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Social Justice and K-12 Teachers' Effective Use of OER: A Cross-Cultural Comparison by Nations

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Open educational resources (OER) have the potential to promote social justice imperatives in education, but because of the uneven provision of technical infrastructure across different countries, it remains uncertain whether the people who need OER the most are its primary beneficiaries. In K-12 education, educators play a major role in the effort to incorporate OER into classroom teaching but, even if they are able to source such resources (overcoming the "first-level digital divide"), many lack the practical capacity to effectively use (e.g., adapt) OER (the "second-level digital divide"). This exploratory research paper employs a cross-cultural perspective to interrogate how the second-level digital divide shapes K-12 teachers' effective use of OER. With the goal of understanding how this divide influences OERs' potential to enhance social justice, this research attempts to identify the factors accounting for teachers' effective use of OER – and any reception gap – between different countries by conducting a series of stepwise logistic regressions applied to a largescale survey of K-12 educators. It does so by assessing OER use amongst 675 K-12 educators around the world in relation to their developmental and cultural contexts, as expressed through the Human Development Index, the Gender Development Index, and Hofstede's six dimensions of national culture. The findings of this exploratory study provide new insights to support OER adoption in K-12 settings worldwide from a cultural perspective.

Introduction

The provision and distribution of educational resources is highly uneven across the globe, a fact that impedes the attainment of social justice for many communities, especially in developing countries (Lambert 2018; Tang & Wang 2017). Due to high tuition and textbook costs, many students in poorer areas often have limited or even no access to educational resources. To close the gap in student access to educational resources, teachers in underdeveloped areas can consider using Open Educational Resources (OER) as an alternative to expensive textbooks (Robinson, Fischer, Wiley & Hilton 2014; Wiley, Hilton, Ellington & Hall 2012). OER are free online resources that are openly licensed and can be retained, reused, revised, remixed, and redistributed to meet personalized instructional needs at no cost (Hilton 2016; Hilton, Robinson, Wiley & Ackerman 2014; Hilton, Wiley, Stein & Johnson 2010). For those who reside in underdeveloped areas, OER offers the hope of obtaining a more equitable level of access to education (Atkins, Brown & Hammond 2007;

Ngimwa & Wilson 2012), but whether adopting OER can help attain social justice remains uncertain.

Following Fraser (2005), social justice is a process and an outcome, focused on overcoming the injustices of *economic* maldistribution, *cultural* misrecognition, and *political* misrepresentation. Efforts to overcome the obstacles related to these injustices can be "affirmative" (ameliorative strategies that reduce the symptoms associated with the injustice, though not its root cause) or "transformative" (radical strategies aimed at dismantling the core structure of a situation of injustice). In relation to education, as an innovation that allows for the legal sharing of free, adaptable resources, OER contribute to the promotion of social justice in a number of ways, some affirmative, some transformative, depending on the context (Hodgkinson-Williams & Trotter 2018). As "free" educational resources that can bring down the costs associated with such materials, OER form part of the promotion of redistributive justice in education (Lambert 2018). However, for recognitive justice (i.e., acknowledging the disparity in culture and gender) and representational justice (i.e., allowing the unheard groups or individuals to equally speak out), additional effort is still needed when teachers adapt OER, especially given the digital divide in teachers' access to and effective use of OER.

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The "digital divide" can be understood as comprising two levels: the first-level divide refers to the disparity between groups in their *access to* digital technologies, while the second-level divide refers to the disparity between groups in their *ability to effectively use* those digital technologies (Büchi, Just & Latzer 2016; Scheerder et al. 2017). The first-level divide concerns unequal access to technology (hardware, software, connectivity) resulting in a dichotomy between "haves" and "have-nots" (Dolan 2016; Scheerder, van Deurson & van Dijk 2017). For example, the gap in access to broadband Internet between different countries leads to teachers' first-level digital divide in accessing OER (Haßler & Jackson 2010).

However, now that access to broadband Internet has become more prevalent, the discussion about the digital divide in education has shifted towards the second-level divide, that which concerns the potential gap in skills needed to efficiently engage with digital technologies (Büchi et al. 2016; van Deursen & van Dijk 2014). Therefore, teachers who lack the necessary competencies to search for, find, download, use, adapt, create, or upload openly licensed resources also experience this second-level digital divide when it comes to OER (Hodgkinson-Williams 2015). Indeed, Cobo (2013) notes that a large majority of educators in developing countries lack the competency to find, adapt, and create OER, a fact that likely exacerbates educational inequality for students.

In addition, because most OER are published in English, this limits some teachers' capacity to use such materials, especially non-native English speakers (Kurelovic 2015) who have to overcome language barriers and cultural distance in order to use them.

Furthermore, knowledge gap theory (Tichenor, Donohue & Olien 1970) argues that people with higher socioeconomic status are more likely to benefit from information delivered by the infused mass media, even including the numerous educational opportunities created by the Internet (Rohs & Ganz 2015). In other words, those with higher socioeconomic status may be better poised to leverage the potential of OER than those from lower socioeconomic backgrounds.

To help reduce educational inequality worldwide, it is important to close the digital divide for K-12 teachers who seek to use OER in developing countries. But the question is: what factors explain teachers' lack of OER use capacity? As it stands, few empirical studies shed light on whether and how teachers can effectively use OER in K-12 settings, and even fewer attempt to investigate this question in a cross-cultural perspective. It is also noteworthy that, for effective use of OER, K-12 educators cannot simply insert others' OER into their teaching but also need to make sure they can adapt OER to fit their needs (Hodgkinson-Williams & Trotter 2018; Tang, Lin, & Qian, 2020). Thus, to take an initial step, it is important to understand which nation-level attributes shape teachers' adaption of and reception of OER, attributes which may explain – and help us find a way past – this second-level digital divide.

This exploratory research paper seeks to better understand whether teachers' adaption of OER can promote social justice; that is, greater "parity of participation" (Fraser 2005). It does so by attempting to determine which factors might contribute to overcoming the second-level digital divide in the adaption and reception of OER between K-12 teachers in different countries. Two main dimensions illustrate this divide: whether teachers have adapted OER for their own needs (the gap in effective use OER), and which barriers teachers face in using OER (the reception gap). Working with a data set of 675 survey responses by K-12 teachers, conducted by the OER Research Hub (OERRH 2014), this study employed logistic regressions to understand which nation-level data metrics – Human Development Index, Internet penetration rate for each country, Gender Development Index, and also Hofstede's six cultural dimensions – might explain the OER adaptation and reception gaps between teachers in different countries.

It is hoped that this research will provide insights for scholars, educators, and teacher education programs, with respect to considerations of local conditions, and to better prepare teachers to efficiently integrate OER in K-12 settings to achieve social justice.

Literature Review
Digital Divide and K-12 Education
Research on the equity of technology use can be traced back to knowledge gap theory (Tichenor et al. 1970) which asserts that socioeconomic status (SES) influences how people receive and assimilate information from the mass media. People with higher SES outperform those with lower SES in terms of communication skills, knowledge, social contacts, capacity of selecting information, and access to and facility with the print media (Rohs & Ganz 2015; Tichenor et al. 1970). During the last two decades, information and communication technologies (ICTs) have gradually eclipsed the print media in disseminating information to the public, yet the knowledge gap remains due, in part, to a "digital divide" that describes the uneven distribution of access to and use of technology (Gunkel 2003).

The "digital divide" was a term originally proposed by the USA's National Telecommunications and Information Association (NTIA) in 1999. When it comes to equity of technology access and use, people with higher SES are still advantaged as they are more likely to benefit from numerous educational opportunities afforded by ICTs (Rohs & Ganz 2015). As relevant research proliferates and technology advances, as noted in the introduction, the digital divide has come to be understood as characterized by two "levels" of divides – access to technology as the first level (Scheerder et al. 2017) and technical skills capacity as the second level (Büchi et al. 2016; Dolan 2016; van Deursen & van Dijk 2014; Wood & Howley 2012).

The second-level digital divide also exists in K-12 education, especially given the gap in technology use resulting from disparities arising from gender, race, SES, and school geography (Reinhart, Thomas & Toriskie 2011; Wood & Howley 2012; Zhang 2015). In research across multiple countries, for example, students from marginalized groups are noted as spending more hours using their technological devices to play computer games rather than employing them for educational purposes (Rideout, Foeh & Roberts 2010). This is also the case for children from

lower SES backgrounds (Gershenson 2013; Hollingworth et al. 2011). In addition, language and cultural values influence students' disparity in technology use patterns. For instance, children from native English-speaking families perform better in science courses with more frequent purposeful usage of computers, while home computer access had a negative effect on the science performance of those children who are English language learners (Chang & Kim 2009).

To close the second-level digital divide in K-12 education, teachers must consider factors relevant to their local context and students' socio-demographic and socio-cultural attributes when using technology in the classroom. However, teachers' technological expertise (or lack thereof) might actually magnify the divide, especially given that most teacher preparation programs only prepare pre-service teachers for the general use of technology rather than how to tailor technology use to students' age and subjects (Reinhart et al. 2011). In addition, for teachers from different countries, their capacity of using technology might differ due to the disparity in cultural values, economic conditions, educational level, and many other factors (Reinhart et al. 2011; van Deursen & van Dijk 2014; Zhang 2015). To prepare teachers to efficiently use technology, understanding which factors contribute to the digital divide in teachers' technology use is critical.

Open Educational Resources

OER provide users with free access to openly licensed educational materials that users may utilize, manipulate, and share for their own purposes (UNESCO 2002). With users granted the permission to retain, reuse, revise, remix, and redistribute these resources, OER allow educators to customize and reproduce a broad collection of materials (Hilton 2016; 2017; Hilton et al. 2010; Lin & Tang 2017). They also have obvious positive financial implications, but without any deterioration of pedagogical value: evidence that OER can decrease students' educational costs without harm to their course performance has been well documented. For example, Wiley et al. (2012) reported there was no significant difference in students' standardized test scores between two secondary science courses, one using traditional textbooks and the other using OER.

The Regional Gap in the Effective Use of OER

OER are sometimes advertised as a panacea for overcoming educational inequity, but it is important to realize and resolve the existing gaps in access to OER, use of OER, and the impact of OER between the global south and north as well as between higher education and other educational contexts (Bozkurt, Koseoglu & Singh 2019; Cobo 2013; Cox & Trotter 2016; King, Pegrum & Forsey 2018). For example, King et al. (2018) explain that most OER derive from the global north, which potentially threatens to overwhelm the global south with contextually irrelevant OER. In addition, Cox and Trotter (2016) reveal how important an institution's culture is for encouraging academic staff to adapt and produce OER. Besides resolving the gap in higher education settings between the global south and the global north, Bozkurt et al. (2019) propose

future initiatives should extend the use of OER beyond higher education to K-12 education.

Culture and Development Indices

According to Hofstede (2001), culture is "the collective programming of the mind that distinguishes the members of one group or category of people from another" (p. 9). To explain cultural differences between different countries and societies, Hofstede (1986, 2011) developed a schema comprising six cross-cultural dimensions: power distance, individualism vs. collectivism, uncertainty avoidance, masculinity vs. femininity, long-term orientation vs. short-term orientation, and indulgence vs. restraint (see **Table 1**). This schema provides a useful series of lenses through which to view potential cultural influences on human activity, including OER engagement. While too broad to perhaps be definitive (Nakata 2009), the schema offers a suggestive means for disambiguating the more subtle elements of culture in teachers' pedagogical decisions (Tang & Wang 2017).

In connecting culture to OER use, for example, Jung and Lee (2020) found teachers in Japan tend to consider social influence when adopting OER, while teachers in Korea were more driven by how OER could improve their job performance. Meanwhile, teachers in the United States were found to be more concerned with the price value of OER. However, it remains unknown how each cultural dimension influences teachers' actual usage of and their capacity to effectively use OER.

Beyond culture, differences in gender, race, income, and educational level can expand the second-level digital divide (Reinhart et al. 2011; van Deursen & van Dijk 2014; Zhang 2015). Therefore, in addition to using Hofstede's cultural schema here, this research also investigates how other nation-level attributes relevant to social justice - human development, gender development, and the percentage of a population's access to the Internet – deconstruct the regional gap in teachers' effective use of OER.

The Human Development Index (HDI) is an index released by the United Nations Development Program (UNDP) as a four-tier summary measure of "average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living" (UNDP n.d. a). The countries with "very high human development" are ranked in the first tier (e.g., Norway, Australia, the United States, the United Kingdom); followed by countries with "high human development" in the second tier (e.g., China, Russia, Brazil), then countries with "medium human development" in the third tier (e.g., South Africa, India), and those with "low human development" in the fourth tier (e.g., Nigeria, Chad, Niger).

The Gender Development Index (GDI) is another UNDP index describing "gender gaps in human development achievements by accounting for disparities between women and men in three basic dimensions of human development—health, knowledge and living standards using the same component indicators as in the HDI" (UNDP n.d. b).

Previous research indicates that the difference in these indexes influences patterns of individual OER usage. For

Table 1: Definitions of each dimension in Hofstede's six cultural dimensions (https://geert-hofstede.com/national-culture.html).

Dimension	Definition
Power Distance (PDI)	"…expresses the degree to which the less powerful members of a society accept and expect that power is distributed unequally. The fundamental issue here is how a society handles inequalities among people."
Uncertainty Avoidance (UA)	"…expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. The fundamental issue here is how a society deals with the fact that the future can never be known: should we try to control the future or just let it happen?"
Individualism vs. Collectivism (IDV)	"Individualism can be defined as a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. Its opposite, collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty."
Masculinity vs. Femininity (MAS)	"The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented."
Long-term Orientation vs. Short-term Orientation (Ltowvs)	"Societies who score low on this dimension, for example, prefer to maintain time honored traditions and norms while viewing societal change with suspicion. Those with a culture which scores high, on the other hand, take a more pragmatic approach: they encourage thrift and efforts in modern education as a way to prepare for the future."
Indulgence vs. Restraint (IVR)	"Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it by means of strict social norms."

example, Kizilcec, Piech and Schneider (2013) claim that when taking an open online course, learners from high HDI countries were more likely to complete the course while those from medium HDI countries were more likely to only view the lectures to complete the assessment. Such differences are intriguing and beg to be better understood.

Methodology
Dataset
The dataset assessed here to better understand teachers' effective use of OER was derived from an open secondary dataset published by the OER Research Hub (OERRH 2014) at the Open University, UK. This dataset collected survey responses from K-12 teachers, college instructors, librarians, and learners (formal and informal) in 180 countries regarding their perceived impact of OER on teaching and learning (Farrow et al. 2015). For different categories of respondents, the OER Research Hub provided unique questions addressing the use of OER in their specific settings.

Variables
This research focused on the responses in the survey to two relevant questions (as dependent variables) submitted by teachers in K-12 settings. Specifically, we examined how a set of national demographic variables (as independent variables) predicted the gaps in each of those two dependent variables.

Teachers' effective use of OER

For this variable, we mainly addressed the adaptation gap with a focus on an item, "*I have adapted OER to fit my needs*", from the question "In which of these ways, if any, have you used or created OER?" In particular, we chose this question because we conceptualized that adapting OER for personal needs characterized OER usage. It is important to point out that this item did not inquire of teachers' possibility of using or integrating OER but focused on whether they performed the behavior of finding and repurposing OER for their own needs. We recorded teachers' responses to this item as a categorical variable coded as "0" (have not adapted OER) and "1" (have adapted OER).

Teachers' challenges in using OER

This variable attended to the potential OER reception gap with a focus on the question "Which challenges, if any, do you most often face in using OER?" The question included 17 response statements and an open-ended response box (though the dataset only recorded 16 responses). Referring to work on teachers' barriers to technology use in the classroom (Hew & Brush 2007), we manually categorized the statements into "first-order barriers" and "second-order barriers". First-order barriers concern external factors beyond teachers' control such as infrastructure resources, institutional policies, social culture, and assessment norms, while second-order barriers deal with internal factors within teachers' control including teacher attitudes, beliefs, and knowledge and skills regarding

technology integration (Hew & Brush 2007). Eight of the 16 statements were coded as first-order barriers while the other eight were second-order barriers (see **Table 2** for the coding scheme). We marked "0" for teachers who did not meet such barriers and "1" for those who met any of the two types of barriers.

National Demographic Dataset
A series of national demographic datasets were retrieved from multiple sources as the independent variables in this research. The HDI and GDI were retrieved from the UNDP database published in 2015. Furthermore, the percentage of each national population with Internet access by 2017 was retrieved from Wikipedia1. A detailed description of each index is provided in **Table 3**.

Cultural Dimension Dataset
The matrix used to assess cultural difference in this research was Hofstede's six cross-cultural dimensions (1986, 2011; see **Table 1**). The latest version (v.12/08/2015) of the Cultural Dimension Data Matrix2 was retrieved as the source of cultural dimension values. In particular, the matrix recorded the cultural dimension values for a total of 111 countries and regions, although some countries and regions did not have all of their six cultural dimension scores. The score of each dimension can be considered as a continuous value, ranging from 0 to 112.

Participants
According to Farrow et al. (2015), the OER Research Hub dataset included a total of 6390 survey responses. Based on the responses to the questions "what is your role?" and "within which educational context(s) do you work?", we identified 675 respondents as K-12 educators. We further checked whether these K-12 educators responded to the three questions aforementioned and all of them did. Thus, we focused on the 675 K-12 educators as our participants in this study. In particular, 290 (43%) of them identified

Table 2: Coding scheme for the question about teachers' barriers in using OER, referring to Hew & Brush (2007).

Barriers	Statements
First-order barriers	7. Getting work colleagues/managers to accept the use of open educational resources
	10. Not having enough time to look for suitable resources
	11. Not having connections with open educational resource-using peers who could be a source of support
	12. Missing/needing the support of a tutor or teacher to help me work through open course materials
	14. Not having enough time/opportunities to experiment with using open educational resources in the classroom
	15. Lacking institutional support for my use of open educational resources
	16. Resources not being aligned with professional standards or regulation
Second-order barriers	1. Overcoming technology problems when downloading resources
	2. Knowing where to find resources
	3. Finding suitable resources in my subject area
	4. Finding resources of sufficiently high quality
	5. Finding resources that are up-to-date
	6. Finding resources that are relevant to my local context
	8. Not being skilled enough to edit resources to suit my own context
	9. Not knowing whether I have permission to use, change or modify resources
	13. Not knowing how to use the resources in the classroom

Table 3: Description of each index used to assess national demographic data.

Index(es)	Definition(s)	Source(s)
Human Development Index (HDI)	"a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions."	UNDP
Gender Development Index (GDI)	"The GDI measures gender gaps in human development achievements by accounting for disparities between women and men in three basic dimensions of human development—health, knowledge and living standards using the same component indicators as in the HDI."	UNDP
% of population with access to the Internet (Internetuser)	It describes the percentage of people accessing the Internet using any devices (e.g., laptop, tablet, cellphone) within the gross population in a country.	Wikipedia

as female, 260 (39%) identified as male, one identified as transgender and the remaining 124 (18%) did not indicate a gender. They came from 72 countries and regions of which the top three countries in terms of respondents were the United States, the United Kingdom, and South Africa. In addition, 53% spoke English as their native language, and 53% had taught in K-12 settings for more than three years.

Data Analysis

We performed separate stepwise logistic regressions to find the significant variables that predicted the gaps in K-12 teachers' usage of and reception of OER. Using stepwise logistic regression, a reduced number of variables was kept to build the best fitting logistic regression model. For each step, an additional variable was added to the model. To select the best-fitting model, we used an information-based statistical index named the Akaike information criterion (AIC) index (Akaike 1974). If the Likelihood Ratio proves the added predictive powers of the factors, the factors would be added sequentially (Higashi, Schunn & Flot 2017). The stepwise logistic regression procedure was performed using R software. Upon the analysis, we identified the significant variables predicting each dependent variable.

Results

Teachers' Effective Use of OER

To determine what variables could improve the model fit to the greatest extent, we conducted a stepwise procedure for the logistic regression to examine one additional variable in the model at a time. For the item "*I have adapted OER to fit my needs*", seven variables were selected to be included in the final model. The result is presented below:

$$\log \frac{P(Yes)}{P(No)} = -.06 * PDI + .03 * IDV - .01 * MAS + .05$$
$$* UA - .06 * IVR - .03 * Internetuser + .93 * GDI$$

The model shows that Power Distance (PDI), Individualism vs. Collectivism (IDV), Masculinity vs. Femininity (MAS), Uncertainty Avoidance (UA), Indulgence vs. Restraint (IVR), the percentage of the population with access to the Internet (Internetuser), and the Gender Development Index (GDI) were selected as relevant variables. As presented in **Table 4**, the log of odds of an individual who has adapted OER to their needs is positively related to IDV (p = .23), UA (p = .07), and GDI (p = .96) while being negatively related to PDI (p = .08), MAS (p = .63), IVR (p = .15), and Internetuser (p = .47). Taking the example of PDI, the relationship between PDI and the dependent variable can be further interpreted as, given the scores of other independent variables, an individual from a country with high PDI is less likely to adapt OER to his or her needs with the odds ratio of .94 times lower when PDI increases one unit (see **Figure 1**). The result (see **Table 4**) also reflected the influence of gender equality, as one of the metrics assessing social justice, on teachers' effective use of OER. The result showed that an individual from a country with high GDI is more likely to adapt OER to personal needs with the odds ratio of 2.53 times higher when GDI increases

Table 4: Logistic regression analysis under stepwise procedure for "I have adapted OER to fit my needs."

Variables	Estimate	Std. Error	z value	p	Odds Ratio
Intercept	6.58	14.13	.47	.64	
PDI	−.06	.03	−1.74	.08	.94
IDV	.03	.02	1.19	.23	1.03
MAS	−.01	.03	−.48	.63	.99
UA	.05	.03	1.84	.07	1.05
IVR	−.06	.05	−1.43	.15	.94
Internetuser	−.03	.05	−.72	.47	.97
GDI	.93	16.68	.06	.96	2.53

Note: PDI = Power Distance, IDV = Individualism vs. Collectivism, MAS = Masculinity vs. Femininity, UA = Uncertainty Avoidance, IVR = Indulgence vs. Restraint, Internetuser = The percentage of the population with access to the Internet, GDI = Gender Development Index.

one unit, but it is worth noting that the scale of the GDI ranges from 0.600 to 1.030 so it might not be possible for a one-unit increase in GDI.

Figure 1 illustrates how the probability of endorsing the question "I have adapted OER to fit my needs" decreases as PDI increases. Other independent variables can be interpreted in the same fashion.

Teachers' Challenges in Using OER
First-order Barrier

The stepwise logistic regression chose three variables among the nine variables mentioned in the previous sections. The result of K-12 teachers possessing the first-order barrier is presented below:

$$\log \frac{P(Possess)}{P(not\ Possess)} = -6.96 + .02 * IDV + 10.55$$
$$* HDI - .05 * Internetuser$$

The model selection result for the stepwise logistic regression model of possessing the first-order barrier shows three variables were selected in the best-fitting model which are Individualism vs. Collectivism (IDV), Human Development Index (HDI), and Internetuser. As presented in **Table 5**, the log-odds of possessing the first-order barrier is positively related to IDV (p = .004), HDI (p = .02) and Internetuser (p = .02). Taking the example of HDI, the model again can be further interpreted as, given the scores of other variables, an individual from a country with high HDI is more likely to face a first-order barrier. Specifically, the odds ratio of having the first-order barrier is 38177.44 times greater when HDI increases one unit. The large number of odds indicates the strong effect of the Human Development Index (HDI) on the probability of facing the first-order barrier using OER. Similar to the Gender Development Index (GDI), the scale of HDI ranges from 0.348 to 0.944. Although the coefficient and odds
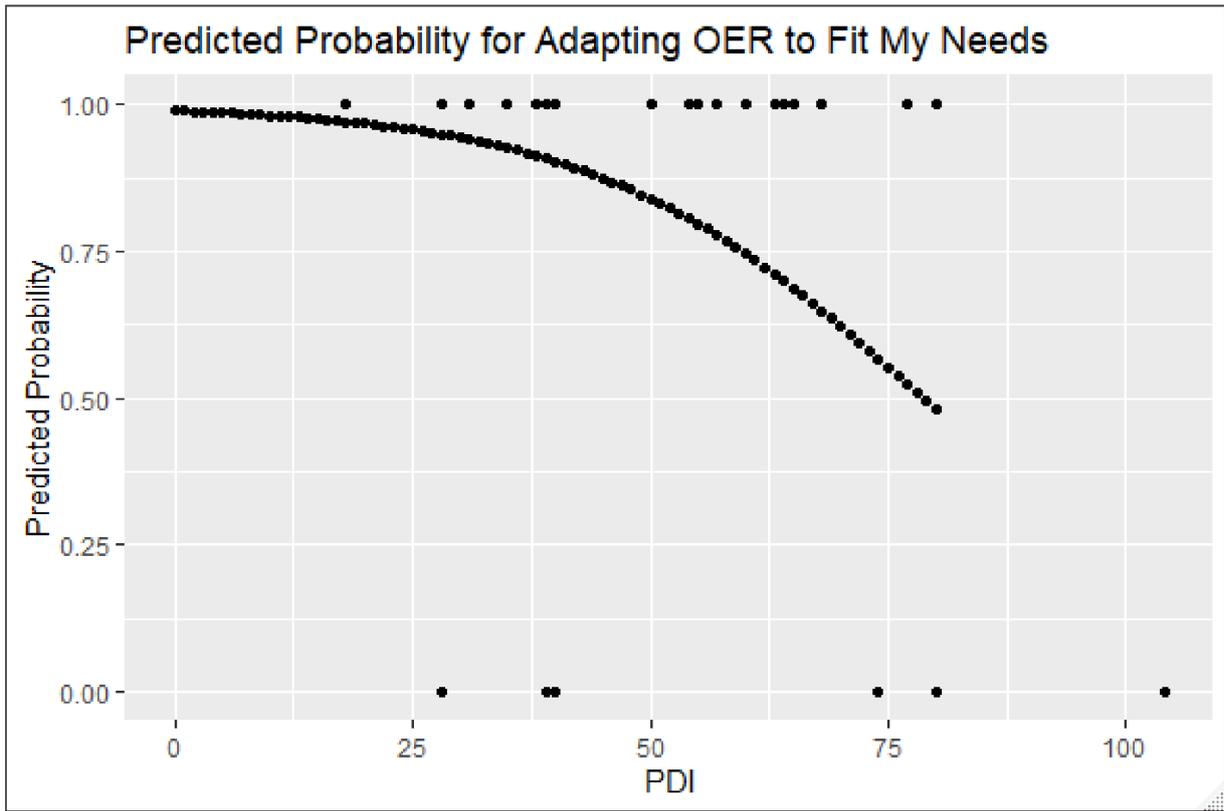
Figure 1: Logistic regression analysis on PDI under stepwise procedure for "I adapted OER to fit my needs" using PDI as an example.

Table 5: Logistic regression analysis under stepwise procedure for first-order barrier.

Variables	Estimate	Std. Error	z value	p	Odds Ratio
Intercept	−6.96	2.55	−2.73	.006	
IDV	.02	.007	2.87	.004	1.02
HDI	10.55	4.59	2.30	.02	38177.44
Internetuser	−.05	.02	−2.35	.02	.95

Note: IDV = Individualism vs. Collectivism, HDI = Human Development Index, Internetuser = The percentage of the population with access to the Internet.

ratio was large for HDI in the logistic regression model, the limited range of HDI did not introduce an unreasonable change of the probability.

Figure 2 illustrates how the probability of K-12 teachers facing a first-order barrier to using OER increases as the Human Development Index (HDI) increases. Other variables can be interpreted in the same fashion.

Second-order Barrier
Results for K-12 teachers facing the second-order skills barrier to using OER is presented below:

$$\log \frac{P(Possess)}{P(not\ Possess)} = .01 * IDV - .02 MAS + 6.51 *$$

$$HDI - .03 * Internetuser$$

The model of K-12 teachers facing the second-order skills barrier to using OER shows that four variables were selected as the best-fitting model among a set of alternative logistic regression models by AIC index: Individualism vs. Collectivism (IDV), Masculinity vs Femininity (MAS), Human Development Index (HDI), and Internetuser. As presented in **Table 6**, the log-odds of possessing the second-order barrier is positively related to IDV (p = .03) and HDI (p = .13), and negatively related to MAS (p = .11) and Internetuser (p = .20). The model again can be further interpreted as, given the scores of other variables, a teacher from a country with a higher level of individualism (IDV) is more likely to face a second-order barrier. Specifically, the odds of having the intrinsic motivation is 1.01 times greater when IDV increases one unit.

Figure 3 illustrates how the probability of possessing the second-order barrier increases as IDV increases. Other variables can be interpreted in the same way.

Discussion
This exploratory study has sought to understand how various cultural and developmental dimensions shape K-12 teachers' effective use of OER. It made an initial step in tapping into the cross-cultural perspective of the second-level digital divide in the teachers' skill dimension of adapting OER in K-12 settings. The findings of this research provide new insights concerning the relationship between OER and social justice by revealing that national demographic attributes and cultural dimensions accounted for gaps in
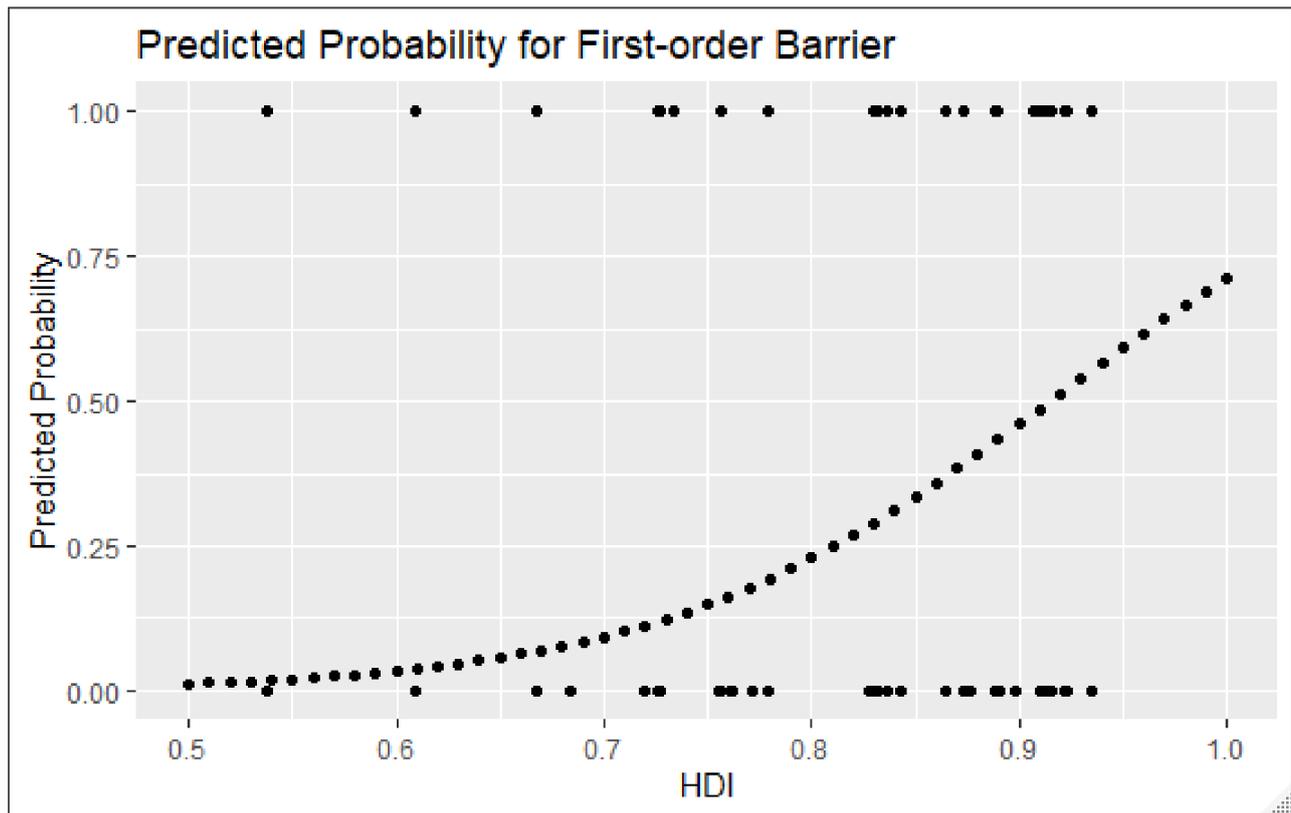
Figure 2: Logistic regression analysis under stepwise procedure for the first-order barrier using HDI as an example.

Table 6: Logistic regression analysis under stepwise procedure for second-order barrier.

Variables	Estimate	Std. Error	z value	p	Odds Ratio
Intercept	−3.46	2.41	−1.43	.15	
IDV	.01	.01	2.12	.03	1.01
MAS	−.02	.01	−1.60	.11	.98
HDI	6.51	4.31	1.51	.13	671.8264
Internetuser	−.03	.02	−1.28	.20	.97

Note: IDV = Individualism vs. Collectivism, MAS = Masculinity vs. Femininity, HDI = Human Development Index, Internetuser = The percentage of the population with access to the Internet.

K-12 educators' effective use (i.e., adaptation) and reception of OER between different countries.

We found that a number of Hofstede's cultural dimensions significantly influenced teachers' adaptation of OER. Some dimensions – such as Individualism vs. Collectivism (IDV) and Masculinity vs. Femininity (MAS) – predicted the possibility of teachers encountering both types of barriers in the use of OER. However, some cultural dimensions – such as long-term vs. short-term orientation – did not have much of an impact and are thus not discussed in detail here. However, gender development (GDI) positively related to whether teachers adapted OER to fit their needs while human development (HDI) influenced whether teachers met any barriers when using OER. In the end, the Internet access rate had an impact on all those three predictions.

The remainder of this section discusses the key findings according to how cultural dimensions influenced teachers' use of OER, how Internet accessibility shaped teachers' use and reception of OER, how GDI shaped OER use, and how HDI related to the barriers teachers faced.

Cultural dimensions significantly influenced teachers' effective use of OER

This study found that two of Hofstede's cultural dimensions significantly influenced teachers' effective use (i.e., adaptation) of OER, namely Individualism vs. Collectivism (IDV) and Masculinity vs. Femininity (MAS). These predicted the possibility of teachers encountering barriers in using OER.

Individualism vs. Collectivism (IDV)

IDV was positively related to the gaps in teachers' adaptation of OER and also teachers' possibility of meeting two types of barriers. Our interpretation is that teachers from high individualism countries (e.g., Australia, UK, USA) attend to their personal needs rather than being constrained by social norms like those in high collectivism countries (e.g., China, Japan, Korea) and thus have a higher likelihood of adapting OER in their courses to meet their needs (Hofstede 1986, 2011). This finding also resonates with Jung and Lee (2020) that, when determining whether to use OER or not, pre-service teachers in Japan will mainly consider the social influence of that decision, but those from the USA are more likely to appraise the price value of OER. On the other hand, people from high IDV countries were more likely to meet both types of barriers. For the first-order barrier, we speculate this might result from
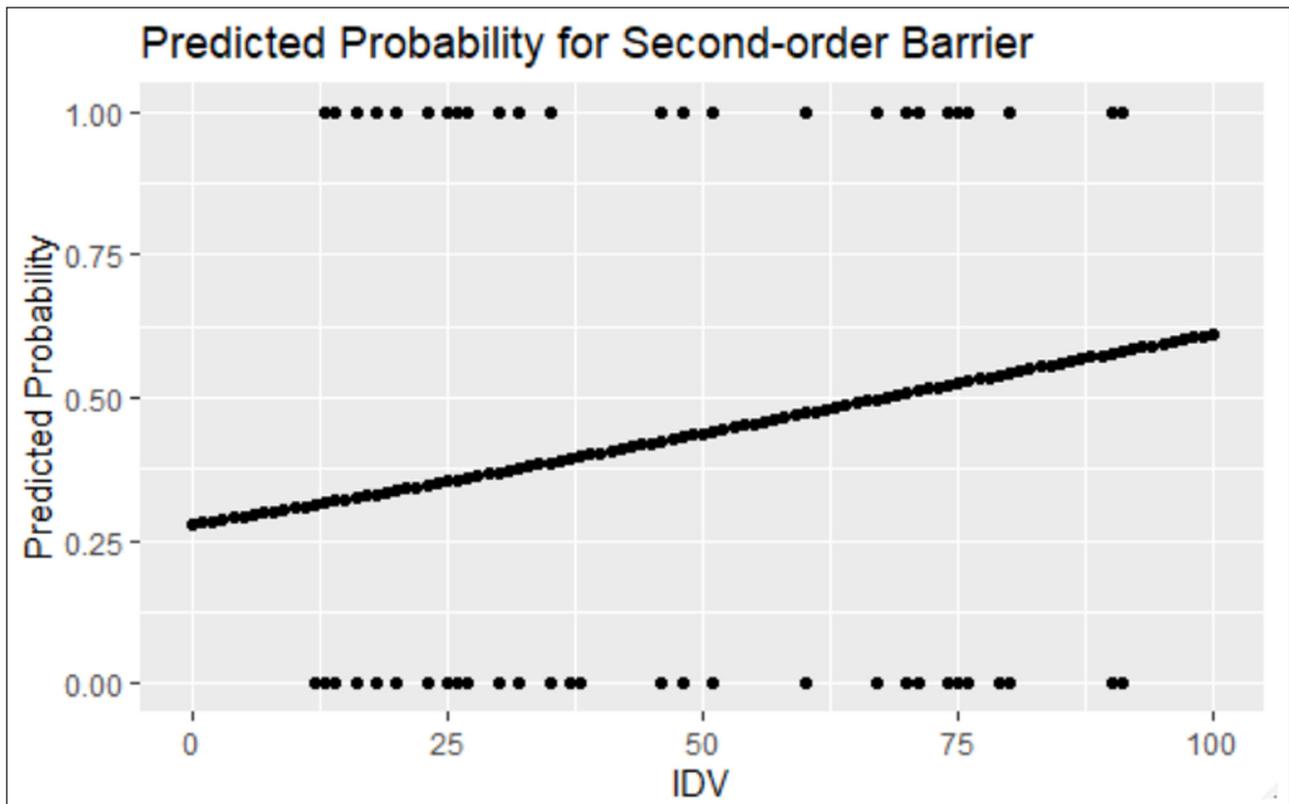
Figure 3: Logistic regression analysis under stepwise procedure for the second-order barrier using Individualism vs. Collectivism (IDV) as an example.

the policy-related disparity between high IDV and low IDV countries. In high IDV contexts, we guess institutions may just let teachers do what they want rather than crafting a positive policy environment for integrating OER into their work. For the second-order barrier, our interpretation focuses on the role of individualism in shaping teachers' belief towards OER, which might lead to teachers' resistance to accept and implement OER in K-12 settings.

Masculinity vs. Femininity (MAS)
MAS was negatively related to the gap in the likelihood of teachers' adapting OER for personal needs and the gap in the likelihood for teachers to meet the second-order barriers. Our speculation is that teachers from low MAS countries (e.g., Norway and Sweden) might not focus on competition or assessment but on their personal appraisal of their teaching experience (Hofstede 1986, 2001). Given that the use of OER, for example in the United States (with a relatively high MAS), might be restrained to abide by the assessment of local school districts, teachers without such concerns in low masculinity countries are more likely to use OER for their personal needs. On the other hand, teachers from a low MAS country were less likely to be restrained by the second-order barriers, but it is worth noting that the variance for each unit increase is quite small (0.98 less likely to meet the second-order barriers when MAS increased one unit).

Most cultural dimensions predicted teachers' adaptation of OER
In our finding, teachers from the high uncertainty avoidance (UA) countries (e.g., Mediterranean countries such as Greece and Italy) tend to adapt OER for personal needs, which might result from their desire to gain more control over how the resource is understood by the students, leading to greater pedagogical certainty (Hofstede 2001, 2011). By adapting OER, teachers in those countries can benefit from the rich collection of resources in their teaching and also prepare to be adaptive to any unforeseen changes.

On the contrary, power distance (PDI) and indulgence vs restraint (IVR) negatively predicted the likelihood of teachers' adapting OER for personal needs. Teachers from low PDI countries (e.g., Austria, Canada, USA) are not bound to strong pressures from an educational authority, but are more likely to adapt OER following their personal intentions.

By identifying how each dimension influenced teachers' adaptation of OER for their personal needs, the research hoped to provide insights from the cultural perspective for scholars, educators, and teacher education programs to prepare teachers for the efficient use of OER in local contexts. It is important to reiterate as aforementioned that adapting OER for personal needs did not concern the possibility of using OER but only addressed the behavior of whether they found and repurposed OER to meet their own needs.

Internet access predicted teachers' adaptation of and reception of using OER
This research found that teachers from countries with higher Internet access rates were less likely to meet either first-order or second-order barriers in using OER; however, they were also less likely to adapt OER to fit their needs. The fact that teachers from high Internet access countries have a lower possibility of encountering such

barriers is not surprising, but we were surprised to learn that they were also less likely to adapt OER to fit their needs, an activity that we would have expected to coincide with lower barriers. This apparently paradoxical finding might be due to the possibility that teachers with high levels of Internet access are well versed in searching for online resources already, with OER playing only a small role in what they adapt for their classroom teaching. Or it might be due to the fact that the survey respondents were already OER users and did not need to worry about Internet access. This is a limitation of our current research that requires attention in future studies.

Gender equality is a predictor of teachers' adaptation of OER

Teachers from high GDI countries (e.g., Sweden, Norway, and the United States) were found to be more likely to adapt OER for their own needs. GDI represents the gap between women and men in human development achievements, with a higher value representing more equality between women and men (UNDP n.d. b). Our guess is that if there are lots of women in the K-12 teaching profession, their greater social equality allows them to enjoy greater autonomy in their classroom teaching practices.

Teachers from high HDI countries were more likely to encounter barriers

It surprised us that higher human development (HDI) was found positively related to the likelihood that teachers would encounter barriers when using OER in K-12 settings. We are unsure about the positive relationship between the value of HDI and the likelihood of teachers' barriers when they use OER in K-12 settings. We wonder if this might result from the fact that a majority of respondents (63%) in this study were teachers from high HDI countries such as the United States, the United Kingdom, Norway, Sweden, and Australia. This is another limitation of this research. Similarly, we also need more empirical evidence and theoretical support to generalize that conclusion.

Social justice and K-12 teachers' effective use of OER

It has been well evidenced that OER contribute to redistributive justice in education, affording free and open access to high quality educational resources (Hodgkinson-Williams & Trotter 2018; Lambert 2018). To ensure redistributive justice, the findings of our research recommend closing the second-level digital divide in teachers' adaption of OER. In addition, the findings of this research suggested that OER initiatives need to reinforce recognitive justice and representation justice to further promote social justice in education. First, this research found that cultural dimensions influenced K-12 teachers' effective use of OER, which indicated the importance of acknowledging the disparity in culture for those OER initiatives in K-12 settings. For example, we might encourage K-12 teachers to recognize the cultural differences and adapt OER with reference to local culture and norms (Hodgkinson-Williams & Trotter 2018; King et al. 2018; Lambert 2018). Meanwhile, we would also encourage K-12 teach-

ers to publish their adapted OER to benefit teachers with shared cultural values and increase the recognition of local culture in OER. Second, gender equality, as a component of social justice, promoted teachers' adaptation of OER to fit their needs. To promote the effective use of OER, future OER initiatives, especially those in low GDI countries, might recognize gender equality by raising the voice of female teachers and including more images or stories about women in the materials (Lambert 2018). Third, future OER initiatives in marginalized groups might encourage K-12 educators to adapt or create OER to claim their own voice in OER rather than merely using existing OER in their own teaching context, which might help reinforce representative justice in education (Hodgkinson-Williams & Trotter 2018; Lambert 2018).

Conclusion

This exploratory research made an initial effort to understand the second-level digital divide in teachers' skills to use OER in a cultural perspective. The findings of this research provided some unique insights for a worldwide effort to further the use of OER in K-12 settings. First, to attain social justice, we cannot simply focus on students' digital divide but must also attend to the second-level digital divide in the teachers' skill dimension of using technology (Büchi et al. 2016; Dolan 2016; van Deursen & van Dijk 2014). Closing the gap in teachers' second-level digital divide precedes the attainment of social justice in terms of both increasing the economic benefits and also the socio-cultural diversity of learning resources. We also find a number of cultural dimensions are significantly related to teachers' adaptation of OER, especially Individualism vs. Collectivism (IDV) and Masculinity vs. Femininity (MAS) which predicted the possibility of whether teachers encounter any barriers while integrating OER in the classroom. Another important insight is that, in a cross-cultural setting, translating existing OER into the local language is not sufficient (Hodgkinson-Williams & Trotter 2018). It is also important to consider the local context and recognize and respect cultural differences (King et al. 2018; Lambert 2018).

Limitations and Future Research

In addition, the findings of this research might be constrained by several limitations. First, one premise for the validated findings of this research lies in the accuracy of coding aligned with relevant frameworks (e.g., first-order and second-order barriers), but the statements included in this dataset were not planned in line with those frameworks. This might limit the validity of our findings. In addition, the cultural dimension data matrix can only roughly estimate the cultural differences rather than accurately reflecting the actual condition (Hofstede 2011).

Moreover, there is an uneven distribution in the origin of these teacher respondents between countries with a high Internet access rate and those with a lower one. This is also the case of the HDI as most of the teacher respondents were from countries with a high HDI value. The research sample might limit the potential generalizability of the findings. Furthermore, this research only included

self-reported data such as surveys. For future research, data collected from multiple sources such as interview and clickstream data might provide enriched implications on how to reinforce K-12 teachers' use of OER in a global scope.

Notes

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Competing Interests

The authors have no competing interests to declare.

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