A1). These results are consistent with findings from the literature on longitudinal studies, which shows that urban households are more likely to fall away (Rayan and Petesch, 2007). Peru stands out by demonstrating the opposite result.

Finally, the cumulative attrition rates by gender show various results (see appendix Figure A1). There are more female drop-offs in Ethiopia, in contrast to Peru and Vietnam where the attrition rates for men are higher. Educational and labor opportunities are usually found at a different location than the respondent's original place of residence, and these opportunities tend to be different for men and women in different cultures (Heckert, 2015). No relevant differences arise in India.

To maintain statistical power and reduce the risk of attrition bias, longitudinal studies must keep attrition rates low. Although attrition rates are relatively low for the YL survey, they are not trivial, and it is therefore important to identify any selective attrition. Empirical evidence shows that attrition in our samples is correlated with socioeconomic characteristics, such as wealth, place of residence, and gender. However, for the characteristics mentioned in this section, Sánchez and Escobal (2020) find that attrition bias is limited when controlling for these observables.

⁵ Terciles are derived from a wealth index, which is further discussed in section 5.2.2.

5.2 Descriptive Statistics

This sub-section presents descriptive statistics and insights into our dependent, independent, and control variables.

5.2.1 Dependent Variables

The dependent variables computer skills and internet skills refer to the respondent's self-reported digital skills. The first nine statements in Table 3 relate to computer skills, followed by the subsequent eight statements relating to internet skills.

For the statements below, response alternatives were provided on a five-point-scale. The responses were then re-coded into a binary variable (yes/no) that took on a conservative approach, with “agree” and “strongly agree” corresponding to “yes” and the three remaining answers, “more or less”, “disagree” and “strongly disagree”, corresponding to “no”. Lastly, we aggregated the two variables by combining the nine and eight responses, respectively, and divided them by the total number of statements to show the share of the eight or nine questions being answered “yes”. The statements cover basic practical skills that are necessary for rudimentary success in utilizing computers and the internet.

Table 3: Digital Skills Statements

Indicator	Statement
<i>Computer Skills</i>	I know how to create a folder on a digital device. I know how to move a file from one folder to another. I know how to delete a file. I know how to retrieve a deleted file from the recycle bin. I know how to use the undo and redo functions, while working on a digital document. I know how to change the margins (for example using Word). I know how to bold, italicize or underline text (for example using Word). I know how to insert a table in a document (for example using Word). I know how to create a presentation (for example using PowerPoint).
<i>Internet Skills</i>	I know how to open downloaded files. I know where to click to go to a different webpage. I know how to complete online forms. I know how to connect to a Wi-Fi network. I find it easy to decide what the best keywords are to use for online searches. I find it easy to find a website I visited before. I know how to create something new from existing online images, music or video. I know which apps or software are safe to download.

Note: Sánchez et al. (2018)⁶

Table 4 shows the mean percentage of skills within the four countries. The table demonstrates two factors of particular interest, the first being that Peru and Vietnam have a substantially higher value for both computer and internet skills than Ethiopia and India, for both genders. The second is that men consistently demonstrate higher skills than women, with computer skills in Vietnam being the only exception.

⁶ To see the variable names as stated in the questionnaire, see Appendix 2. The variable with the name SKLL09R5 is the only digitals skills variable that was not used in our study. In Peru, SKLL09R5 had originally been asked to individuals that answered “Yes, many times in my life”, to the question “Have you ever used the internet”, rather than “Have you ever used a computer”. Consequently, the variable was dropped from the regressions for all countries for the sake of consistency.

Table 4: Dependent Variables

		Ethiopia		India		Peru		Vietnam	
		M	F	M	F	M	F	M	F
Computer Skills (%)	m	.149	.121	.251	.140	.657	.606	.489	.506
	N	427	387	448	474	320	288	447	463
Internet Skills (%)	m	.179	.098	.305	.114	.677	.599	.733	.727
	N	427	387	448	474	320	288	447	463

Note: Data retrieved from the YL survey Round 5. M and F stand for male and female. m and N stand for mean and number of observations.

Table 5 displays more in-depth information regarding respondents who answered “Yes, many times in my life” to the questions “Have you ever used a computer” or “Have you ever used the internet”. Thereby, revealing the distribution of self-reported skills among the relevant samples.⁷ In line with the trends presented in section 2.2, the number of individuals who possess computer and internet skills in Peru and Vietnam is much greater than Ethiopia and India.

⁷ The quartiles were constructed by the percentage of skills that the individuals reported that they possessed out of the total set of statements.

Table 5: Digital Skills Distribution per Country

		Ethiopia		India		Peru		Vietnam	
		M	F	M	F	M	F	M	F
<i>Computer Skills</i>									
- First Quartile	S	.013	.081	.033	.014	.026	.031	.109	.051
	N	1	5	4	1	6	6	31	14
- Second Quartile	S	.078	.097	.024	.041	.026	.031	.085	.029
	N	6	6	3	3	6	6	24	8
- Third Quartile	S	.156	.145	.049	.095	.070	.067	.106	.140
	N	12	9	6	7	16	13	30	31
- Fourth Quartile	S	.753	.677	.894	.851	.895	.872	.701	.807
	N	58	42	110	63	204	170	199	221
<i>Number (Accumulated)</i>		77	62	123	74	228	195	284	274
<i>Internet Skills</i>									
- First Quartile	S	0.05	.077	.032	.032	.033	.044	.033	.032
	N	5	4	5	2	8	9	13	13
- Second Quartile	S	.129	.173	.044	.048	.029	.063	.059	.075
	N	12	9	7	3	7	13	23	31
- Third Quartile	S	.118	.151	.171	.145	.144	.218	.255	.290
	N	11	14	27	9	35	45	100	119
- Fourth Quartile	S	.688	.481	.753	.774	.794	.675	.653	.604
	N	64	25	119	48	193	139	256	249
<i>Number (Accumulated)</i>		93	52	158	62	243	206	392	412

Note: Data retrieved from the YL survey Round 5.⁸ M and F stand for male and female. S and N stand for share and number of observations.

Moreover, the majority of respondents in all samples belong in the fourth quartile. The previous observation that men demonstrate higher skills than women can now be put in context of the percentage of the male and female population that has ever used a computer or the internet. This shows that the previous observation was greatly influenced by a tendency of more men than women previously having used computers and the internet. When observing Table 5, two conclusions can be drawn. The first, that the skills distributions look fairly similar, and the second, that specific country relevant patterns are insinuated. Finally, it is important to remember that the data does not demonstrate real skills, instead it illustrates self-reported skills.

⁸ The quartiles were generated as follows: the first quartile consists of people answering “yes” to 0-25% of the statements (nine for computers and eight for internet), the second quartile is 26-50%, the third quartile is 51-75%, and the fourth quartile is 76-100%.

The self-reported approach was adopted by YL from the four options originally considered. The other three included 1) a direct measure of skills, 2) use of multiple-choice questions about a variety of computer and internet skills tasks, and 3) self-reporting on knowledge of internet-related terms. The advantages with the chosen method include not having to choose a hardware or software that everyone could perform digital tasks on and being able to measure a range of skills in a short period of time (Cueto et al., 2018). However, this does not leave self-reported digital skills without drawbacks. Primarily, the issue of reporting bias in the form of social desirability arises, which is that children may report a higher number of skills than what they actually possess or presents themselves favorably compared to their peers (Cueto et al., 2018). To mitigate this risk, YL introduced a pilot test in the countries studied, of which the conclusion was that the skills questions should only be asked to respondents who previously answered “Yes, many times in my life” to the question “Have you ever used the following?” The reason is that only respondents with frequent digital usage could reasonably respond to the skills questions, while respondents without digital access seemed uncomfortable acknowledging their lack of computer or internet skills (Cueto et al., 2018). Furthermore, another risk is the difference between genders in their self-reported skills, a factor that Hargittai and Shafer (2006) found in one of their studies and which we discussed in section 3.3. We attempt to account for this in the subsequent section regarding control variables.

5.2.2 Control Variables

Table 6: Household Characteristics, Individual Characteristics and Test Scores

	Ethiopia			India			Peru			Vietnam		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Household Characteristics												
Rural, R1	.649	.478	1000	.751	.433	1008	.258	.438	714	.800	.400	1000
Wealth Index, R5	.403	.177	991	.646	.154	980	.627	.183	712	.625	.144	999
Paternal Education, R2												
- None	.276	.447	913	.426	.495	988	.018	.135	652	.069	.254	955
- Primary School	.571	.495	913	.290	.454	988	.397	.490	652	.418	.493	955
- Secondary School	.140	.347	913	.224	.417	988	.505	.500	652	.461	.499	955
- Higher Education	.013	.114	913	.060	.237	988	.080	.271	652	.052	.223	955
Maternal Education, R2												
- None	.500	.500	966	.603	.489	986	.100	.300	681	.097	.296	981
- Primary School	.422	.494	966	.271	.445	986	.486	.500	681	.479	.500	981
- Secondary School	.077	.266	966	.102	.303	986	.376	.485	681	.397	.489	981
- Higher Education	.001	.032	966	.023	.151	986	.038	.192	681	.028	.164	981
Individual Characteristics												
Female, R1	.490	.500	1000	.513	.500	1008	.459	.499	714	.498	.500	1000
Age in Whole Years, R5	22.024	.311	807	22.001	.350	916	21.925	.418	608	22.278	.330	906
Number of Siblings, R1	4.323	2.569	998	2.147	1.456	1008	2.791	2.299	709	1.875	1.608	999
Birth Order, R1												
- First Child	.196	.397	994	.277	.448	1008	.309	.462	709	.367	.482	1000
- Second Child	.162	.369	994	.335	.472	1008	.251	.434	709	.308	.462	1000
- Third child	.642	.480	994	.388	.488	1008	.440	.497	709	.325	.469	1000
Child Education, R4/R5												
- None	.273	.446	809	.065	.246	929	.013	.115	596	.121	.326	908
- Primary School	.159	.366	809	.212	.409	929	.812	.391	596	.272	.445	908
- Secondary School	.551	.498	809	.515	.500	929	.149	.357	596	.401	.490	908
- Higher Education	.016	.126	809	.208	.407	929	.025	.157	596	.206	.405	908
Test Scores												
- Receptive Vocabulary, R3	0.00	1	962	0.00	1	944	0.00	1	652	0.00	1	947
- Mathematics, R3	0.00	1	935	0.00	1	944	0.00	1	666	0.00	1	950

Note: Data retrieved from the YL surveys. Area of residence (rural and urban), gender, number of siblings, and birth order are from Round 1. Parental education is from Round 2. Cognitive skills scores are from Round 3. Child education is from Round 4 and 5. Wealth index and age in whole years is from Round 5. SD and N stand for standard deviation and number of observations.

Table 6 shows substantial heterogeneity within the data sample. This heterogeneity can be divided into within-cluster heterogeneity and between-cluster heterogeneity. To identify whether the independent variables influence digital skills, within-cluster and between-cluster heterogeneity needs to be accounted for.

As previously mentioned, between-cluster heterogeneity is accounted for through adding a vector of fixed effects on the cluster level. Therefore, the control variables presented in Table 6 will primarily be used to deal with within-cluster heterogeneity. The wealth index is an aggregated variable on a scale from zero to one that YL has calculated using a housing quality index, consumer durables index and services index. The household characteristics indicates a large variety in parental education in which fathers are slightly more educated than mothers in all countries.⁹ The number of siblings hides a positive skewness in which most YL children have a maximum of six siblings, while a few households have up to 14 children in total. Moreover, the sample contains an overrepresentation of the number of YL children that are the first-born child compared with the probability distribution that arises from the number of siblings variable. The variable child education indicates a higher average level of education of the YL children compared with their parents.¹⁰ Lastly, the test scores have been standardized to a mean of zero and a standard deviation of one for the respective countries.

⁹ For parental education in Ethiopia, India and Vietnam, the same answering alternatives were available to the respondents and therefore, the same re-coding was made. Primary School includes: one to eight years of school, as well as adult literacy programs and religious education. Secondary School includes: 9-12 years of school and vocational training programs. Higher Education includes university education. In India the re-coding looked slightly different. Primary School includes: one to eight years of school and adult literacy programs. Secondary School includes: 9-11 years of school, incomplete technical college, and complete technical college. Higher Education includes incomplete university and complete university.

¹⁰ The educational systems differ between the sample countries, which means that an assessment was made by us regarding what constitutes the different educational categories. As part of our assessment, age was the most important factor. Primary school is in this sample defined as up until between the seventh and the ninth grade, depending on the country. Secondary School is all education that is above primary school and lower than Higher Education. Higher Education is defined as university studies. The data for all countries except for India are from Round 5. In India, the newest data available regarding child education was used, meaning that it came from both Round 4 and Round 5, depending on whether the child had continued to study after Round 4. In Ethiopia the re-coding looked the following. Primary School includes the completion of grade eight. Secondary School includes the completion or receipt of Ethiopian general secondary education, Ethiopian higher education entrance certificate, first cycle of primary teacher training certificate and TVET certificate. Higher Education includes university degree. In India the re-coding looked the following. Primary School includes the completion of primary and upper primary school. Secondary School includes the completion or receipt of matriculation certificate, senior secondary school certificate, intermediate certificate, ITI certificate and diploma in technical education. Higher Education includes university degree and post-university degree. In Peru the re-coding looked the following. Primary School includes the completion of primary education and secondary education. Secondary School includes the completion or receipt of higher education and productive technical center (CETPRO). Higher

It is worth acknowledging that the use of control variables account for the fact that the attrition in the sample is correlated with socioeconomic characteristics, such as wealth, place of residence, and gender. Moreover, by controlling for gender, we attempt to control for difference between genders in their self-reported skills, which was mentioned in the previous section.

5.2.3 Independent Variables

The three independent variables will now be presented and elaborated upon: motivation and grit, socio-emotional competence, and gender beliefs.

Motivation and grit is an aggregate variable composed of the four following statements: “Setbacks don’t discourage me”, “I am a hard worker”, “I finish whatever I begin”, and “I am diligent”.¹¹ The answers are provided on a five-point-scale in which respondents answering, “mostly like me” and “very much like me” were re-coded into “yes”, otherwise their responses were re-coded into “no”. From a list of eight original variables, we excluded four as they were not relevant for the variable in question.

Socio-emotional competence is an aggregate variable composed of 23 statements. Examples include: “I like cooperating in a team”, “I can be a good leader”, “If someone opposes me, I can find the means and ways to get what I want”, “I make friends easily”, “I’m as good as most other people”, “When I am confronted with a problem, I can usually find several solutions”, and “If I am in trouble, I can usually think of a solution”.¹² The answers are provided on a four-point-scale in which “agree” and “strongly agree” were re-coded into “yes”, otherwise the answer was re-coded into “no”.

Education includes university degree. In Vietnam the re-coding looked the following. Primary School includes the receipt of certificate for completion of lower secondary education. Secondary School includes the completion or receipt of certificate for completion of (short term) vocational training, general education diploma (completion of upper secondary school), diploma for completion of professional secondary school, diploma for completion of vocational secondary school and diploma of vocational college. Higher Education includes diploma for college education and university diploma. If a respondent from any of the four countries answered “other” education than what has been listed here, they were dropped from the sample.

¹¹ To see the variable names as stated in the questionnaire, see Appendix 3.

¹² From the original list of statements collected by YL and that is present in the data, the statements used in this study reflected one of the following: interpersonal skills, openness to experience, self-efficacy, and emotional stability. Furthermore, from our chosen statements, nine additional statements were excluded as they had not been included in the YL surveys conducted in Peru. Consequently, these nine statements were dropped for all countries for the sake of consistency. To see the list of statements used and variable names as stated in the questionnaire, see Appendix 4.

Gender beliefs is an aggregate variable composed of 12 statements. Examples include: “Swearing is worse for a girl than for a boy”, “On a date, the boy should be expected to pay all expenses”, “On the average, girls are as smart as boys”, “More encouragement in a family should be given to sons than daughters to go to college”, “It is all right for a girl to want to play rough sports like football”, and “In general, the father should have greater authority than the mother in making family decisions”.¹³ The answers were provided on the same four-point-scale as previously mentioned for socio-emotional competence.¹⁴

Separately, the dummy variables from the respective statements were added into an aggregate variable, these were then divided by the total number of statements related to that variable, which results in aggregate variables in the form of percentage terms. Table 7 demonstrates the mean, standard deviation, and number of observations, per independent variable and country. It shows slight differences in the self-perception of the variables in the countries studied, which are accounted for by country specific regressions.

Table 7: Independent Variables

	Ethiopia			India			Peru			Vietnam		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Motivation and Grit	.709	.287	813	.771	.218	911	.696	.294	606	.598	.330	907
Socio-Emotional Competence	.881	.126	773	.904	.117	859	.900	.125	590	.756	.166	863
Gender Beliefs	.712	.190	801	.497	.176	833	.765	.173	593	.726	.175	902

Note: Data retrieved from YL survey Round 5. SD and N stand for standard deviation and number of observations.

5.3 Econometric Model

To determine the relationships of motivation and grit, socio-emotional competence, and gender beliefs, on computer and internet skills, we use the following econometric model, in which i denotes individuals, j denotes cluster, 3 and 5 denotes Round 3 and Round 5, k takes on the

¹³ To see the list of statements used and variable names as stated in the questionnaire, see Appendix 5.

¹⁴ The same re-coding was used as for socio-emotional competence, but with one adjustment. The statements change directions in their point of reference, meaning that the progressive answer may be “strongly agree” for one statement, but for another statement the progressive answer may be “strongly disagree”.

value of 1 and 2, as there are two test scores variables, l takes on the value of 3, 4, and 5, as there are three independent variables:

$$Y_{ij5} = \alpha + X_{ij}A + Y_{ij5}B + \varepsilon_{ij5} \quad (1)$$

$$+ \Gamma_j \quad (2)$$

$$+ \beta_k TestScores_{ij3} \quad (3)$$

$$+ \beta_l Z_{ij5} \quad (4)$$

In Eq. (1) $X_{ij}A$ represent the previously sampled vector of control variables: area of location (rural or urban), father's and mother's completed education (no formally completed education is the omitted group), gender, number of siblings, and birth order of the individual (first child being the omitted group). $Y_{ij5}B$ includes a vector of contemporaneous variables: wealth index (lowest tercile is the omitted group), age in years, and the individual's education (no formally completed education is the omitted group). Alpha is a constant and epsilon is the error term. In Eq. (2) gamma signifies a vector of fixed effects based on the original clusters in which the individual was living in Round 1. Thereby restricting comparisons to between individuals from the same clusters and accounting for cluster level heterogeneity. Eq. (3) adds two test scores to the regression: receptive vocabulary and mathematics. In Eq. (4) zeta denotes a vector which includes our independent variables: motivation and grit, socio-emotional competence, and gender beliefs.

6. Results

In this section we present core findings from our computer and internet skills regressions. The two regressions are shown separately in Table 8 and Table 9. The tables are divided into sections representative of the respective countries. We started by introducing the (1) baseline OLS model containing the control variables and including clustered standard errors, then (2) fixed effects were added, this was followed by (3) adding test scores, and finally (4) the independent variables were included.

6.1. Regressions

Table 8 (p. 34) reports the estimated coefficients of the non-cognitive skills and gender beliefs variables on computer skills in the four countries.

Several of the control variables in Table 8, despite not being our main area of interest, are worth commenting on. The top-tercile, in the wealth index, is positively correlated with computer skills, and statistically significant in India. For paternal education, regressions in Ethiopia indicate that a low level of education is statistically significant and negatively correlated with the child's computer skills. Secondary education for all columns in India, and higher education in column (1), (2), and (3) for Vietnam, are statistically significant and positively correlated with computer skills. Higher education, for maternal education, shows statistically significant and positively correlated coefficients for all regressions in India. Unlike in the other countries, higher education in Ethiopia exhibits negative significant effects. Even though the results show statistical significance, the economic significance is inconclusive, as only one individual is part of this sample, compared to 23-27 people having completed higher education for the other countries.

For child education, further education in the form of secondary school or higher education, demonstrates positive significant effects in all countries except Peru. From the test scores, mathematics demonstrates the most statistically significant results. Furthermore, when the test scores are included, it is evident that the statistical significance of the wealth index decreases.

In Table 8, coefficients and statistical significance of the non-cognitive skills and gender beliefs variables can be observed to differ in the respective countries. However, they are all positively correlated. In Ethiopia, both motivation and grit and socio-emotional competence are statistically significant at the 0.05 critical level, while gender beliefs is not. India shows no statistical significance for any of the independent variables. While in Peru and Vietnam, gender beliefs are statistically significant at the 0.001 and 0.01 critical levels, respectively, but motivation and grit and socio-emotional competence are not.

Table 9 (p. 35) reports the estimated coefficients of the non-cognitive skills and gender beliefs variables on internet skills in the four countries.

In Table 9, the top-tercile in the wealth index is positively correlated with computer skills. In India, all columns show statistical significance, while for Peru and Vietnam only column (1) and (2) show statistically significant coefficients. For paternal education in India, secondary school demonstrates statistically significant and positive coefficients in all four columns, while higher education demonstrates statistically significant and positive coefficients in column (1), (2), and (3). Statistically significant results are not observed for the other countries. Maternal

education in Ethiopia demonstrates statistically significant results for higher education. However, similar to Table 8, these results are limited since there is only one individual who have achieved higher education in Ethiopia in our sample. For child education, similar to Table 8, further education in the form of secondary school or higher education, exhibits statistically significant and positive coefficients in all countries except Peru. Mathematics show positive coefficients in all countries, but it is only statistically significant in column (4) in Ethiopia and Vietnam. Receptive vocabulary also shows positive coefficients in all countries, but it is only statistically significant in column (4) in Ethiopia and Peru.

The four countries show contrasting coefficients and statistical significance levels of non-cognitive skills and gender beliefs. In Ethiopia, socio-emotional competence is positively correlated and statistically significant at the 0.01 critical level, while the other two variables are not statistically significance at any relevant critical level. The same statistically significant results can be found in Vietnam, but with a slightly lower coefficient. In India, motivation and grit is positively correlated and statistically significant at the 0.05 critical level, but socio-emotional competence and gender beliefs do not show statistically significant results. The opposite can be seen for Peru, in which motivation and grit shows no statistical significance, however, socio-emotional competence and gender beliefs are both positively correlated with internet skills and statistically significant at the 0.05 and 0.001 critical levels, respectively.

Table 8: Regression on Computer

	Ethiopia				India				Peru				Vietnam			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Household Characteristics																
Rural, R1	-0.164 [*] (0.058)	0 (.)	0 (.)	0 (.)	-0.102 (0.067)	0 (.)	0 (.)	0 (.)	-0.124 (0.070)	-0.112 (0.097)	-0.112 (0.092)	-0.148 (0.083)	0.028 (0.042)	0 (.)	0 (.)	0 (.)
Wealth Index, R5																
- Middle Tercile	0.016 (0.018)	0.013 (0.021)	0.017 (0.026)	0.016 (0.026)	0.034 (0.019)	0.040 [*] (0.018)	0.040 (0.019)	0.046 (0.025)	0.114 (0.059)	0.124 [*] (0.057)	0.098 (0.057)	0.084 (0.048)	0.041 (0.022)	0.021 (0.024)	0.012 (0.022)	0.005 (0.022)
- Top Tercile	0.035 (0.020)	0.051 [*] (0.024)	0.047 (0.023)	0.037 (0.026)	0.111 [*] (0.041)	0.117 ^{**} (0.040)	0.099 [*] (0.041)	0.104 [*] (0.048)	0.159 ^{***} (0.040)	0.153 ^{***} (0.039)	0.100 [*] (0.041)	0.080 (0.040)	0.044 (0.033)	0.022 (0.034)	0.030 (0.035)	0.021 (0.037)
Paternal Education, R2																
- Primary School	-0.042 [*] (0.018)	-0.043 [*] (0.017)	-0.050 [*] (0.018)	-0.054 [*] (0.020)	0.021 (0.022)	-0.004 (0.022)	-0.008 (0.021)	-0.008 (0.023)	-0.002 (0.111)	0.047 (0.100)	0.002 (0.107)	0.061 (0.101)	-0.013 (0.055)	-0.010 (0.056)	-0.050 (0.054)	-0.058 (0.055)
- Secondary School	0.014 (0.045)	0.021 (0.042)	0.003 (0.040)	-0.005 (0.038)	0.104 ^{**} (0.028)	0.073 [*] (0.028)	0.066 [*] (0.028)	0.072 [*] (0.029)	0.129 (0.106)	0.137 (0.097)	0.044 (0.097)	0.081 (0.094)	0.077 (0.049)	0.068 (0.048)	0.024 (0.049)	0.014 (0.056)
- Higher Education	-0.075 (0.177)	-0.055 (0.169)	-0.078 (0.187)	-0.080 (0.187)	0.171 (0.083)	0.171 (0.085)	0.150 (0.084)	0.149 (0.093)	0.213 (0.115)	0.193 (0.108)	0.061 (0.107)	0.117 (0.108)	0.220 ^{**} (0.061)	0.200 ^{**} (0.065)	0.149 [*] (0.067)	0.118 (0.074)
Maternal Education, R2																
- Primary School	-0.017 (0.014)	-0.018 (0.015)	-0.012 (0.016)	-0.011 (0.019)	0.023 (0.024)	0.024 (0.018)	0.014 (0.020)	0.022 (0.021)	-0.082 (0.072)	0.040 (0.079)	0.037 (0.075)	0.032 (0.082)	0.054 (0.060)	0.073 (0.068)	0.058 (0.066)	0.058 (0.069)
- Secondary School	0.113 (0.068)	0.115 (0.067)	0.094 (0.059)	0.080 (0.058)	0.017 (0.038)	0.047 (0.033)	0.003 (0.041)	0.014 (0.056)	0.040 (0.079)	0.143 (0.093)	0.124 (0.083)	0.114 (0.088)	0.133 (0.069)	0.154 (0.079)	0.120 (0.074)	0.114 (0.076)
- Higher Education	-0.161 [*] (0.060)	-0.190 ^{**} (0.063)	-0.285 ^{***} (0.059)	-0.173 ^{**} (0.055)	0.365 ^{***} (0.076)	0.383 ^{***} (0.078)	0.294 ^{**} (0.092)	0.270 [*] (0.105)	0.105 (0.099)	0.216 [*] (0.098)	0.174 (0.098)	0.155 (0.100)	0.190 [*] (0.077)	0.209 [*] (0.084)	0.141 (0.073)	0.152 (0.074)
Child Characteristics																
Female, R1	-0.056 [*] (0.026)	-0.059 [*] (0.026)	-0.038 (0.025)	-0.010 (0.022)	-0.101 ^{***} (0.025)	-0.107 ^{***} (0.026)	-0.083 ^{**} (0.029)	-0.101 [*] (0.036)	-0.029 (0.033)	-0.025 (0.032)	-0.012 (0.037)	-0.020 (0.038)	-0.081 ^{**} (0.025)	-0.076 [*] (0.027)	-0.088 ^{**} (0.026)	-0.098 ^{**} (0.0305)
Age in Whole Years, R5	0.053 (0.027)	0.039 (0.026)	0.037 (0.028)	0.004 (0.033)	-0.038 (0.030)	-0.014 (0.032)	-0.024 (0.033)	-0.002 (0.040)	-0.013 (0.059)	-0.008 (0.060)	-0.001 (0.065)	0.007 (0.064)	-0.046 (0.028)	-0.036 (0.029)	-0.052 (0.028)	-0.071 [*] (0.033)
Number of Siblings, R1	0.002 (0.006)	0.002 (0.006)	0.000 (0.006)	0.001 (0.006)	-0.017 (0.009)	-0.016 (0.010)	-0.019 (0.010)	-0.016 (0.010)	0.001 (0.011)	0.007 (0.012)	0.003 (0.014)	0.001 (0.013)	-0.018 (0.012)	-0.014 (0.011)	-0.011 (0.012)	-0.013 (0.013)
Birth Order, R1																
- Second Child	0.000 (0.047)	-0.008 (0.046)	-0.005 (0.046)	-0.014 (0.044)	-0.028 (0.029)	-0.019 (0.027)	-0.012 (0.028)	-0.019 (0.031)	0.053 (0.054)	0.039 (0.054)	0.058 (0.051)	0.051 (0.051)	-0.054 [*] (0.021)	-0.049 [*] (0.020)	-0.046 [*] (0.021)	-0.043 (0.025)
- Third Child+	0.002 (0.045)	0.010 (0.044)	0.012 (0.046)	-0.001 (0.047)	-0.009 (0.032)	-0.001 (0.028)	0.017 (0.031)	0.013 (0.035)	-0.040 (0.043)	-0.039 (0.047)	-0.014 (0.047)	-0.017 (0.045)	-0.034 (0.025)	-0.022 (0.025)	-0.048 (0.031)	-0.039 (0.036)
Child Education, R5																
- Primary School	-0.009 (0.011)	-0.015 (0.012)	-0.035 [*] (0.013)	-0.033 [*] (0.013)	-0.028 (0.023)	-0.094 ^{**} (0.029)	-0.063 [*] (0.026)	-0.075 ^{**} (0.026)	0.258 (0.135)	0.243 (0.130)	-0.0932 (0.132)	-0.181 (0.164)	0.070 [*] (0.029)	0.086 [*] (0.130)	0.025 (0.036)	0.003 (0.040)
- Secondary School	0.138 ^{***} (0.023)	0.133 ^{***} (0.026)	0.074 ^{**} (0.024)	0.068 ^{**} (0.022)	0.068 [*] (0.028)	0.030 (0.026)	0.011 (0.029)	0.014 (0.033)	0.430 ^{**} (0.141)	0.419 ^{**} (0.143)	0.046 (0.145)	-0.083 (0.169)	0.407 ^{***} (0.038)	0.433 ^{***} (0.039)	0.311 ^{***} (0.042)	0.273 ^{***} (0.051)
- Higher Education	0.412 ^{***} (0.098)	0.340 ^{**} (0.113)	0.225 [*] (0.097)	0.209 (0.128)	0.248 ^{***} (0.058)	0.208 ^{**} (0.059)	0.160 ^{**} (0.056)	0.148 [*] (0.061)	0.419 [*] (0.148)	0.416 ^{**} (0.138)	0.0264 (0.141)	-0.0914 (0.178)	0.675 ^{***} (0.045)	0.701 ^{***} (0.045)	0.554 ^{***} (0.052)	0.500 ^{***} (0.064)
Test Scores																
- Receptive Vocabulary, R3			-0.005 (0.012)	-0.008 (0.012)			-0.004 (0.0163)	-0.001 (0.017)			0.086 ^{**} (0.023)	0.055 (0.028)			0.005 (0.0184)	-0.005 (0.018)
- Mathematics, R3			0.082 ^{***} (0.016)	0.074 ^{***} (0.016)			0.084 ^{***} (0.017)	0.070 ^{**} (0.019)			0.064 ^{**} (0.017)	0.049 [*] (0.019)			0.103 ^{***} (0.016)	0.100 ^{***} (0.017)
Non-Cognitive Skills and Gender Beliefs Scores																
- Motivation and Grit, R5				0.098 [*] (0.041)				0.119 (0.058)				0.082 (0.050)				0.028 (0.043)
- Socio-Emotional Competence, R5				0.167 [*] (0.074)				0.051 (0.072)				0.269 (0.174)				0.152 (0.093)
- Gender Beliefs, R5				0.053 (0.087)				0.140 (0.094)				0.515 ^{***} (0.118)				0.202 ^{**} (0.066)
Clustered Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
_cons	-0.986 (0.581)	-0.795 (0.572)	-0.711 (0.613)	-0.229 (0.690)	1.019 (0.666)	0.460 (0.718)	0.694 (0.722)	0.019 (0.893)	0.540 (1.322)	0.304 (1.349)	0.589 (1.490)	-0.181 (1.453)	1.125 (0.619)	0.900 (0.649)	1.423 [*] (0.631)	1.623 [*] (0.731)
Number of observations																
R ²	0.239	0.111	0.158	0.159	0.300	0.234	0.266	0.264	0.239	0.137	0.194	0.232	0.469	0.416	0.444	0.443

Standard errors in parentheses
^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

Table 9: Regression on Internet

	Ethiopia				India				Peru				Vietnam			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)			
Household Characteristics																
Rural, R1	-0.178*** (0.044)	0 (.)	0 (.)	0 (.)	-0.035 (0.059)	0 (.)	0 (.)	0 (.)	-0.150* (0.065)	-0.074 (0.090)	-0.057 (0.072)	-0.091 (0.072)	0.013 (0.027)	0 (.)	0 (.)	0 (.)
Wealth Index, R5																
- Middle Tercile	0.023 (0.017)	0.020 (0.019)	0.026 (0.023)	0.032 (0.026)	0.036 (0.018)	0.038* (0.017)	0.038 (0.019)	0.047 (0.024)	0.100 (0.053)	0.099 (0.052)	0.072 (0.051)	0.061 (0.044)	0.078* (0.028)	0.056 (0.029)	0.044 (0.028)	0.034 (0.029)
- Top Tercile	0.0459 (0.0225)	0.039 (0.030)	0.037 (0.029)	0.016 (0.031)	0.089* (0.034)	0.094* (0.036)	0.088* (0.037)	0.090* (0.042)	0.145*** (0.041)	0.122** (0.039)	0.072 (0.044)	0.055 (0.039)	0.085* (0.032)	0.071* (0.033)	0.062 (0.032)	0.041 (0.031)
Paternal Education, R2																
- Primary School	-0.022 (0.019)	-0.020 (0.022)	-0.024 (0.023)	-0.032 (0.024)	0.047 (0.033)	0.023 (0.033)	0.022 (0.032)	0.025 (0.033)	0.041 (0.111)	0.067 (0.103)	0.001 (0.114)	0.060 (0.108)	0.065 (0.054)	0.055 (0.051)	0.049 (0.052)	0.046 (0.045)
- Secondary School	0.065 (0.063)	0.079 (0.052)	0.075 (0.052)	0.050 (0.053)	0.139*** (0.030)	0.112** (0.032)	0.106** (0.034)	0.115** (0.039)	0.180 (0.098)	0.179 (0.093)	0.084 (0.104)	0.120 (0.100)	0.095 (0.059)	0.096 (0.060)	0.082 (0.061)	0.071 (0.057)
- Higher Education	0.028 (0.188)	0.050 (0.177)	-0.025 (0.171)	-0.042 (0.184)	0.227* (0.097)	0.231* (0.100)	0.203* (0.094)	0.183 (0.099)	0.196 (0.117)	0.185 (0.116)	0.062 (0.126)	0.118 (0.124)	0.129 (0.066)	0.121 (0.063)	0.104 (0.062)	0.086 (0.056)
Maternal Education, R2																
- Primary School	-0.007 (0.022)	0.005 (0.028)	0.012 (0.029)	0.002 (0.031)	0.033 (0.030)	0.030 (0.032)	0.011 (0.036)	0.020 (0.040)	-0.010 (0.057)	0.077 (0.075)	0.074 (0.075)	0.070 (0.087)	0.208** (0.067)	0.110 (0.067)	0.093 (0.059)	0.077 (0.055)
- Secondary School	0.079 (0.085)	0.077 (0.081)	0.058 (0.078)	0.078 (0.089)	-0.040 (0.044)	-0.028 (0.043)	-0.064 (0.053)	-0.043 (0.065)	0.078 (0.067)	0.147 (0.088)	0.116 (0.084)	0.108 (0.093)	0.209* (0.075)	0.142* (0.068)	0.119 (0.059)	0.112 (0.057)
- Higher Education	0.847*** (0.066)	0.831*** (0.056)	0.743*** (0.072)	0.812*** (0.083)	0.297* (0.125)	0.298* (0.129)	0.224 (0.135)	0.202 (0.154)	0.080 (0.102)	0.163 (0.106)	0.104 (0.105)	0.086 (0.100)	0.221* (0.094)	0.144 (0.090)	0.111 (0.079)	0.096 (0.077)
Child Characteristics																
Female, R5	-0.119*** (0.029)	-0.121*** (0.030)	-0.106*** (0.027)	-0.085** (0.026)	-0.173*** (0.027)	-0.176*** (0.029)	-0.159*** (0.033)	-0.170*** (0.042)	-0.057 (0.030)	-0.055 (0.032)	-0.037 (0.033)	-0.045 (0.033)	-0.062** (0.017)	-0.057** (0.018)	-0.054* (0.019)	-0.043* (0.020)
Age in Whole Years R5	0.064* (0.026)	0.076* (0.031)	0.076* (0.033)	0.050 (0.038)	-0.009 (0.042)	0.009 (0.047)	-0.001 (0.049)	0.013 (0.054)	-0.018 (0.056)	-0.007 (0.059)	-0.013 (0.058)	-0.006 (0.057)	-0.013 (0.031)	-0.000 (0.031)	-0.003 (0.034)	-0.003 (0.036)
Number of Siblings, R1	-0.004 (0.003)	-0.003 (0.003)	-0.005 (0.003)	-0.005 (0.003)	-0.006 (0.012)	-0.012 (0.012)	-0.011 (0.012)	-0.009 (0.014)	0.000 (0.007)	0.005 (0.008)	0.004 (0.010)	0.002 (0.009)	-0.019 (0.009)	-0.008 (0.009)	-0.007 (0.010)	-0.005 (0.011)
Birth Order, R1																
- Second Child	-0.002 (0.031)	-0.023 (0.035)	-0.013 (0.033)	-0.022 (0.030)	-0.030 (0.027)	-0.024 (0.027)	-0.019 (0.029)	-0.028 (0.030)	0.051 (0.045)	0.052 (0.046)	0.071 (0.048)	0.061 (0.049)	-0.050* (0.022)	-0.052* (0.022)	-0.054* (0.022)	-0.046 (0.023)
- Third Child+	0.030 (0.040)	0.024 (0.039)	0.031 (0.038)	0.020 (0.039)	-0.039 (0.035)	-0.030 (0.035)	-0.025 (0.039)	-0.028 (0.043)	-0.011 (0.033)	-0.005 (0.031)	0.023 (0.034)	0.022 (0.036)	0.018 (0.028)	0.001 (0.027)	-0.005 (0.028)	0.001 (0.032)
Child Education, R5																
- Primary School, R5	0.019 (0.018)	0.011 (0.019)	-0.013 (0.018)	-0.017 (0.018)	-0.029 (0.023)	-0.070* (0.026)	-0.090* (0.033)	-0.109** (0.035)	0.124 (0.149)	0.120 (0.174)	0.057 (0.207)	-0.038 (0.240)	0.156* (0.056)	0.166** (0.053)	0.132* (0.055)	0.142* (0.058)
- Secondary School, R5	0.115*** (0.026)	0.105*** (0.024)	0.056* (0.023)	0.044 (0.023)	0.096** (0.031)	0.067* (0.026)	0.005 (0.026)	0.004 (0.027)	0.274 (0.149)	0.273 (0.181)	0.177 (0.213)	0.039 (0.244)	0.320*** (0.051)	0.331*** (0.051)	0.270*** (0.057)	0.255*** (0.059)
- Higher Education, R5	0.565*** (0.104)	0.476*** (0.095)	0.390*** (0.091)	0.412*** (0.103)	0.240*** (0.038)	0.218*** (0.038)	0.135** (0.039)	0.122* (0.046)	0.281 (0.147)	0.281 (0.175)	0.171 (0.207)	0.043 (0.249)	0.423*** (0.051)	0.425*** (0.050)	0.352*** (0.056)	0.320*** (0.057)
Test Scores																
- Receptive Vocabulary, R3			0.010 (0.008)	0.014* (0.006)			0.020 (0.018)	0.028 (0.022)			0.096*** (0.022)	0.064* (0.026)			0.026* (0.012)	0.023 (0.013)
- Mathematics, R5			0.054** (0.015)	0.044* (0.016)			0.051* (0.018)	0.043 (0.022)			0.045* (0.020)	0.029 (0.019)			0.033* (0.012)	0.033* (0.012)
Non-Cognitive Skills and Gender Beliefs Scores																
- Motivation and Grit, R5				0.037 (0.039)				0.130* (0.060)				0.073 (0.045)				0.002 (0.022)
- Socio-Emotional Competence, R5				0.274** (0.088)				-0.042 (0.107)				0.276* (0.130)				0.209** (0.066)
- Gender Beliefs, R5				0.107 (0.093)				0.077 (0.076)				0.553*** (0.117)				0.050 (0.061)
Clustered Fixed Effects _cons	No -1.205 (0.580)	Yes -1.575* (0.670)	Yes -1.540* (0.725)	Yes -1.298 (0.791)	No 0.342 (0.926)	Yes -0.0216 (1.039)	Yes 0.257 (1.066)	Yes -0.138 (1.153)	No 0.715 (1.232)	Yes 0.380 (1.278)	Yes 0.664 (1.321)	Yes -0.107 (1.293)	No 0.507 (0.681)	Yes 0.301 (0.669)	Yes 0.452 (0.753)	Yes 0.284 (0.778)
Number of observations	731	731	691	652	883	883	807	709	562	562	530	520	857	857	816	773
R ²	0.295	0.151	0.176	0.186	0.275	0.244	0.256	0.257	0.228	0.111	0.172	0.225	0.403	0.290	0.298	0.298

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In both Table 8 and Table 9, R-squared greatly diminishes for all countries when adding fixed effects in column (2). This is to be expected as the regression in column (2) only uses the within-cluster variation in the data, which is substantially lower than when between-cluster variation is included in column one. Furthermore, as test scores and independent variables scores are included, R-squared increases in almost all cases. That the increase is not universal is the result of a loss in observations that arises when more variables are included.

On a general note, there is an overlap between computer and internet skills for socio-emotional competence in Ethiopia, and gender norms in Peru, where independent variables were statistically significant in both cases. Worth pointing out is that socio-emotional competence showed a statistically significant effect in three out of four countries when it comes to internet skills, while gender norms showed a high degree of statistical significance when it came to computer skills in the two most digitally and economically developed countries, i.e., Peru and Vietnam.

6.2 Examining the Loss of Observations

The attrition rates discussed in section 5.1.2, elaborated that the cumulative attrition rates increased over time and were skewed towards certain directions, i.e., correlated with specific individual and household characteristics. Interpreting Table 6, the overall accumulated attrition rate in Round 5 is visible primarily through the number of observations for the variables “age in whole years” and “child education”, across all countries. However, the regressions are not only limited by the overall attrition rate, but they are also limited by other specific variables. The impact of variable specific response rates helps explain the lower number of observations that are part of the country specific regressions in column (1) in Table 8 and Table 9, compared to the original sample size in Round 1 of the YL surveys. In India, the overall attrition rate explains almost all the decrease in number of observations. For the remaining countries, apart from being greatly limited by the overall attrition rate, paternal education has a major impact in diminishing these countries' number of observations. In-depth data analysis supports these claims. Moreover, both test scores, added in column (3), and the independent variables scores, added in column (4), decreases the number of observations further.

Interpreting the independent variables in Table 7, it is worth noting that one question in particular is responsible for the decrease in number of observations that occur between column

four and five in Tables 8 and 9, i.e., socio-emotional competence. One explanation for this may be that socio-emotional competence is composed of 23 sub-questions, substantially higher than motivation and grit and gender beliefs, which are comprised of four and 12 questions, respectively. The larger number of questions increases the risk of individuals abstaining from one of the relevant questions, or the risk that one of the questions has a missing value, which excludes more observations from the sample than other aggregate variables with a lower number of sub-questions. Furthermore, the relatively high number of observations in the variable gender beliefs, which only has four sub-questions, supports this reasoning.

7. Discussion

The coefficients and statistical significance of motivation and grit, socio-emotional competence, and gender beliefs differ between computer and internet skills and between the countries studied. In these cases, all significant findings speak to a positive correlation with digital skills. This section will elaborate in what ways the results are related to existing literature, on the implications of our results, the limitations of the study, and areas for future research.

7.1 Discussion on Results

The results from our study can help shed light on whether non-cognitive skills and gender beliefs variables are associated with higher levels of digital skills. Thereby, advancing the understanding of previous studies and their findings.

Overall, our results can be seen to build on the findings of the technical note by Cueto et al. (2018) and utilizes the YL data to establish new findings. Cueto et al. (2018) limit their data sample to individuals who have previously used computers or the internet many times in their lives. This is a constraint that we did not impose on our data as it would limit our conclusions to the computer- and internet-using population in the sample countries, rather than the population as a whole. Findings from Cueto et al. (2018) in the form of statistically significant predictors of digital usage and access were partially used in determining applicable control variables in our analysis of non-cognitive skills and gender beliefs.

Previous studies by Duckworth et al. (2007) and Duckworth and Gross (2014) have both shown a positive correlation between grit and performance for students. Furthermore, Aparicio et al. (2017) was able to establish the same relationship between grit and students' e-learning performance. The results from our regressions are more diverse. With motivation and grit only showing significant results in Ethiopia for computer skills, and in India for internet skills, our results do not necessarily support or contradict their results, as our results are not as consistent as theirs. The beta coefficients can be interpreted as the following: possessing the full set of motivation and grit characteristics is equivalent to a 9.8 percentage point increase in computer skills for Ethiopia and a 13.0 percentage point increase in internet skills for India. An alternative interpretation would be a 2.45 and a 3.25 percentage point increase, respectively, as a result of possessing one additional motivation and grit characteristic. Our results seem to indicate a greater importance of motivation and grit in the less digitally developed countries, i.e., Ethiopia and India, compared to the more digitally developed countries Peru and Vietnam. One explanation could be that, as computers and internet devices are scarcer in the less digitally developed countries, acquiring digital skills to a greater extent depends on an individual's personal determination to acquire these skills. Limited access to computers and the internet requires greater motivation and grit, i.e., the capacity and stamina to pursue long-term objectives, to acquire digital skills.

The previously stated studies in the referenced literature and the conceptual framework sections, by Fathema et al. (2015), Sharma and Chandel (2013), Stewart (2007) and Helsper and Eynon (2013), laid the foundation for our previously un-researched assumption that socio-emotional competence influences digital skills. Our results are not completely unambiguous. Socio-emotional competence is statistically significant for three out of four countries for internet skills, compared to one out of four for computer skills. This indicates that interpersonal skills, openness to experience, self-efficacy, and emotional stability, drive internet skills more than computer skills. The coefficients can be interpreted as follows: possessing the full set of socio-emotional competence skills is equivalent to a 16.7 and a 27.4 percentage point increase in computer skills and internet skills, respectively in Ethiopia. Alternatively, a 0.73 and a 1.19 percentage point increase in computer skills and internet skills are the result of possessing one additional socio-emotional competence skill. One reason for these results could be that the internet to a greater extent can be used as a social medium, of which it is possible that early adopters are more likely to be characterized as having a higher degree of socio-emotional

competence. It is possible that these individuals with a high socio-emotional competence have more acquaintances that use the internet and who encourage and incentives them to do it as well, or that their sociability makes them more susceptible to changes in social and behavioral trends.

Social norms impact social pressures to pursue or not pursue a certain behavior, and Venkatesh and Morris (2000) have found that this effect is stronger for women than for men. These findings could be assumed to suggest that gender beliefs impact the use and acquisition of digital skills. Similar to the case of motivation and grit and socio-emotional competence, a universal conclusion cannot be determined. Our study only shows significant results in Peru and Vietnam, but these results demonstrate very low critical levels. The gender beliefs coefficients can be interpreted as the following: possessing the full set of progressive gender beliefs is equivalent to 51.5 and a 55.3 percentage points increase in computer skills and internet skills in Peru. Alternatively, 4.29 and 4.61 percentage points increase in computer skills and internet skills as a result possessing one additional progressive gender belief. We find that the most promising reason for our results has to do with country level differences. The countries possess, among other distinctions, different economic, social, and cultural backgrounds. It is therefore reasonable that the effect of progressive gender beliefs vary. Thus, the importance of gender beliefs should be studied in greater detail, by accounting for dissimilarities, which results in country specific circumstances.

Based on our results, we can ultimately reject the two null-hypotheses that motivation and grit, socio-emotional competence, and gender beliefs, jointly, have no effect on computer or internet skills among young adults in any of our sample countries. It is observable that the impact of motivation and grit, socio-emotional competence, and gender beliefs differ by country, and they have different effects on computer and internet skills. We have proposed several reasons for these findings. Ultimately, a causal relationship cannot be determined, but the existence of a correlation is, in several cases, apparent.

7.2 Revised Beta Coefficients

The previously discussed significance of different variables leaves room for an interpretation of their relative importance. In isolation, the beta coefficients are of limited use as individuals are more likely to be susceptible to incremental changes and advancements. Therefore, we

attempt to provide a method and a revised beta coefficient that helps further the discussion on the economic significance of statistically significant variables. To understand their relative importance, child education will be used as a benchmark. More specifically, the incrementation from secondary school to higher education for computer and internet skills, for the respective countries. Child education provides a suitable benchmark as it is shown to be significant in almost all countries for digital skills. Furthermore, this benchmark likely results in a conservative interpretation of other coefficients, as the shift from secondary school to higher education has, on average, high beta coefficients as compared to other variables.

Table 11 shows an incrementation from a lower bound to an upper bound, usually in the form of a shift between the 50th percentile and the 75th percentile. Apart from child education, there are two exceptions, the first: parental education, which, for the sake of consistency, follows the same reasoning as was stated for child education. The second: wealth index, which uses beta coefficients from the middle and higher tercile. The difference between the lower and upper bound are shown in column three, the beta value in column four, and the difference multiplied by the beta coefficient gives the revised beta in column five. In the case of child and parental education, the revised beta is calculated as the difference between the beta coefficients of the lower and upper bound, and for the wealth index, the revised beta is calculated as the difference between the beta coefficient of the middle tercile and the upper tercile.

Table 10: Comparison of Variable Relevance

	Lower Bound	Upper Bound	Difference	Beta Coefficients	Revised Beta (%)
Ethiopia: Computer					
Child Education	0.016	0.037	0.021	-	2.1
Mathematics	-0.173	0.644	0.816	0.074	6.0
Motivation and Grit	0.750	1.000	0.250	0.098	2.5
Socio-Emotional Competence	0.913	1.000	0.087	0.167	1.5
Ethiopia: Internet					
Child Education	0.044	0.412	0.368	-	36.8
Receptive Vocabulary	0.290	0.836	0.546	0.014	0.8
Mathematics	0.173	0.644	0.816	0.044	3.6
Socio-Emotional Competence	0.913	1.000	0.087	0.274	2.4
India: Computer					
Child Education	0.014	0.148	0.134	-	13.4
Wealth Index	0.046	0.104	0.058	-	5.8
Paternal Education	0.072	0.149	0.077	-	7.7
Maternal Education	0.014	0.270	0.256	-	25.6
Mathematics	-0.074	0.714	0.788	0.070	5.5
India: Internet					
Child Education	0.004	0.122	0.118	-	11.8
Paternal Education	0.115	0.183	0.068	-	6.8
Motivation and Grit	0.750	1.000	0.250	0.130	3.3
Peru: Computer					
Child Education	-0.083	-0.091	-0.008	-	-0.8
Mathematics	0.136	0.668	0.533	0.049	2.6
Gender Beliefs	0.833	0.917	0.083	0.515	4.3
Peru: Internet					
Child Education	0.039	0.043	0.004	-	0.4
Receptive Vocabulary	0.131	0.826	0.694	0.064	4.4
Socio-Emotional Competence	0.957	1.000	0.043	0.276	1.2
Gender Beliefs	0.833	0.917	0.083	0.553	4.6
Vietnam: Computer					
Child Education	0.273	0.500	0.227	-	22.7
Mathematics	0.130	0.809	0.679	0.100	6.8
Gender Beliefs	0.750	0.833	0.083	0.202	1.7
Vietnam: Internet					
Child Education	0.255	0.320	0.065	-	6.5
Mathematics	0.130	0.809	0.679	0.033	2.2
Socio-emotional Competence	0.783	0.870	0.087	0.209	1.8

Note: Data retrieved from the YL surveys. Included variables are those that demonstrate significant results in Table 8 and 9, with the exception of child education for Peru in Table 9.

The table shows that the results vary for both computer and internet skills and for the respective countries. For computer skills in Ethiopia, motivation and grit and socio-emotional competence seem to carry economic significance when compared to child education. However, in regard to internet skills, socio-emotional competence seems to play a much smaller role compared to the stark influence of child education. In India, the independent variables are neither statistically nor economically significant for computer skills. For internet skills in India, motivation and

grit shows a revised beta that is below that of other variables, but that could still be seen as relatively important. Moreover, the data in Table 10 suggests that gender beliefs for computer skills, and socio-emotional competence and gender beliefs for internet skills, are of economic significance, in Peru. For computer skills in Vietnam, gender beliefs carry little weight, while socio-emotional competence is moderately important for internet skills.

Overall, the revised beta coefficient is lower than the original beta for all independent variables, as the revised beta coefficient captures the effect of an incrementation. Despite the fact that non-cognitive skills and gender beliefs show statistically significant results in many instances, the economic significance can often be interpreted as limited. Furthermore, that the results greatly vary between countries diminishes the applicability of our study on other countries.

7.3 Limitations of the Study

There are several limitations to the findings presented in this study. The first relates to various data limitations. The sampled individuals share many similar characteristics with the general population in the respective countries, but they should not be an exact representation (Flores and Escobal, 2008). The data is therefore most applicable for panel data analysis, which is the focus of our study, and not for comparisons of population characteristics between countries.

The second limitation is the statistical biases that may be present. Firstly, attrition bias, which has been discussed extensively in this paper, limits the reliability of the results. The attrition has been shown not to be at random, but rather, that it is correlated with specific individual and household characteristics. Control variables have been used to account for these characteristics. However, it cannot be assumed that we have accounted for all relevant factors. Secondly, the issue of omitted-variable bias arises, as it is possible that an omitted variable is correlated with an included explanatory variable. By studying the effects of non-cognitive skills and gender beliefs, which cover concepts that are difficult to navigate because of different, often overlapping, definition and theories, our results may be influenced by confounding variables. This could result in a violation of the zero conditional mean assumption, which causes the OLS estimator to be biased and inconsistent. However, when addressing the relationship between the residuals and the independent variables, no evidence of a violation of the zero conditional mean assumption was observed.

The third limitation is that the study may be subjected to specific methodological limitations possibly giving rise to a form of reporting bias. Using self-reported digital skills is one example. Previous research has already demonstrated a difference in self-perceived skills and actual skills between genders (Hargittai and Shafer, 2006). Moreover, individuals are subjective to the problem of social desirability, which can further influence their reported skills. The overall propensity of individuals is to overreport or underreport their skills, therefore, negatively influence the reliability of the results. Further, the issue of social desirability may also influence the independent variables: motivation and grit, socio-emotional competence, and gender beliefs. Particularly because of the interviews being conducted in a face-to-face format. These issues are difficult to control for, however, by using gender as a control variable this issue is somewhat diminished.

The fourth limitation is reversed causation, which also weakens the interpretation of our results and the inferences that can be made. Unlike most of the other variables, our independent variables are collected in the same round as the dependent variables, in Round 5. By collecting the independent and dependent variables simultaneously, the causal influence of independent variables on the dependent variables cannot be determined. Ideally, the YL data on our independent variables would therefore have been collected in an earlier round. This constrains the extent of our findings and our contribution. Therefore, we cannot proclaim a causal relationship, but rather, we make a more modest claim of representing the first study that can establish a correlation.

A final limitation that is worth acknowledging is that of the revised beta coefficients used in section 7.2 and the interpretations and conclusions which are derived. Firstly, the method of using child education as a benchmark for comparing results across regressions and countries is not without drawbacks, primarily, as child education is not statistically significant for internet skills in Peru. Secondly, the choices of incrementations are relevant, and other upper and lower bounds could be employed.

7.4 Future Research

There are several implications of our study on future research. Firstly, we have indicated that there are correlations between motivation and grit, socio-emotional competence, and gender beliefs on computer and internet skills. We encourage research to continue to build on the

existing literature and our findings, in order to support or contradict our results. Further, we recognize that our findings and the implications that follow may be limited by data and methodology limitations. We therefore call on future research to further evaluate our results and the possibility of a causal relationship.

Secondly, since our data analysis has been constrained by the number of observations, we encourage future research into gender specific effects of motivation and grit, socio-emotional competence, and gender beliefs on computer and internet skills. It may be the case that the effects of these independent variables have different implications for different genders. For example, based on Mudege et al. (2016) and Twyman et al. (2015), it could be the case that gender beliefs have very different implications on the digital skills depending on gender. This is something that could be evaluated in the future by using the younger cohort in the YL study, when the same questionnaire regarding our independent and dependent variables have been collected, and as the younger cohort consist of more observations.

Thirdly, we encourage future research within more specific niches of the second digital divide by looking at the effect of motivation and grit, socio-emotional competence, and gender beliefs, on computer and internet skills, when controlling for computer and internet access or usage. It is possible that individuals with different levels of motivation and grit, socio-emotional competence, and gender beliefs use computers and the internet for different activities and acquire different levels of digital skills. In practice, this could provide an extension of the technical note by Cueto et al. (2018).

Finally, our results related to progressive gender beliefs are not yet completely understood. Gender beliefs is likely to differ between countries as its impact is likely shaped by many variables which include economic, social, and cultural backgrounds. However, except for the role it plays in Peru and to some extent in Vietnam, very few conclusions can be drawn about gender beliefs. By studying the effect of gender beliefs in a wider range of contexts and with more comprehensive data, more conclusive results can be obtained.

8. Conclusion

The influence of non-cognitive skills and gender beliefs on digital skills has so far remained unstudied, even though the World Bank (2016) defines digital inequality as one of the most important issues we face today, and despite the positive impact that an increased level of digital skills may have on productivity, improvement of services and expansion of job opportunities. This paper has therefore tried to address this research gap by using individual-level longitudinal data on young adults in four different countries.

The evidence we have put forth indicates that non-cognitive skills and gender beliefs differ by country and that they have different effects on computer and internet skills. Motivation and grit is shown to have the greatest effect in less digitally developed countries, indicating that the ability and stamina to pursue long-term objectives is of greater importance for acquiring digital skills. Socio-emotional competence has a greater impact on internet skills than computer skills, which likely is because the internet to a greater extent can be used as a social medium. The impact of progressive gender norms can be characterized as very country-specific and is therefore greatly influenced by country-specific characteristics. Although these results are statistically significant, the economic significance is limited in many cases.

We recognize the limitations of our study, especially the limitations of the data at hand and the specific methodological limitations that exist, which weaken the reliability of our results and the extent to which robust conclusions can be drawn. Furthermore, our findings and the limitations of our study leave room for several areas of future research. We encourage evaluation of our results and further studies of the importance of non-cognitive skills and gender beliefs variables for different genders. We also believe that it is important to look at the impact of non-cognitive skills and gender beliefs variables when accounting for computer and internet access or usage, and to further analyze the effect of progressive gender norms in a wider range of contexts.

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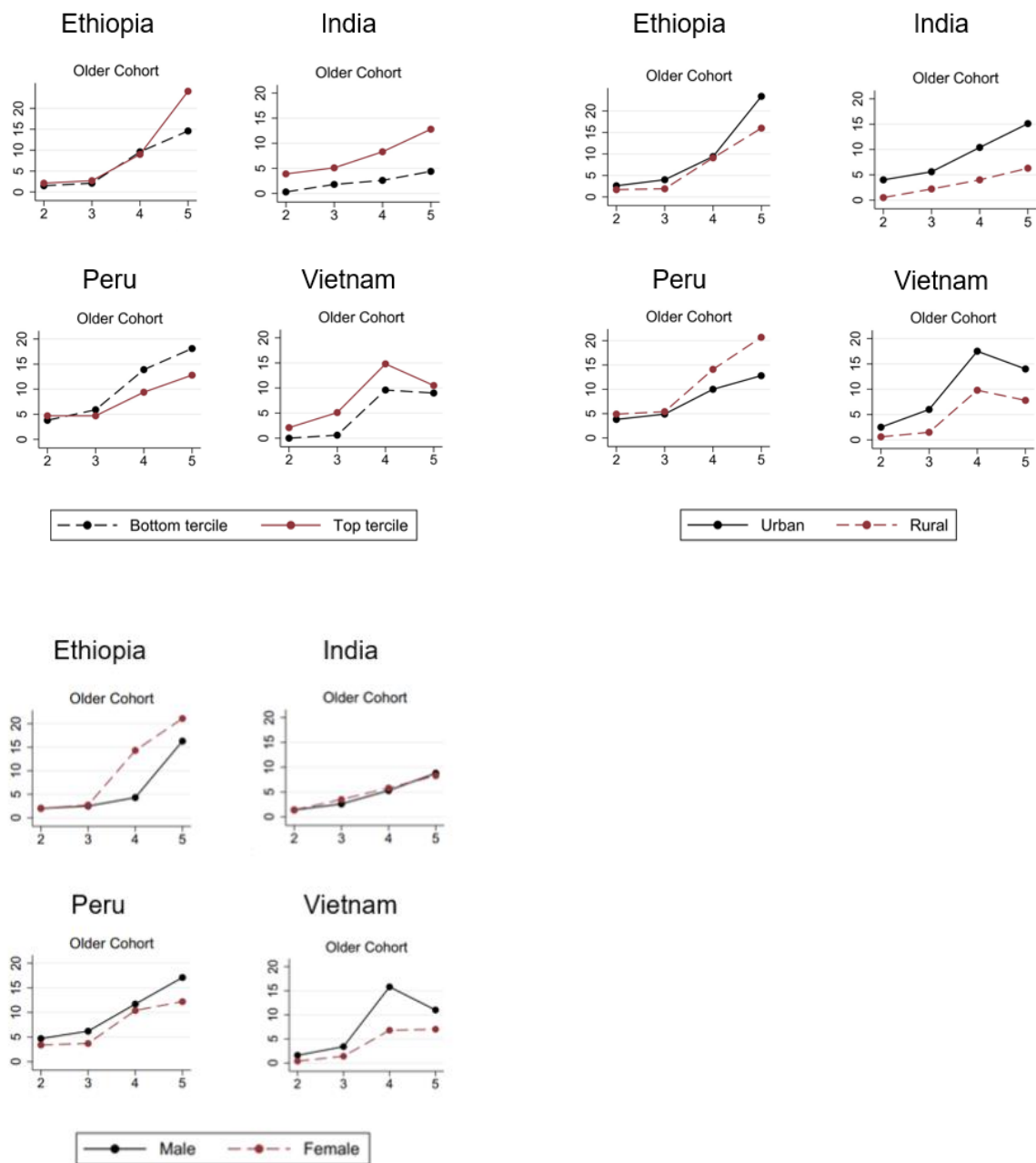
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10. Appendix

Figure A1: Cumulative attrition rates



Note: Sánchez and Escobar (2020)

Table A1: Digital Skills Statements

Variable Name:	Variables Statement:
SKLL01R5	I know how to create a folder on a digital device.
SKLL02R5	I know how to move a file from one folder to another.
SKLL03R5	I know how to delete a file.
SKLL04R5	I know how to retrieve a deleted file from the recycle bin.
SKLL05R5	I know how to use the undo and redo functions, while working on a digital document.
SKLL06R5	I know how to change the margins (for example using Word).
SKLL07R5	I know how to bold, italicize or underline text (for example using Word).
SKLL08R5	I know how to insert a table in a document (for example using Word).
SKLL10R5	I know how to create a presentation (for example using PowerPoint).
SKLL11R5	I know how to open downloaded files.
SKLL12R5	I know where to click to go to a different webpage.
SKLL13R5	I know how to complete online forms.
SKLL14R5	I know how to connect to a Wi-Fi network.
SKLL15R5	I find it easy to decide what the best keywords are to use for online searches.
SKLL16R5	I find it easy to find a website I visited before.
SKLL17R5	I know how to create something new from existing online images, music or video.
SKLL18R5	I know which apps or software are safe to download.

Note: Sánchez et al. (2018)

Table A2: Motivation and Grit Statements

Variable Name:	Variables Statement:
GRIT02R5	Setbacks don't discourage me.

GRIT04R5	I am a hard worker.
GRIT07R5	I finish whatever I begin.
GRIT08R5	I am diligent.

Note: Sánchez et al. (2018)

Table A3: Socio-emotional Competence Statements

Variable Name:	Variables Statement:
LIKOPR5	I like cooperating in a team.
GDLEADR5	I can be a good leader.
FEAY01R5	If someone opposes me, I can find the means and ways to get what I want.
FEAY02R5	I make friends easily.
FEAY04R5	I'm as good as most other people.
FEAY06R5	When I am confronted with a problem, I can usually find several solutions.
FEAY09R5	If I am in trouble, I can usually think of a solution.
FEAY12R5	I am confident that I could deal efficiently with unexpected events.
FEAY14R5	Most other kids like me.
FEAY16R5	I can do things as well as most people.
FEAY17R5	I can always manage to solve difficult problems if I try hard enough.
FEAY18R5	Other kids want me to be their friend.
CANCOPR5	I cooperate well when working in a team.
CPLEADR5	I am capable of being a good leader.
FEAY23R5	I have more friends than most other kids.
FEAY26R5	A lot of things about me are good.
FEAY27R5	I have lots of friends.
FEAY30R5	I can usually handle whatever comes my way.
FEAY31R5	I do lots of important things
FEAY32R5	Thanks to my resourcefulness, I know how to handle unforeseen situations.

FEAY34R5	When I do something, I do it well.
GODCOPR5	I am good at cooperating with team members.
SNLEADR5	I am seen as a capable leader.

Note: Sánchez et al. (2018)

Table 4A: Gender Beliefs Statements

Variable Name:	Variables Statement:
SCNR01R5	Swearing is worse for a girl than for a boy
SCNR02R5	On a date, the boy should be expected to pay all expenses.
SCNR03R5	On the average, girls are as smart as boys.
SCNR04R5	More encouragement in a family should be given to sons than daughters to go to college.
SCNR05R5	It is all right for a girl to want to play rough sports like football.
SCNR06R5	In general, the father should have greater authority than the mother in making family decisions.
SCNR07R5	It is all right for a girl to ask a boy out on a date.
SCNR08R5	It is more important for boys than girls to do well in school.
SCNR09R5	If both husband and wife have jobs, the husband should do a share of the housework such as washing dishes and doing the laundry.
SCNR10R5	Boys are better leaders than girls.
SCNR11R5	Girls should be more concerned with becoming good wives and mothers than desiring a professional or business career.
SCNR12R5	Girls should have the same freedoms as boys.

Note: Sánchez et al. (2018)