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Exploring the Influence of Countries' Economic Conditions on Massive Open Online Course (MOOC) Participation: A Study of 3.5 Million MITx Learners

Nergiz Ercil Cagiltay, Sacip Toker and Kursat Cagiltay

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Article abstract

It is well known that there are disparities in access to education around the world, with developed countries generally having better educational resources and opportunities compared to developing countries. Massive open online courses (MOOCs) have been proposed as a way to bridge this gap by providing free or low-cost online education to anyone with an Internet connection. This study aimed to better understand the effects of location, both country and region, on the use of MOOCs, using data from 3.5 million learners who registered for MOOCs offered by the Massachusetts Institute of Technology (MIT). The data set provided a broad picture of how MOOCs are being used around the globe. The results of the study indicated significant differences in the use of MOOCs among students from different countries and their corresponding economic levels. In order to address these differences and improve access to education through MOOCs, the study suggested several actions that could be taken. These include providing better infrastructure and support for MOOC learners in developing countries, increasing awareness of and access to MOOCs in these regions, and working to improve the quality and relevance of MOOC offerings. Overall, the study highlighted the potential of MOOCs to bridge the educational gap between developed and developing countries, but also emphasized the need for continued efforts to remove barriers and improve access to these resources.

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Exploring the Influence of Countries' Economic Conditions on Massive Open Online Course (MOOC) Participation: A Study of 3.5 Million MITx Learners

Nergiz Ercil Cagiltay[1], Sacip Toker[2], and Kursat Cagiltay[3]
[1]Atilim University, Software Engineering Department, Incek, Ankara, Turkiye;
[2]Atilim University, Information Systems Engineering Department, Incek, Ankara, Turkiye;
[3]Sabanci University, Faculty of Engineering and Natural Sciences, Istanbul, Turkiye; Azerbaijan State University of Economics (UNEC), The Digital Economy Research Center, Baku, Azerbaijan

Abstract

It is well known that there are disparities in access to education around the world, with developed countries generally having better educational resources and opportunities compared to developing countries. Massive open online courses (MOOCs) have been proposed as a way to bridge this gap by providing free or low-cost online education to anyone with an Internet connection. This study aimed to better understand the effects of location, both country and region, on the use of MOOCs, using data from 3.5 million learners who registered for MOOCs offered by the Massachusetts Institute of Technology (MIT). The data set provided a broad picture of how MOOCs are being used around the globe. The results of the study indicated significant differences in the use of MOOCs among students from different countries and their corresponding economic levels. In order to address these differences and improve access to education through MOOCs, the study suggested several actions that could be taken. These include providing better infrastructure and support for MOOC learners in developing countries, increasing awareness of and access to MOOCs in these regions, and working to improve the quality and relevance of MOOC offerings. Overall, the study highlighted the potential of MOOCs to bridge the educational gap between developed and developing countries, but also emphasized the need for continued efforts to remove barriers and improve access to these resources.

Keywords: massive open online courses, geographic region, country's income level, distance education, online learning

Introduction

The use of massive open online courses (MOOCs) has grown rapidly in recent years, with many universities and other institutions offering a wide range of online courses available to anyone with Internet access. These courses are often free or low-cost, making them an attractive option for learners who may not have access to traditional forms of higher education. The rapid growth of MOOCs in recent years has been driven by a number of factors, including the increasing availability of online education platforms and a growing demand for flexible and affordable forms of higher education. The first MOOCs were offered by a group of Stanford University professors in 2011, and since then the number of MOOCs available has grown rapidly, with more than 900 universities around the world now offering over 59,000 courses. With the impact of the pandemic, at the end of 2021, 220 million students were enrolled in MOOCs (Shah et al., 2022).

However, despite their potential to increase access to education and bridge the gap between developed and developing countries, the use of MOOCs in developing countries has been limited by a number of barriers and challenges (Gameel & Wilkins, 2019; Ma & Lee, 2019; Shcherbinin et al., 2019). MOOCs hold promise for providing quality education to learners in the most deprived parts of the globe. Nevertheless, a large part of the enthusiasm about the possibilities of MOOCs in non-OECD countries has yet to be substantiated. Initial efforts to increase access for the least educated have faced difficulties in the areas of infrastructure, long-term viability, and assessment (Castillo et al., 2015). A common misunderstanding about MOOCs is that because the course materials are accessible for free to users, such platforms have the potential to democratize education across different genders, ethnicities, and economic classes. However, the opportunity cost of not pursuing other activities can still present a major obstacle for students all over the world, even if the course content itself is free (Daniel, 2012).

The term digital divide refers to the unequal access to technology and the Internet among different groups of people, often based on factors such as income, geography, and education level (Rohs & Ganz, 2015). This divide can create barriers to the use of MOOCs, particularly in developing countries where access to technology and the Internet may be limited. These barriers may include a lack of access to reliable Internet and computer technology, low levels of digital literacy among potential learners, and a lack of awareness or understanding of MOOCs in these regions. To overcome these challenges and ensure that MOOCs are accessible to learners in all regions of the world, it will be important to address these barriers and provide the necessary infrastructure and support to enable more people to take advantage of these online courses.

Researchers who have studied the impact of MOOCs in some developing countries have found that these courses have the potential to help reduce the educational gap and increase access to education for individuals who may not have access to traditional forms of higher education. For example, a study of MOOCs in the Sri Lankan higher education context found that these courses could potentially help to reduce the digital divide and promote digital equity in developing countries (Lee et al., 2018). According to the results of one survey, MOOCs provided by the higher education institutions of Sri Lanka offered benefits for professionals as well as students (Warusavitarana et al., 2014). Similarly, by analyzing MOOC usage in Colombia, the Philippines, and South Africa, researchers reported that information and communication technology skills were not a barrier for participating in MOOCs (Garrido et al., 2016). Contrary to these findings, Liyanagunawardena et al. (2013) argued that despite the prevalent notion that MOOCs will extend opportunities and be adopted by learners in developing countries who currently lack direct access to educational opportunities, particularly at advanced levels, the actuality may be that

they will only cater to the privileged in developing countries who already possess access to digital technologies and international language learning.

For example, in China, the usage barrier (a cause of users' resistance to MOOCs), the value barrier (the performance-to-price ratio of MOOCs), and the tradition barrier (resistance as a result of the break with established traditions caused by MOOCs) have been found to be the main barriers to MOOC adoption (Ma & Lee, 2019). Studies provided several insights into the effects of countries' income levels and regions on MOOC usage. For instance, by evaluating the demand for MOOCs using Google Trends for the Organization for Economic Co-operation and Development (OECD) and Baidu Index for China, researchers have reported that (a) demand was affected by higher unemployment, whereas (b) in OECD countries the effective factor was high school level or higher education, and (c) in China it was Internet speed and average income (Tong & Li, 2018). Considering countries' income level, another study reported that online degrees provided by MOOCs are not affordable for students from lower-income countries (Shcherbinin et al., 2019). By considering the performances of learners from French-speaking countries, researchers have reported a gap between learners from European countries and low- and middle-income countries (Chaker & Bachelet, 2020). According to the results from five English and Arabic MOOCs, the region in which learners lived created a significant difference in the essential skills required to be successful in MOOCs (Gameel & Wilkins, 2019).

According to Daniel (2012), the idea that offering non-credit open online courses from the US will solve the challenges of expanding higher education in the developing world is a misconception. In line with this view, El Said (2017) reported that several components of MOOC platforms were designed within the distinct context of the United States. Moreover, there is a danger that MOOCs might increase existing inequalities in education instead of reducing differences (Rohs & Ganz, 2015). MOOC researchers have agreed that to date, there has been insufficient data to conduct a detailed analysis of the socio-cultural conditions of MOOC participants. Additional research is necessary to examine how learners from developing countries can reap advantages from MOOCs, and whether individuals who access certain MOOC content without finishing the course obtain educational and career benefits (El Said, 2017).

Overall, while the economic and digital divide can create challenges for the use of MOOCs in developing countries, these courses also have the potential to help address this divide and increase opportunities for individuals who may not otherwise have access to higher education. However, currently MOOCs are not being accessed by a significant number of less educated individuals in developing countries. Despite the positive and ambitious proclamations of many MOOC providers, these courses have not yet achieved the goal of making education borderless, gender-blind, race-blind, class-blind, and bank account-blind (Christensen et al., 2013). It will be important to continue to address the challenges posed by several factors in order to ensure that MOOCs are accessible to learners in all regions of the world.

Despite the potential advantages of MOOCs for bridging the digital divide and promoting fairness in educational opportunities, the use of MOOCs is still falling behind in developing countries, due to multiple factors such as limited access to technology and the internet, as well as a lack of awareness and resources to support online learning. The people who stand to benefit the most from the MOOC revolution—those who lack access to higher education in developing nations—are not well-represented among the early adopters (Ma & Lee, 2019). As very few studies have provided a deeper understanding of the MOOCs' effects on society by considering the learners' countries, this study aimed to fill this gap

in the literature. Hence, this study explored the impact of income level and geographical region on the use of MOOCs using data from 3.5 million learners who registered for 174 MOOCs offered by MIT.

Material and Methods

This study explored four main research questions:

1. How are MOOC enrollment and course activities distributed in terms of countries' income level?

2. Do the rate of course activities to the number of enrollments differ based on countries' income levels?

3. How are enrollment and course activities distributed by region?

4. Do changes in the rate of course activities to enrollments differ depending on region?

Research Design

Both causal-comparative and descriptive research designs were used in this study. While the causal-comparative research design, one of the quantitative research methodologies, focuses on the causes or effects of existing diversity between or within groups of participants or groups in the sample, the descriptive design examines the current state of a phenomenon, condition, or factor (Fraenkel at al., 2012).

Study Sample

This study examined data from 174 MOOCs offered by the Massachusetts Institute of Technology, with 3,538,295 students enrolled from 225 countries between 2012 and 2016. Criterion sampling was used for this study (Campbell et al., 2020; Palinkas et al., 2015; Shavelson et al., 1985). As a sampling strategy, the researchers initially set criteria to identify the individuals having information on the phenomenon of interest. Because the sample size was large, a data set with the necessary information was created. As a result, the data set was created in a detailed and broadly applicable form. Only data from countries with 600 or more registered students for MITx courses was analyzed, resulting in a final data set of 3,523,692 learners from 204 countries (see Table 1).

Table 1

MITx Registered Students and Their Gender Distributions

Gender	Number	%
Female	734,903	20.86
Male	2,322,594	65.91
Others	12,264	0.35
Not declared	453,931	12.88
Total	3,523,692	100.00

The data was consolidated according to country by considering course activities (namely, viewed, explored, completed, and certified). In the MITx database, if the learner registered in the course, accessed the course main page, and viewed course information such as the syllabus (Ho et al., 2014), the database parameter *viewed* was assigned a value of true. Otherwise, the value was assigned as false. If the learner viewed the course and completed at least half of the course chapters (Ho et al., 2014), the value true was assigned to the database parameter named *explored*. Otherwise, its value was false. If the learner completed the course, the database parameter named *completed* was set to true. Finally, if the learner finished the course and received a certificate, the database parameter *certified* was set to true. If they left the course without getting a certificate, the database parameter certified was set to false.

The country income and region classifications were entered into this consolidated data by using the World Bank country classifications. The World Bank has a list of countries in specific regions. The distribution of countries in the data set of this study was based on these regional classifications is shown in Table 2. As seen from Table 2, according to the World Bank, there are 38 countries in the East Asia and Pacific region, and among them there are learners from 35 countries in the data set of this study. In general, the data set covers 93.58% of the countries in the world. Hence, the data set is very large, covering almost all countries in the world.

Table 2

Frequency Distribution of Countries with MITx Learners (Based on Region)

Region	Number of countries in the region [a]	Number of countries in MITx (*n*)	% [b]	% [c]
East Asia and Pacific	38	35	17.16	92.11
Europe and Central Asia	58	56	27.45	96.55
Latin America and the Caribbean	42	40	19.61	95.24

Middle East and North Africa	21	20	9.80	95.24
North America	3	3	1.47	100.00
South Asia	8	8	3.92	100.00
Sub-Saharan Africa	48	42	20.59	87.50
Total	218	204	100.00	93.58

Note. n = Total number of countries having enrolled students to the MITx. [a] Data from World Bank Open Data portal available at http://data.worldbank.org. [b] Calculated by dividing n by the total number of countries in the study (N = 204).[c] Calculated by dividing n by the total number of countries in each corresponding region.

The World Bank categorizes countries into four economic levels. In order to understand the MITx learners' countries according to this classification, the number of countries in the data set according to this economy level classification is given in Table 3. As seen from this table, the highest number of enrollments were from countries classified as high-income economies (see Table 3, n = 79, 38.73%, income level $12,536 or more).

Table 3

Frequency Distribution of Countries Based on Income Level

Income level	Number of countries in level [a]	Number of countries in MITx (n)	% [b]	Total students
Low	29	25	12.25	22.702
Lower-Middle	50	47	23.04	831.539
Upper-Middle	56	53	25.98	625.181
High	83	79	38.73	2,041,167
Total	218	204	100.00	3,523,692

Note. [a] Data from World Bank Open Data portal (http://data.worldbank.org) [b] Calculated by dividing n by total number of the countries in the present study (N = 204).

Table 4 lists the top 20 countries with the highest number of enrolled learners in the MITx courses; the majority (51%) were from the United States. Among high-income economies, the United States had the most enrolled students (1,798,020), followed by the United Kingdom, Canada, and Germany with 243,410, 219,263, and 166,470 students, respectively.

Table 4

Top 20 Countries According to Number of Students Enrolled in MITx

Country	Number of students	%
United States	1,798,020	51.03
India	1,014,463	28.79
United Kingdom	243,410	6.91
Canada	219,263	6.22
Brazil	214,602	6.09
Germany	166,470	4.72
Spain	153,554	4.36
China	152,038	4.31
Mexico	137,706	3.91
Russian Federation	131,025	3.72
Australia	113,428	3.22
France	108,465	3.08
Pakistan	107,096	3.04
Egypt	103,823	2.95
Colombia	84,810	2.41
Turkey	80,791	2.29
Poland	77,801	2.21
Italy	72,884	2.07
Greece	71,592	2.03
Singapore	71,174	2.02

Data Analysis

To begin, descriptive statistics, including measures of central tendency, were examined. For nominal and interval variables, frequency and percentage information were used; for continuous variables, means and standard deviations were used. For inferential statistics, a MANOVA was employed. In a MANOVA, two or more continuous measures and one or more independent variables on a nominal or interval scale are used to determine whether there is a significant difference between the independent variable categories (Field, 2013).

Before the analyses, the normal distribution of the variables as well as univariate and multivariate outliers were checked. Hence, even though the data were from a huge data set, the shape of the data did not impact the confidence levels for both univariate and multivariate normality (Field, 2013). However, we calculated the skewness and kurtosis of each dependent variable, and found that all these values for four dependent variables were between -1.5 and +1.5, which is accepted as normal distributions (Tabachnick & Fidell, 2007). The normal distribution was not a cause for concern in this data. The univariate outliers in the data were within acceptable proportions of 5%, so the outliers were not removed as Field (2013) suggested since they represented a country. The multivariate outliers were also checked via Cook's distance, and there was no value higher than one, which is the indication of an outlier (Field, 2013). Moreover, the correlations among the dependent variables and the course activities (viewed, explored, completed, and certified) were estimated. The result showed that the course activities were medium level, with significant and positive correlations except for completed and certified (N = 204, $r_{viewed - explored}$ = .528, $p < .01$, $r_{viewed - completed}$ = .519, $p < .01$, $r_{viewed - certified}$ = .534, $r_{explored - completed}$ = .604, $p < .01$, $r_{explored - certified}$ = .616, $p < .01$, $r_{completed - certified}$ = .989, $p < .01$). Since certified courses must first be completed, a high-level correlation was found. On the other hand, since certification required payment, it may be possible to differentiate based on countries' income levels. According to Frane (2015), the correlations to use in MANOVA (or not use) are essentially myths, and no specific link distinguishes MANOVA as particularly potent, independent of effect sizes. Additionally, Frane (2015) claims that MANOVA is used as a protection for multivariate cases as stage 1, and then as stage 2 univariate analysis of each dependent variable with the independent variable should be checked. We follow this suggestion in the present study.

Finally, for MANOVA, we tested the equality of covariance matrices with Box's M, and for follow-up ANOVAs, we tested the equality of variances with Levene's Homogeneity of Variances tests. The corresponding results and remedial processes for these tests are given in the results section.

Results

The results are given below, organized according to each research question.

Distribution of Enrollment and Course Activities by Countries' Income Levels (RQ1)

In Table 5, the sums of enrolled students and course activities are presented by the countries' income levels. The highest percentage of student enrollment was in high-income economies (57.99%); the lowest was in low-income economies (0.64%). Furthermore, the course activities and completion rates within corresponding groups were calculated. The rate of learners' having viewed their course ranged from 60.58% to 63.53%. The rate increased from low-income economies to high-income economies. For the rate or learners who explored their course, high-income economies had the highest (12.01%), and the lower-middle-income economies had the lowest (9.19%). The upper-middle-income and low-income economies were second and third, respectively. Higher-income economies had the highest percentages of students who completed and were certified (4.37% and 4.15%, respectively); lower-middle-income economies had the lowest percentages (2.65% and 2.52%, respectively). The upper-middle-income and lower-income economies had the second and third rates, respectively. It appears that when the number of enrollments and the course activities for viewed, explored, completed, and certified were considered, high-income economies had more access compared to other countries. When the conversion rates (i.e., the process of enrolling in a course and being certified) were examined, high-

income and upper-middle-income economies ranked first and second. Surprisingly, low-income economies ranked third, surpassing lower-middle-income economies. Overall, more than 3.5 million students were enrolled in the MITx system. Among them, 62.89% viewed a course once, and 11.14 of them explored a course. The course completed rate was 3.82%, and the certified ratio was 3.63%, meaning that those who completed a course but did not get a certificate amounted to 0.19% of total students. When income levels were considered, the gap between completed and certified was smallest in lower-middle-income economies and greatest in upper-middle- and higher-income economies.

Table 5

Enrollments and Course Activities by Countries' Income Level

			Activities			
Income level		Total students	Viewed	Explored	Completed	Certified
Low	*n*	22,702	13,754	2,540	719	678
	%	0.64[a]	60.58[b]	11.19[b]	3.17[b]	2.99[b]
Lower-Middle	*n*	831,539	511,434	76,385	22,000	20,989
	%	23.62[a]	61.50[b]	9.19[b]	2.65[b]	2.52[b]
Upper-Middle	*n*	625,181	392,365	68,208	22,620	21,451
	%	17.75[a]	62.76[b]	10.91[b]	3.62[b]	3.43[b]
High	*n*	2,041,767	1,297,187	245,123	89,247	84,686
	%	57.99[a]	63.53[b]	12.01[b]	4.37[b]	4.15[b]
Total	*N*	3,523,692	2,216,193	392,470	134,646	127,858
	%	100.00[a]	62.89[b]	11.14[b]	3.82[b]	3.63[b]

Note. [a] Represents the percentage of the total number of learners. [b] Represents the percentage of the total number of learners in the corresponding category.

Analysis of our first research question showed that high-income economies dominated the total enrollments and differentiated from other countries in course completed and certified rates. Additionally, lower-middle income countries had higher enrollment rates than did upper-middle income countries.

Rate of Course Activities to the Number of Enrollments Based on Countries' Income Levels (RQ2)

A MANOVA was run for this question. According to Box's M test, the equality of covariance matrices assumption was violated, $M = 166.056$, $F_{(30, 43979.454)} = 5.298$, $p < .01$. Since there was more than one variate, Pilliai's Trace was used due to its robustness compared to the other statistics (Field, 2013; Olson, 1979;

Stevens 1980). The result was .178 and significant, $F_{(4, 12)} = 3.134$, $p < .01$, partial $\eta^2 = .059$, indicating that countries' income levels could explain 5.9% of the activities, a small effect.

The rates of course activities significantly differed in terms of income levels among countries. The effect of country income levels on the rate of learners who viewed their MOOC explained 6.1% of the total variance with a significant difference among countries' income levels, $F_{(3, 200)} = 4.296$, $p < .001$, partial $\eta^2 = .061$. The effect of countries' income levels on the rate of learners who explored MOOCs explained 9.0% of the total variance with a significant difference among countries' income levels, $F_{(3, 200)} = 6.586$, $p < .001$, partial $\eta^2 = .090$. For rates of completed and certified, the values were 14.5% and 15.3%, respectively, with a significant difference among countries' income levels, $F_{(3, 200)} = 11.336$, $p < .001$, partial $\eta^2 = .145$, and $F_{(3, 200)} = 12.032$, $p < .001$, partial $\eta^2 = .153$. These results indicated that the difference in income levels among countries was more viable when completed and certified course activities were considered.

To reveal which category of income level caused a significant difference, the Scheffe test, a post-hoc test used when the homogeneity of variances has not been violated, was performed for all course activities viewed [F(3, 200) = .481, p = .696], explored [F(3, 200) = .467, p = .900], completed [F(3, 200) = 2.199, p = .089], and certified [F(3, 200) = 2.665, p = .50]. The difference in the course activity of learners having viewed their MOOC was due to the difference between lower-middle income economies and high-income economies (p <.01). In other activities, high-income economies outperformed both lower-middle and upper-middle-income economies (p <.05). Analysis of our second research question revealed that learners' course activities were influenced by their countries' income levels, but with a small effect size. The reason for this disparity in all course activities was that high-income economies had higher rates than did other countries.

Distribution of Enrollment and Course Activities by Region (RQ3)

Although there were only three countries in the North America region (the United States, Canada, and Bermuda), about 30% of students enrolled in MITx were from there (Table 6). The second highest enrollment came from Europe and Central Asia (17.26%). The Sub- Saharan Africa region had the lowest enrollment rate (2.58%). Learners from Europe and Central Asia had the highest rate of having viewed their MOOC (65.06%). Since the data set was very large, all the details of countries cannot be shown in this study. However, some examples from the data set served to highlight the key differences. For instance, the rate for viewed courses was 76.34% in Greenland, 64.91% in Switzerland, and 64.26% in the Netherlands. Learners in the Middle East and North Africa were least likely to have viewed courses (59.07%); for example, rates were 50% in Yemen, 52.91% in Iran, and 52.95% in Bahrain. In terms of having explored courses, Europe and Central Asia had the highest rate (13.41%), including, for instance, Monaco (41.49%), Greenland (26.78%), and Spain (17.44%). The explored rate was lowest (8.59%) in the Middle East and North Africa, including Yemen (4.42%), Tunisia (7.65%), and Egypt (8.69%). Regarding completed and certified course activities, once again, Europe and Central Asia had the highest rates at 5.32% and 5.04%, respectively. To illustrate, rates of certification were 13.13% in Monaco, 10.75% in Greenland, and 6.77% in Spain. On the other hand, completed and certified course activity rates were lowest in the Middle East and North Africa, at 2.03% and 1.93%, respectively. For instance, the certified rates were 0.59% in Libya, 0.94% in Yemen, and 1.47% in Iraq.

Table 6

MITx Enrollment and Course Activities by Region

Region	Total students		Viewed		Explored		Completed		Certified	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
East Asia and Pacific	390,126	11.08[a]	244,712	62.73[b]	42,497	10.89[b]	13,115	3.36[b]	12,319	3.16[b]
Europe and Central Asia	853,042	24.23[a]	554,949	65.06[b]	114,376	13.41[b]	45,401	5.32[b]	42,972	5.04[b]
Latin America and the Caribbean	364,543	10.35[a]	229,650	63.00[b]	41,328	11.34[b]	13,519	3.71[b]	12,773	3.50[b]
Middle East and North Africa	153,301	4.35[a]	90,562	59.07[b]	13,167	8.59[b]	3,116	2.03[b]	2,960	1.93[b]
North America	1,061,452	30.14[a]	663,588	62.52[b]	115,481	10.88[b]	40,653	3.83[b]	38,813	3.66[b]
South Asia	607,856	17.26[a]	376,812	61.99[b]	55,774	9.18[b]	16,286	2.68[b]	15,610	2.57[b]
Sub-Saharan Africa	90,869	2.58[a]	54,467	59.94[b]	9,633	10.60[b]	2,496	2.75[b]	2,357	2.59[b]
Total	3,521,189	100.00[a]	2,214,740	62.90[b]	392,256	11.14[b]	134,586	3.82[b]	12,7804	3.63[b]

Note. [a] Represents the percentage of the total number of learners. [b] Represents the percentage of the total number of learners in the corresponding category.

Analysis of our third research question led us to conclude that North American countries had highest rates of courses viewed while European and Central Asian countries had greater rates of courses explored, completed, and certified. Overall, countries in Western regions led the rates in terms of course activities.

How Changes in the Rate of Course Activities to Enrollments Differ Depending on Region (RQ4)

A MANOVA was run for this question. According to Box's M test, the equality of covariance matrices assumption was violated, M = 284.913, F(50, 6085.359) = 5.181, p < .01. Since there was more than one variate, Pilliai's Trace was used as it is more robust compared to other statistics (Field, 2013; Olson, 1979; Stevens, 1980). The result was .353 and statistically significant, F(24, 788) = 3.178, p < .01, partial η2 = .088. The rates of course activities differed significantly in terms of countries' income levels. The impact of countries' regions on the rate of the viewed course activity explained 15.5% of the total variance with a significant difference among regions, F(6, 197) = 6.043, p < .001, partial η2 = .155. The value for the explored course activity was close to 15.1% with a significant difference among regions, F(6, 197) = 5.856, p < .001, partial η2 = .151. For the completed and certified course activities, results were 27.7% and 28.3%, respectively, with a significant differences among regions, F(6, 197) = 12.560, p < .001, partial η2 = .277, and F(6, 197) = 12.988, p < .001, partial η2 = .283. These values indicated that the gaps among regions were more viable when completed and certified course activities were considered.

To determine which regions caused the significant difference, the Dunnett C test, a post-hoc test used when the homogeneity of variances has been violated, was performed for completed course activities, [F(6, 197) = 2.487, p < .05], and the Scheffe test, a post-hoc test used when the homogeneity of variances was not violated, were performed for viewed [F(6, 197) = 1.427, p = .206], explored [F(6, 197) = 1.325, p = .248], and certified [F(6, 197) = 2.059, p = .060] course activities. In terms of the viewed activity, Europe and Central Asia had significantly higher rates than did East Asia and the Pacific, Latin America and the Caribbean, the Middle East and North Africa, and Sub-Saharan Africa. Regarding the explored activity, Europe and Central Asia demonstrated significantly higher rates than did East Asia and the Pacific, South Asia, the Middle East and North Africa, and Sub-Saharan Africa regions. For the completed and certified activities, Europe and Central Asia demonstrated significantly higher rates than did East Asia and the Pacific, South Asia, Latin America and the Caribbean, the Middle East and North Africa, and Sub-Saharan Africa regions. Analysis of our third research question revealed that countries in Europe and Central Asia outperformed the majority of countries in other regions in all course activities. Moreover, it can be inferred that countries in Europe and Central Asia had more certified course activity compared to other regions. From courses viewed to courses certified, the size of the effect of the difference between Europe and Central Asia compared to other regions increased.

Discussion

The results of this study showed important differences among the learner behaviors of different countries when considering country regions and income levels. The results indicated that for the countries with high-income economies, the percentage of student enrollment and rate of viewed, explored, completed, and certified course activities were higher compared to the countries with lower-income economies. In support of the findings of the present study, average income was also found to be among the factors that shaped MOOC demand in developing countries (Shcherbinin et al., 2019; Tong & Li, 2018). Our results aligned with Lee et al. (2018) who suggested that although MOOCs are available ubiquitously for everybody, their promise of minimizing the educational gap as well as increasing access and digital equity in developing countries has not been fully enabled. As Dell'Acqua (2014) noted, access to MOOCs has been constrained while MOOCs themselves are inherently rich and diverse opportunities

for education. Unfortunately, the present research confirmed the concerns related to MOOCs and their impact on the digital divide, as argued previously by Gameel and Wilkins (2019).

When conversion rates (the process of enrolling in a course and being certified) were examined in the present study, high-income and upper-middle-income economies were ranked first and second. Surprisingly, low-income economies ranked third, surpassing lower-middle-income economies. The gap between completed and certified was lowest in lower-middle-income economies; however, it was highest in upper-middle- and higher-income economies.

The regional data can be interpreted in two ways: (a) as the rate of countries using MOOCs in their respective regions, and (b) as each region's rate among other regions. Regarding the former, the current study found that all countries in North America and South Asia used MOOCs (see Table 2, 100%). This rate was around 95% in Latin America and the Caribbean, Europe and Central Asia, and the Middle East and North Africa. In Sub-Saharan Africa, this rate decreased to 87.5%. With the latter interpretation, the results showed that Europe and Central Asia had the highest rates of completed and certified activities between 2013 and 2016, while rates were lowest in Sub-Saharan Africa. The results also showed that these rates were significantly higher in Europe and Central Asia than in the East Asia and the Pacific, South Asia, Latin America and the Caribbean, Middle East and North Africa, and Sub-Saharan Africa regions. Similarly, the rates for the viewed activity were significantly higher in Europe and Central Asia than in East Asia and the Pacific, Latin America and the Caribbean, the Middle East and North Africa, and Sub-Saharan Africa. The rates for explored were also significantly higher in Europe and Central Asia than in the East Asia and Pacific, South Asia, the Middle East and North Africa, and Sub-Saharan Africa. One possible explanation for these regional differences may be related to the Internet and other such infrastructure issues due to geography. Significant differences have been reported among learners from different regions (Gameel & Wilkins, 2019).

Learners' education levels may be another factor causing this difference among different countries and regions. Earlier studies have shown that most MOOC learners are well educated (Cagiltay et al., 2013) and the number of well-educated people is lower in developing countries compared to developed countries. Language may be another barrier. For example, according to Aboshady et al. (2015) language was not recognized as a barrier to MOOCs in Egypt. However, since most MOOCs are in English, students speaking a variety of languages in a single class could cause problems, and MOOCs need to be organized with an understanding of these problems (Tahirsylaj et al., 2018). Additionally, as reported by an earlier study, there could be other barriers, such as learners from less-developed countries feeling uncomfortable in the learning environment (Kizilcec et al., 2017).

The context of the MOOC may create distress among learners and negatively impact enrollment rates (Essex & Cagiltay, 2001). One contextual issue is related to the proposed course topic itself, as learners may be more interested in some topic areas than others. Since the MITx courses were developed in the US mainly for the needs of that audience, this may have an impact on enrollment rates (Daniel, 2012). Another important contextual issue is the reputation of the institution, MIT, offering the courses. People from low-income countries are attracted by the institution. However, the teaching methods and expectations in MITx MOOCs may have differed from what some learners in low-income countries were used to (El Said, 2017). Even though we have no data to support this inference, it should be considered for exploration in future studies. Closely related is the issue of limited access to technology which may also hamper learners' ability to get into courses as well as complete assignments or assessments required for completing the course. Finally, contextual factors such as course length, difficulty level,

and availability of resources (such as textbooks or supplementary materials) can also influence enrollment. Developing mechanisms to provide support and guidance to learners from low-income countries may help to increase course completion rates. Recent developments in artificial intelligence technologies (e.g., ChatGPT by OpenAI) may play an important role in overcoming some of the reported challenges.

These results indicated that living in a high-income or Western region country positively influenced completed and certified activities in the MITx courses. An earlier study attributed this to the fact that the vast majority of the students are from high-income countries and the courses follow these students' interests, which in turn increases their motivation in the courses (Shcherbinin et al., 2019). As these courses can be reached from all over the world, it is not possible to address regional motivations and requirements in a single MOOC. Local universities may be encouraged to collaborate with the major MOOC providers and develop MOOC solutions by considering the specific motivations and requirements of their region.

Conclusion

Based on analysis of more than 3.5 million learners in MITx courses, this study provided recommendations for improving MOOCs. Several suggestions applied to MOOC providers, such as offering more introductory-level courses on specific topics, providing free certification for these courses to eliminate economic barriers for learners from developing countries, and adapting MOOCs to the local context to better meet the needs of learners in different regions.

This study reported significant differences among MITx learners from different parts of the world. A range of factors, such as geographical effects, education levels, language, as well as cultural and psychological factors, could be key influences. Such differences may improve access to education in these regions through more tailored, local support for learners in developing countries. Supportive of our results, an earlier study also reported some cultural differences in patterns of acceptance behaviors between Turkish and Malaysian engineering students (Arpaci et al., 2020).

MOOC providers may also choose to develop localized pricing strategies like those at Netflix, for example. In addition, local universities may collaborate with major MOOC providers and develop MOOC solutions by considering the specific motivations and requirements of their region. For instance, an earlier study reported that learners' performance was influenced by their online listening responses in course forums (Du et al., 2022), for which the course language can be a barrier. Hence, an adoption strategy for each country may be developed in collaboration with local universities and MOOC providers. In order to improve these adoption processes, global entities such as the United Nations Development Programme and United Nations Educational, Scientific and Cultural Organization may also provide additional support.

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