Exploring the relevance of single-gender group formation: What we learn from a massive open online course (MOOC)

Rebecca Yvonne Bayeck, Adelina Hristova, Kathryn W. Jablokow and Fernanda Bonafini

Rebecca Yvonne Bayeck is a dual-degree PhD candidate at the Pennsylvania State University, in Learning Design and Technology and Comparative International Education Programs. She studies games and learning, video games and representation, learning and teaching in online environments,Massive open online courses (MOOCs) and gender. Adelina Hristova earned a masters degree from Sofia University in Bulgaria, and is currently a doctoral student in Adult and Comparative and International Education at Penn State University. She studies massive open online courses, the latest developments in distance and online education, and what these developments can teach us about learning theories such as social constructivism and connectivism. Kathryn W. Jablokow is an Associate Professor of Engineering Design and Mechanical Engineering at Penn State University. She studies the impact of cognitive diversity in engineering, including the influence of cognitive style and other individual differences in online education. Fernanda Bonafini earned a Masters degree in mathematics education from São Paulo State University. She is currently working on a Ph.D. in Curriculum and Instruction (Mathematics Education), with a concurrent Masters degree in Applied Statistics, both at Penn State University. She studies Massive Open Online Courses for teachers, online professional development for teachers, and teaching and learning with technology in both face-to-face and online environments. Address for correspondence: Rebecca Yvonne Bayeck, Penn State University, Learning Performance Systems, University Park, Pennsylvania, USA. Email: ryb105@psu.edu

Abstract

This paper reports the results of an exploratory study on participants' perception of the importance of single-gender grouping in a massive open online course (MOOC) delivered through the Coursera platform. Findings reveal that female and male learners' perception of single-gender grouping differs. Female students more than males indicated less preference for single-gender grouping. Views on single-gender grouping also differed across regions, suggesting the effect of participants' regions of origin on their opinions about single-gender grouping. Moreover, an interaction was established between participants' region and gender. In particular, our study reveals that men in the "Asia and Pacific" region tended—more than men and women from other regions of the world—to give more importance to single-gender grouping in this MOOC. In addition, younger participants cared less about single-gender groups compared to older respondents. This study sheds light on our understanding of the importance of gender and age importance in online learning environments such as MOOCs. The findings also point to the role gender and age may play as MOOCs continue to gain in popularity and to adopt collaborative approaches to teaching and learning.

Introduction

Massive open online courses (MOOCs) in nature are free and open to all. MOOCs have the potential to provide equal access to learning to all irrespective of gender, economic status or education (Diver & Martinez, 2015) and the use of contemporary interface design to allow people around the world to enroll into courses and sometimes work in groups (Kizilcec & Halawa, 2015; Zhong, Wang, & Lim, 2008). The absence of gender-marked cues in online learning environments encourages equal participation of females and males in online-group work (Koh & Lim, 2012).

Practitioner Notes

What is already known about this topic

- Gender and culture affect group work in collaborative learning settings.
- Diverse groups in MOOCs are beneficial for learning attainment and cultural awareness.

What this paper adds:

- We investigated perception of single-gender groups among students' enrolled in a Massive Open Online Course (MOOC) prior to their assignment to groups.
- Perception of the importance of single-gender grouping differs between female and male students.
- Perception of single-gender grouping differs across regions.
- Single-gender view is influenced by participants' regions of origin Age influences attitude towards single-gender grouping.

Implications for practice and/or policy

- Single-gender group perception should be taken into account when assigning students to groups in MOOCs and other online learning environments.

While relatively new, MOOCs are not different from other online learning environments (Li *et al.*, 2014).

Learners' approach to online group work depends on participants' perception of their own status (Augustinova, Oberlé, & Stasser, 2005). Gender has been identified as a significant status that affects participation in online learning and face-to-face collaboration (Augustinova *et al.*, 2005). Hence, gender becomes an interesting issue to investigate in MOOCs (Chen & Chen, 2015; Diver & Martinez, 2015). Additionally, because of their potential to bridge the educational gap between men and women, allowing many to attain their full potential, MOOCs have embedded in them the promises of a democratized education (Knox, 2014). Groups in MOOCs are effective (Chen & Chen, 2015; Li *et al.*, 2014), still, studies investigating factors important to MOOC learners from different regions of the world in group-formation are limited.

Gender is a complex concept that entails dimensions not yet fully studied or understood. This exploratory study examines single-gender group perception in group formation across six different regions of the world. In this article, single-gender group perception refers to participants' attitude or preference towards female or male only groups. Regions are classified according to the global gender index of the World Economic Forum of 2014, which identifies trends in gender equality in countries and regions. This classification of regions was used as an indicator of the culture of the regions. Thus, culture in this paper refers to equality or inequality of gender in the regions. These findings will enrich the understanding of students' perceptions of gender relations and will inform formation of diverse MOOC groups in the future.

Why study single-gender group perception in MOOCs?

Increasingly, groups are being used in MOOCs to facilitate collaboration, create a sense of belonging and learning communities (Kizilcec, 2013; Salmon, Ross, Pechenkina, & Chase, 2015). Grouping students implies some level of collaboration, and group formation is key in any form of collaboration because it can influence "the way people work together towards a common goal and eventually the learning outcome itself" (Manske, Hecking, Hoppe, Chounta, & Werneburg, 2015). MOOCs present a challenge for group formation because of their scale and the high

dropout rate (Sanz-Martinez *et al.*, 2015). Though work on groups in MOOCs is burgeoning, literature shows that researchers have used different strategies to create groups in MOOCs: students' prior knowledge, personality and random surveys (Sanz-Martinez *et al.*, 2015). Yet, groups are often formed by instructors based on their experiences, and criteria such as students' social skills and gender (Manske *et al.*, 2015).

Still finding students to work with each other in MOOCs is still challenging (Rothkrantz, 2015). Place and time distance among students make group work difficult in MOOCs (Rothkrantz, 2015) even though, grouping learners from different regions contributes to the diversification of viewpoints in groups and affects collaboration quality (Kizilcec, 2013; Rothkrantz, 2015). In fact, learning in groups is dependent on group members' characteristics (Rothkrantz, 2015), which can include, but are not limited to attitudes, gender, perception of collaboration and cultural contexts (Resta & Laferrière, 2007; So & Brush, 2008). Assuming perception of single-gender groups and the region/culture in which students live coshape and coconstruct quality of group work and learning, it would be best to examine learners' view of single-gender groups before group formation.

Review of related literature

Gender in MOOC groups and other online contexts

When considering group work and gender in MOOCs most studies focus on face-to-face study groups (i.e., groups of MOOC students living in proximity who gather in person to study) and on strategies that can enhance student learning experiences within these groups (Chen & Chen, 2015; Li *et al.*, 2014). Lim, Coetzee, Hartmann, Fox, and Hearst (2014) discussed MOOC groups in which students meet synchronously online to answer questions related to the course content, but the study did not address gender. Kulkarni, Cambre, Kotturi, Bernstein, and Klemmer's (2015) study highlighted new perspectives gained by groups of diverse students in MOOC video discussions. Yet, Kizilcec and Halawa (2015) differ from previous research as they exposed geographical and gender achievement gap among learners enrolled in 20 MOOCs. Although informative, Kizilcec and Halawa's (2015) research did not focus on group work. In view of the scarcity of MOOC-group studies addressing gender, this literature review is extended to include computer-supported collaborative learning (CSCL). Indeed, with developments in computer and information technology, CSCL approaches have expanded to include MOOCs (Zhan & Mei, 2013).

Literature in CSCL examines gender in terms of performance, attitude towards the course, learning outcomes and group success (Monereo, Castello, & Martinez-Fernandez, 2013; Zhan, Fong, Mei, & Liang, 2015). Gender and its relationship with communication, interaction styles, quality of discussion and collaboration is also reviewed (Asterhan, Schwarz, &Gil, 2012; Takeda & Homberg, 2014). For instance, females in single-gender groups performed better than males and had a better attitude towards the course (Ding, Bosker, & Harskamp, 2011; Zhan *et al.*, 2015). Females in mixed-gender groups learning outcomes surpassed male students in similar group, and females in the all-females group (Suhre, Harskamp, & Ding, 2008).

Gender has been vastly used as grouping strategy in various educational settings. Despite its broad use in group formation, literature is diffused regarding the effects of grouping individuals by gender (Zhan *et al.*, 2015). Some authors argue that single-gender grouping is a better strategy for grouping people because they are more purposeful than mixed-gender groups (Bennett, Hogarth, Lubben, Campbell, & Robinson, 2010). While for Willoughby *et al.*, (2009) prefer mixed-gender groups for the enhanced collaboration.

Culture, gender and groups in MOOCs

As previously stated, in this study, we associate culture to the gender equality index of learners' regions. Nevertheless, MOOC researchers found persistence and performance differences among

participants from different regions and cultural backgrounds (Kizilcec & Halawa, 2015). Kulkarni *et al.*, (2015) research denoted that geographically diverse groups in MOOCs were beneficial because they exposed students to others and to other ways of thinking. Nevertheless, culture effect on groups is often analyzed through Hofstede, Hofstede, and Minkov (2010) cultural dimensions and an extensive discussion of culture is found in CSCL studies.

When people from different cultures work in groups, there is potential for an interactive interchange between cultures which may affect group communication and outcomes. In Hofstede's cultural dimension, cultural groups may differ in their preference for: a loose social framework or a tight social framework (ie, individualism *vs.* collectivism); their acceptance of inequalities among people (ie, power distance); their focus on the future (ie, for short term or long-term orientation); their preference for competition versus cooperation (ie, masculinity *vs.* femininity) and their level of comfort with uncertainty and ambiguity that is uncertainty avoidance (Hofstede *et al.*, 2010). Research in CSCL indicates that people with different cultural backgrounds have different perceptions on learning and group work (Zhong *et al.*, 2008). For instance, gender differences are more pronounced in individualistic cultures than in collectivistic cultures (Zhong *et al.*, 2008). Popov *et al.*,'s (2014) study revealed difference in perceptions on collaborative learning between women from individualistic cultures and women in collectivist cultures. Performance (Elliott, Terlouw, Pilot, & Phuong-Mai, 2009), role played (Nguyen, Terlouw, & Pilot, 2006) and learning outcomes (Popov *et al.*, 2014) are also influenced by culture in CSCL environments.

Communication in online learning environments is also shaped by culture (Popov *et al.*, 2014). Popov *et al.*, (2014) explained that students from individualistic cultures reported difficulties getting their messages across to their partner, while students from collectivistic cultures stated problems understanding their partner's viewpoints in the absence of visual signals.

We used the World Economic Forum (WEF) global gender gap index (GGI) to group regions. The index measures gender-related disparities and forms of gender equality around the world using a scale of zero (unequal) to one (equal) (World Economic Forum, 2013). The global GGI divides the world into six regions: North America, Europe and Central Asia, Latin America and the Caribbean, Sub-Saharan Africa, Asia and the Pacific and Middle East and North Africa. GGI looks at gender equality achievements "across four key areas: health, education, economy and politics" (World Economic Forum, 2014). Assumption behind employing the GGI was that overall gender equality, especially in the area of education, will affect participants' attitudes towards single-gender groups.

North America, Europe and Central Asia, Latin America and the Caribbean regions have greater gender equality because of the high score on the GGI scale (approximately 0.80) than Sub-Saharan Africa, Asia and the Pacific and the Middle East and North Africa (approximately 0.60). GGI has been used among other instruments to characterize the equality or inequality of a culture by authors discussing culture, gender and educational attainment (Guiso, Monte, Sapienza, & Zingales, 2008; Hyde, Mertz, & Schekman, 2009). Figure 1 shows the WEF ranking of regions based on GGI (World Economic Forum, 2014).

Overall, the review of the literature establishes that gender and culture (ie, country of origin in this case) are among factors that play a role in group work. In other words, group composition in terms of gender and culture matters. Nevertheless, gender, culture and group work in the current literature are discussed within groups or after groups are created and students assigned to these specific groups. This paper therefore explores learners' perceptions of single-gender group formation prior to their assignment to groups.
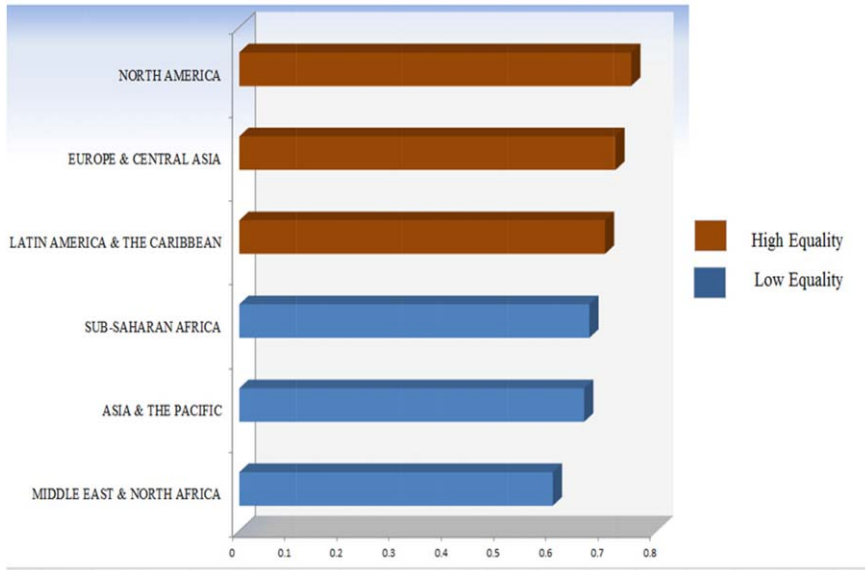
Figure 1: Source: Global Gender Gap Index ranking by regions. Reprinted from World Economic Forum, 2014, Retrieved from http://www.weforum.org/reports/global-gender-gap-report-2014. [Colour figure can be viewed at wileyonlinelibrary.com]

Research questions and hypothesis

This paper seeks to answer the following research questions:

1. Is there a significant difference between males and females in their perceptions of the importance of single-gender grouping in group formation?
2. Is there a significant difference in participants' view of the importance of single-gender grouping in group creation across regions?
3. What is the effect of participants' gender/sex and region on single-gender grouping perception?
4. What is the effect of employment status and age on single-gender grouping view?

Based on the research questions and the literature showing gender and culture effect on groups (e.g., learning outcomes, perception on online collaboration, cultural and geographical differences), we hypothesized that there would be differences in the perceived importance of single-gender in group formation between female and male participants. This perception was also expected to be significantly different across regions.

Methods

Study process and course description

The study was conducted with students enrolled in the Creativity, Innovation and Change (CIC) 2.0 MOOC via Coursera platform from July to August, 2014 (Jablokow, Matson, & Velegol, 2014). The objective of the CIC MOOC was to equip students with tools that would enhance creativity, encourage original conduct and stimulate positive change around the world. The CIC MOOC was delivered over 6 weeks in which students had to complete projects, readings, exercises, quizzes, engage in discussion forums and watch videos (Jablokow *et al.*, 2014).

The recruitment for this study was done by email. CIC students were invited to participate in a study which overall goal was to explore the effect of groups on students' success (course completion) in the MOOC. Permission to conduct this study was obtained from the Institutional Review

Table 1: *Results of t-test and descriptive statistics for perception of the importance of single-gender group formation based on different Gender/Sex*

| | Gender | | | | | | 95% CI for Mean | | |
| | Male | | | Female | | | Difference | *T* | *df* |
	M	*SD*	*N*	*M*	*SD*	*n*			
Single-Gender grouping	7.49	1.69	249	7.78	1.47	394	0.045–0.542	0.000*	641

*p < 0.05.

Board (IRB) at the Pennsylvania State University. It was stated that only large data from the respondents (big data) would be used to ensure participants' confidentiality and anonymity. After IRB approval, volunteers were assigned to groups (Bayeck, 2016; Zhang *et al.*, 2016). This paper reports on the precourse questionnaire, focusing on the participants' response to the following question: "What factors are most important to you when forming a group to work together on this course?"

Seven hundred and seventy (770) precourse surveys were collected. Due to the number of participants and in line with the literature on grouping in MOOCs (Kulkarni *et al.*, 2015; Lim *et al.*, 2014), a quantitative approach was used to analyze students' preferences regarding their placement into groups. Moreover, our research questions sought to confirm our hypothesis and made quantitative analysis appropriate (Creswell, 2014).

Measures
A 30-question precourse survey asked participants for information related to their demographics, employment status, preferred modes of communication (synchronous or asynchronous), preferred language and intention to complete the course. Volunteers were also asked to rank the importance of factors that could influence their participation to a group. These factors included
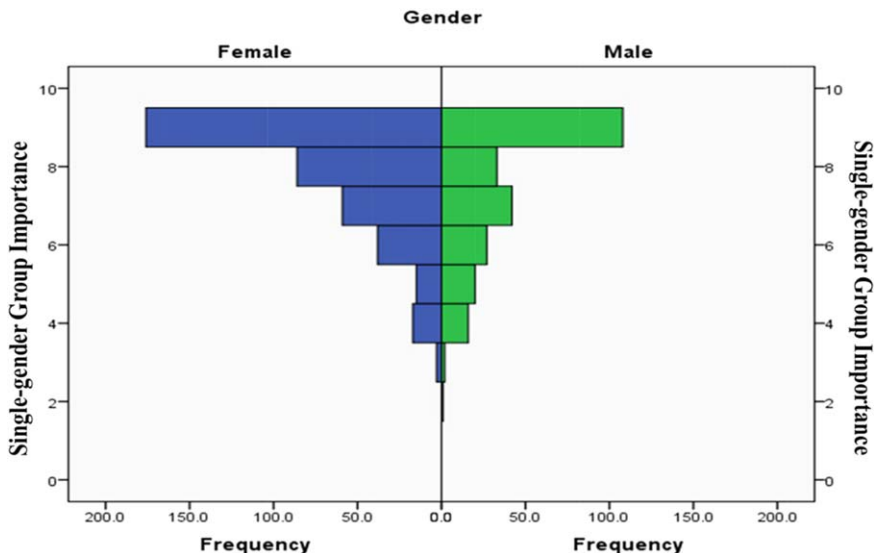

Figure 2: *Distribution of single-gender grouping perception by sex/gender. [Colour figure can be viewed at wileyonlinelibrary.com]*

Table 2: Results of a factorial ANOVA of participants' perception of the importance of single-gender group formation

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared
Regions	26.953	5	5.391	2.770	0.046	0.018
Gender	7.998	1	7.998	3.368	0.067	0.005
Regions* Gender	32.499	5	6.500	2.737	0.019*	0.021
Error	1496.203	630	2.375			
Total	39345.000	642				

Note: R Squared = 0.043 (Adjusted R Squared = 0.026).
  *$p = 0.05$.

elements such as language, age, education, gender (female or male only) and difference in country of origin, profession (Bayeck, 2016; Zhang *et al.*, 2016). A scale of nine points (1–9) was employed to indicate the significance of each factor. We associated the number one on the scale with *most important* and number nine on the scale with *least important*.

To explore single-gender grouping perception importance in group formation, the scores of single-gender group formation on the nine-level scale was used. For example, a score of one on the scale meant that participant (s) did view studying only with participants of the same sex as very important. Also, selecting nine meant that participant(s) did not think that groups of same gender were very important. Independent *t* tests and ANOVA were conducted to analyze differences between males' and females' impression on the importance of single-gender group formation.
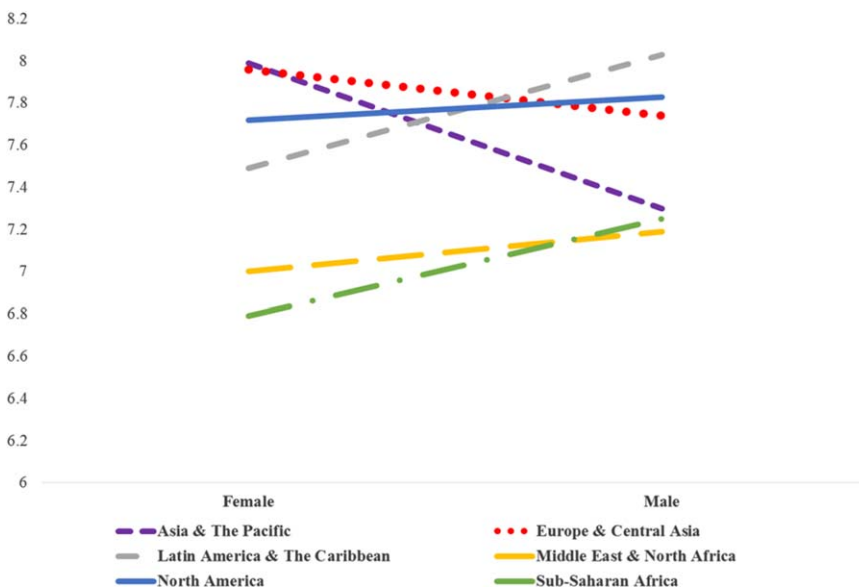

Figure 3: Interaction between participants' gender and regions. [Colour figure can be viewed at wileyonlinelibrary.com]
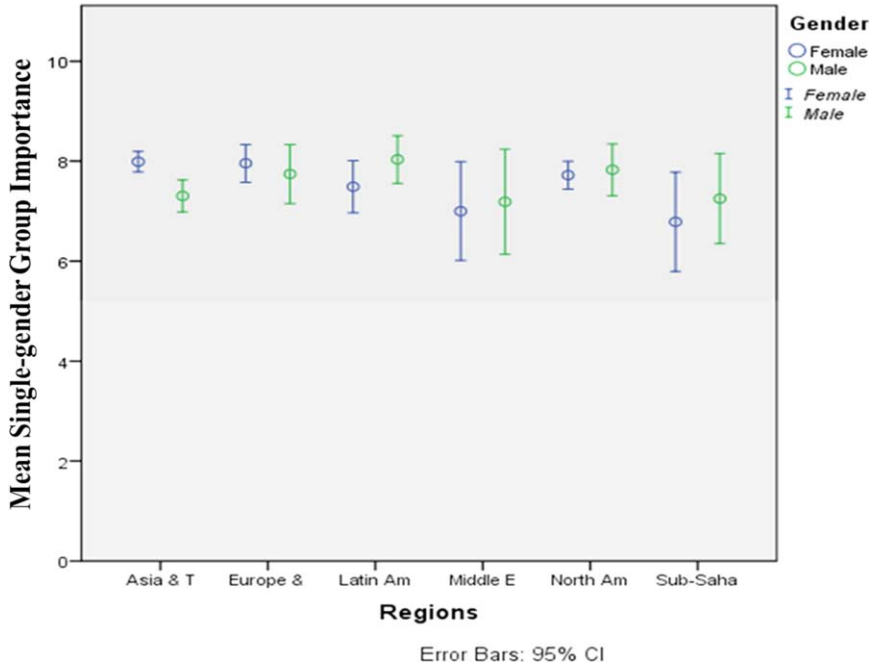
Figure 4: Simple main effect analysis of the significance of the difference in gender importance among regions between male and female participants. [Colour figure can be viewed at wileyonlinelibrary.com]

Study participants

Clean data of 665 volunteers from the precourse questionnaire were analyzed. Of the participants, 60% were female and 38% were male, with 1.5% ignoring the question on gender. In terms of country of origin, volunteers in the study came from 82 countries: nine percent (9%) were from India, 18% from the United States and 25% from China. Chinese were the largest group and this may be justified by the translation of the course in Chinese (Bayeck, 2016; Zhang *et al.*, 2016). Thirty-three countries such as Croatia, Austria, Cameroon and Bolivia had approximately 0.2% participants. With regard to age, 52.5% of participants were under thirty years old. Most participants (82.3%) lived in their country of birth during the study, and 60.5% were employed. Level of education varied from primary education (1.2%) to graduate education, 36% (Bayeck, 2016; Zhang *et al.*, 2016). The countries of origin and openness of MOOCs that allow

Table 3: Effect of age and employment on perceived importance of single-gender grouping

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	68.011[a]	17	4.001	1.635	0.051
Intercept	15801.477	1	15801.477	6459.341	0
Age	27.612	5	5.522	2.257	0.047*
Employment	2.586	2	1.293	0.529	0.59
Age* employment	18.664	10	1.866	0.763	0.665
Error	1541.168	630	2.446		
Total	39544	648			
Corrected total	1609.179	647			

[a]R Squared = 0.042 (Adjusted R Squared = 0.016).

*p = 0.05.

everyone with the desire to learn to enroll into a course explain learners' different levels of education.

Data collection procedure and analysis
The questionnaire was administered online using Qualtrics. Data were later analyzed through calculating the means of participants' rankings of the importance of single-gender grouping across regions to assess perception about this dimension of gender. It is important to mention that in this study, a lower mean in the ranking of gender indicates that participants view single-gender grouping as important when creating groups, while a higher mean shows single-gender is seen as less important when deciding to work in a group.

To explore the effect of regions on perception of single-gender group formation, this study classified countries in terms of gender equal or unequal regions based on the WEF 2014 GGI (World Economic Forum, 2014).

Results
Perception of the importance of single-gender in group formation between male and female students
Table 1 shows that men have a lower mean ($M = 7.49$, $SD = 1.69$) on single-gender grouping perception than women ($M = 7.78$, $SD = 1.47$), $t(641) = -2.319$, $p < 0.001$. The statistical difference ($p < 0.001$) reveals that men and women significantly differ in their view of the importance of single-gender grouping. This finding supports our hypothesis on differences between men and women.

Given the significant difference in the means ($p < 0.001$), a frequency was run to analyze the distribution of single-gender group formation and its distribution between men and women. Figure 2 shows this distribution, which indicates that a greater number of women saw single-gender group formation as less important compared to men.

Effect of participants' gender/sex, region on perceived importance of single-gender grouping
To determine whether there was an effect of gender (i.e., male or female), and regions, on views of the significance of single-gender in group formation, a two-way ANOVA was performed. In this factorial analysis, single-gender grouping was the dependent variable while gender/sex and regions were the independent variables. Table 2 demonstrates that the effect of gender on participants' view of the importance of single-gender group formation is not significant. Yet, the main effect of regions is significant ($F(5, 630) = 2.270$, $p = 0.046$), which supports our assumption about the difference in perception of single-gender group formation across regions.

We were also interested in knowing whether the effect of participants' region of origin changed depending on students' gender. We looked at the interaction and the results also suggest a significant interaction between participants' region of origin and their gender, $F(5, 630) = 2.270$, $p = 0.019$). Specifically, Figure 3 illustrates the interaction plot revealing that perception of single-gender grouping was affected by the gender and regions of participants. Figure 3 indicates that in some regions, such as Asia and Pacific, females ($M = 7.99$, $SD = 1.281$) seem to give less importance to single-gender group formation than males ($M = 7.30$, $SD = 1.793$). In the Latin America and Caribbean region, men appear to view single-gender grouping as less important ($M = 8.03$, $SD = 1.303$) when compared to women ($M = 7.49$, $SD = 1.727$).

In light of the interaction between regions and participants' gender, we investigated the significance of the difference among regions between male and female students. We conducted a simple main effect analysis in order to identify the level of difference or intervals within regions between male and female participants' perception on single-gender group formation. Figure 4 shows that in the Asian and Pacific region, single-gender group formation was ranked higher by male participants than by females from the same region. Males from the Asia and Pacific region in this study

appeared to be significantly more likely to perceive single-gender group formation as an important factor when electing with whom to work in a group. In other regions, the figure shows no significant difference for perception.

Effect of employment status and age on perceived importance of single-gender grouping
Finally, we explored the effect participants' employment status and age could have on their attitude towards single-gender groups. To perform the factorial ANOVA, the recorded categories of employment status such as full-time student, part-time working student, full-time or part-time employee, retiree, self-employed, unable to work and unemployed, were transformed into two categories: employed and unemployed. Participants' age which varied was grouped into six categories of approximately 10 years' interval from 10–19, 20–29, to 60 and above.

The findings (Table 3) indicate that age (F (5, 630) $= 2.257$, $p = 0.047$) has an impact on single-gender grouping views; but the main effect of employment status on single-gender grouping was not significant (F (2, 630) $= 1.293$, $p = 0.52$). Learners aged 60 and above were more likely to see single-gender grouping as important ($M = 7$, $SD = 2.138$), whereas participants below 60 years old cared less about single-gender groups. This perception is particularly high among learners aged below 20 years old ($M = 8.28$, $SD = 1.268$). Thus, younger participants are more likely to work with any gender and in any type of group.

Summary and discussion
This study showed differences between men and women in the perceived importance of single-gender when forming groups to work in a MOOC. Compared to male participants, women viewed single-gender groups as less important in MOOC group formation. Although literature does not examine perception of single-gender prior to group work, the observed differences may explain why in the literature, women perform better than men in mixed and single-gender groups (Zhan *et al.*, 2015). These results also call for a greater sensitivity when it comes to assigning males to mixed-gender groups.

With regard to geographical regions, the statistically significant difference (ie, main effect of regions, $p < 0.05$) signals the effect of one's region on participants' perception of single-gender group formation. Regional culture shapes views of gender. It is not then surprising to see the unimportance of single-gender groups in gender equal regions and the reverse in gender unequal regions. Interestingly, within gender unequal regions, we noticed a difference between men and women. This difference suggests varieties of views among people of the same region, which could also offer some clarifications to the mixed effects of participants' culture (hinder communication, and exposure to different perspectives) found in the literature (Kulkarni *et al.*, 2015; Popov *et al.*, 2014). These findings indicate that single-gender group perception is a factor that counts when using grouping as learning or teaching strategy in MOOCs and other learning environments. The results highlight the need to have a student-centered approach even in forming groups in MOOCs and other learning environments. Learners certainly approach group work with predispositions and perceptions (Augustinova *et al.*, 2005) on whether and how females and males should work together, which may later influence group interactions.

Finally, opinions on single-gender grouping are influenced by participants' age. This finding adds to the relevance of learners' view of single-gender grouping. In other words, while assigning students to groups in MOOCs learning environments, age of participants should be taken into consideration.

These findings give an insight into what could be seen for instance as the reason behind gender differences in group work: participants' perception of single-gender group formation and participants' culture/region effect. In this regard, this study differs from previous studies (Elliott *et al.*,

2009; Popov *et al.*, 2014) as it explores perception of who can work with whom prior to group formation and can provide insight into why people's approach to group work may be related to how they view themselves and others (Augustinova *et al.*, 2005).

Conclusion

This study shows that gender, and particularly students' view of single-gender grouping should be surveyed prior to putting them in groups. The study also highlights the need for a bottom-up approach to group formation in learning environments. With the openness of MOOCs, formation of effective group may need to include not only perception on collaboration, but also feelings on different types of groups (mixed or single) depending on the age and the regions of learners.

Implications

This study has implications for research and practice. The results suggest the need to consider different gender perceptions among participants and across cultures in group work for open online courses such as MOOCs that attract diverse learners (Goldschmidt & Greene-Ryan, 2014; Liyanagunawardena, Lundqvist, & Williams, 2015). As shown by previous research, online courses or collaborative technologies are not exempt from the problems of communication experienced in face-to-face diverse groups (Popov *et al.*, 2014; Zhong *et al.*, 2008). While the current work does not provide explanations for the differences in single-gender group perception, we can speculate that this perception may affect collaboration and communication in online learning environments. Thus, more research is needed to explain the influence of this perception on participation, communication, collaboration and even on group members' interaction in online learning environments. Although these findings are based on a precourse questionnaire, we predict that the growing popularity of MOOCs will make it necessary for developers and instructors intending to use group work as a teaching/learning strategy to know more about participants' perception of single-gender grouping and the differences in perceptions across cultures.

Statements on open data, ethics and conflicts of interest

Data from this study can be accessed by contacting the corresponding author. The data are property of Penn State University, and will be released to others only after the requestor's Institutional Review Board has approved a study involving the data. In addition, Penn State's MOOC data policy requires that the investigators invite members of the MOOC team that created the data to be collaborators on the research project. Participants in this study were volunteers and understood the purpose of the study they were engaged. All participants' data is anonymized and confidential in the research. This study makes use only of quantitative data sets. Participants in this study did not receive different forms of evaluation during this MOOC. Ethical permission was received from the Pennsylvania State University to conduct this study.

There are no potential conflicts of interest.

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