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PREFERENCE FOR STEM BY ADOLESCENT GIRLS ACCORDING TO THEIR GEOGRAPHICAL LOCATION

It's critical to achieve gender equality in STEM fields. Women do, however, choose this field less frequently than men. Stereotypes about gender primarily influence this choice. However, we speculate that there may be additional factors at play in this issue, one of which we attempted to investigate in our study–geographical position. This study aims to determine whether girls' perceptions of STEM careers differ between urban and rural areas. In the study, we looked into the career interests and career choices of teenagers from both urban and rural schools. Surveys were used in the study because they were the most efficient way to gather data and cover larger areas. As a result, urban females are more interested in and engaged in STEM fields, and they are less likely to choose fields where women predominate. Additionally, less participation in STEM-related extracurricular activities was seen among both men and women, which suggests that rural schools have fewer STEM resources. We will now have a better understanding of the factors causing the gender gap in STEM fields, which has a significant impact on education policy and management.

Key words: gender equality, STEM, rural areas, urban areas, high school students, career choices.

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Жасөспірім қыздардың географиялық орналасуына байланысты STEAM-ді таңдауы

STEM салаларында гендерлік теңдікке қол жеткізу өте маңызды. Алайда, әйелдер бұл аймақты ерлерге қарағанда аз таңдайды. Бұл таңдауға ең алдымен гендерлік стереотиптер әсер етеді. Бірақ, біз бұл мәселеде қосымша факторлар болуы мүмкін деп ойлаймыз. Біз соның бірін осы зерттеу жұмысында анықтауға тырысып көрдік: географиялық орналасуы. Бұл зерттеудің мақсаты – қалалық және ауылдық қыздардың STEM карьерасы туралы пікірін анықтау. Зерттеу барысында біз қалалық және ауылдық мектептерден жасөспірімдердің мансаптық қызығушылықтары мен мамандық таңдауын зерттедік. Зерттеулерде сауалнама қолданылды, өйткені олар деректерді жинаудың ең тиімді әдісі болды және үлкен аумақтарды қамтыды. Нәтижесінде, қалалық әйелдер STEM салаларына көбірек қызығушылық танытты әрі олармен айналысады, және олардың әйелдер басым болатын аймақтарды таңдау ықтималдығы аз. Сонымен қатар, STEM-ге байланысты сыныптан тыс жұмыстарға аз қатысу ауылдық жерлердегі ерлер мен әйелдер арасында байқалды, бұл ауылдық мектептерде STEM ресурстары аз екенін көрсетеді. Зерттеу нәтижесінде біз STEM саласындағы гендерлік айырмашылықты тудыратын факторлар жайлы ой түйдік. Бұл өз кезегінде білім беру саясаты мен басқаруға айтарлықтай әсер етеді.

Түйін сөздер: гендерлік теңдік, STEM, ауылдық өңір, қалалық өңір, орта мектеп оқушылары, мамандық таңдау.

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Предпочтение STEM девочками-подростками в зависимости от их географического положения

Крайне важно добиться гендерного равенства в областях STEM. Однако женщины выбирают эту сферу реже, чем мужчины. На этот выбор в первую очередь влияют стереотипы о гендере, но мы предполагаем, что в этом вопросе могут быть задействованы дополнительные факторы. Географическое положение является одним из таких факторов, исследуемых нами в нашей

работе. Это исследование направлено на то, чтобы определить, различается ли восприятие девочками карьеры STEM в городских и сельских районах. В ходе исследования мы изучали профессиональные интересы и выбор профессии подростков как из городских, так и сельских школ. В исследовании использовались опросы, так как они являются наиболее эффективным способом сбора данных и охвата больших территорий. Исследование показало, что городские женщины больше интересуются областями STEM и занимаются ими, и они с меньшей вероятностью выбирают профессии, в которых преобладают женщины. Кроме того, как мужчины, так и женщины меньше участвовали во внеклассных мероприятиях, связанных со STEM, что говорит о том, что в сельских школах меньше ресурсов STEM. Теперь у нас сформировались знания о факторах, вызывающих гендерный разрыв в областях STEM, который оказывает значительное влияние на некоторые решения в области образования.

Ключевые слова: гендерное равенство, STEM, сельские районы, городские районы, старшеклассники, выбор профессии.

Introduction

Science and technology are crucial components of global social and economic advancement. Expert human capital is the key resource for global development (Manassero & Vasquez, 2003). However, gender and socioeconomic considerations have divided and influenced science and technology work throughout history (Inter-American Development Bank, 2010), and women are underrepresented in this field in most nations (Blickenstaff, 2005). Even though the number of women in STEM fields is increasing, women are still outnumbered by men (Hill et al., 2010). According to UNESCO, just 35% of STEM students in higher education are female, and there are gender inequalities within STEM disciplines. For example, barely 3% of female students choose to study technology and communication technologies (ICT) (Bokova, 2017). Gender disparities are especially marked in some of the future's fastest-growing and highest-paying jobs, such as computer science and engineering (Fry et al., 2021). Moreover, less women than males with STEM degrees go on to work in STEM fields or stay in those fields once they graduate (Sassler et al. 2017). In the past, women were frequently discouraged from seeking employment outside the home, especially in professions that were usually viewed as «masculine,» like those in STEM (Robinson and McIlwee, 1991).

In the two largest and most male-dominated STEM fields, computer science and engineering, there have been opposite demographic shifts in the composition of degree holders over time. In the field of computer science, the proportion of women among the holders of an academic degree has significantly decreased, even despite the diversification of the composition of female graduates. In the mid-1980s, women accounted for more than a third of graduates; in recent years, this proportion has declined. In comparison to the 1980s, women received just 50% of bachelor's degrees in computer science by 2013 (Corbett and Hill, 2015).

Equal access to science is not just a social and ethical need for progress, but it is also a necessity (UNESCO, 1999). Gender discrepancies in ST are a problem because they affect fairness, social justice, and the efficient use of social and private investments in talent, socio-economic development, and competitiveness (Vázquez-Cupeiro, 2015). Giving women equal opportunities to pursue and succeed in STEM occupations helps to narrow the gender wage gap, improve women's economic security, and assure a diverse and competent STEM workforce (Jean et al, 2015). Thus it is important to identify the reasons behind the underrepresentation of women in STEM and to narrow this gap. Moreover, as there is little known about the origins of the gender gap in STEM, we are going to explore this topic more.

Although there are many reasons for the gender gap in STEM education and employment, the goal of this study is to find out whether girls' career decisions are influenced by their geographic location. Because the environment plays a significant role in gender disparity (Alon and DiPrete, 2015), it is critical to investigate how this problem is applied in practice. This study adds to the existing literature by examining the differences and similarities in career choices in rural and urban areas, which may help to explain the gender gap. The paper's second contribution is to explain gender differences in STEM education and career opportunities in a small developing country context governed by important societal and cultural norms and values.

Our study will focus on the career choices of high school students in rural and urban schools due to their geographical locations in Central Asia, particularly Kazakhstan.

The Republic of Kazakhstan, a landlocked nation with 18.2 million people in 2018, is one of the least densely inhabited nations in the world. On the 2017 WEF Global Gender Gap Index, Kazakhstan is ranked 80 out of 144 nations (The World Bank, 2021).

State policy has attempted to give women governmental support since the country gained independence in 1991. Kazakhstan was the first nation in Central Asia to form a national organization to advance gender equality (the National Commission on Women, Family, and Demographic Policy) (UN Women, 2022).

Kazakhstan's urban population is 58.9% of the total population, a considerable increase from 2010. (54.5 percent) (Makhanov, n.d.).

In Kazakhstan, the popular higher educational areas for girls are arts and humanities(71%), pedagogical sciences(70%), natural sciences, mathematics, and statistics(68%). Gender equality of growth is shown in agriculture and bioresources (49.5%), business, management, and law (48%). However, in the minority, girls study in the following areas like technical sciences and technologies (31.6%), ICT (30%), engineering, manufacturing, and construction industries (28.7%) (Forbes Kazakhstan, 2022).

Reasons of gender gap in STEM

Cognitive ability

Some studies have been conducted to investigate the causes of the gender gap in STEM. The first indication is cognitive ability. According to research, while girls achieve higher math grades than boys, boys outperform girls on high-stakes standardized tests (Voyer et al., 2007). However, recent meta-analyses have found that gender differences in math ability on many standardized tests are minor, with small average effect sizes that vary greatly depending on the sample, testing provider, grade level, and year of study. It means that cognitive ability does not affect the gender gap (Hyde et al., 2008).

Environment

A study investigates whether there is a correlation between high school classroom gender composition and students' participation in STEM using data from the Danish register (Brene & Zölitz, 2020). The findings show that the peer environment at school has an impact on the workplace, the gender wage gap, and fertility. In classrooms with more female peers, fewer women are likely to enroll in and complete STEM programs. The presence of more female peers, on the other hand, increases male participation in STEM. The findings confirm that women exposed to more female peers have lower earnings, more children, and a lower likelihood of working in STEM fields. According to this data, the gender composition of girls' school classes influences their career choices.

Another explanation for this problem is the peer group theory. Peer support is positively related to female students' motivation in math and science classes during their adolescent years (Leaper et al. 2011) . If their «in the group» struggles academically in STEM courses, peer pressure serves as a deterrent. Friends can be influential in approving or disapproving of the adoption of gender-conforming behaviors. Research demonstrates that adolescents may conform to gender-stereotypical behaviors if their peers punish non-conformity and reward conformity (Kessels, 2015), which can reduce the likelihood of young women pursuing STEM fields.

Professional goals are part of the unique self-image that emerges during the socialization process, which lasts from birth to puberty (Gottfredson, 2005). Forming professional goals includes examining how well one's perspective of oneself and that of the profession align. Because the «wrong» gender type of a profession is more important to one's self-esteem than the prestige of the profession or personal interests, the gender image of the profession is especially important in the career selection process. Numerous studies using Gottfredson's theory have found that the gender image of the profession has a significant impact on the process of choosing a job (Bubany and Hansen, 2011).

Biological and sociocultural reasons

To explain the link between gender and cognitive performance, researchers have looked at the possible effects of biology and the environment. Several studies have been conducted to determine whether biological factors such as testosterone exposure and increased brain lateralization are associated with better mathematical reasoning and poorer verbal ability in males, but the results have been inconclusive (Valla & Ceci, 2011). The findings of the sociocultural impact on gender differences in quantitative and verbal reasoning, on the other hand, are more consistent. Parents can shape their children's math expectations and performance by sharing their gender-biased perspectives on how well boys and girls should perform in math (Jacobs & Eccles, 1992). A separate study claims that gender-based misconceptions about math and science may influence how many students choose

to major in STEM fields (Makarova et al., 2001). They have a negative impact on young women's self-identification with STEM academic disciplines, as well as their self-esteem and subject interests. As a result, female students are discouraged from majoring in science and pursuing a science-related career. Furthermore, if there is less association with the masculine image of science, the likelihood of STEM career aspirations increases. It means that sociocultural factors may be one of the reasons why women are less likely to pursue STEM careers.

Additional studies have also confirmed that stereotypes about women's abilities and motivation to pursue STEM careers are harmful. When young women compare themselves to these stereotypes, they feel a disconnect, as if they do not «belong» in STEM fields (Master et al., 2016). Early gendered socialization and stereotypes have an impact on career choices because they reduce confidence, interest, and willingness to participate in STEM fields (Cvencek et al.,2011).

Career choices

Because of gender differences in career interests, women are underrepresented in STEM fields. According to the findings, males prefer working with objects, while females prefer working with others. The size of these gender differences was significant (Su et al., 2009). Men's higher interest in STEM fields and women's higher preference for socially conscious occupations were both associated with significant effect sizes. Altruism may be the driving force behind women's preferences for socially conscious careers because they express a stronger desire than men to help others and advance society (Freund et al., 2012): Many women overlook STEM careers because they are frequently perceived as incompatible with societal objectives (Diekman et al., 2011). Even within STEM fields, women are more likely to choose degrees that emphasize community or are people-oriented. Women, for example, are more likely than men to pursue degrees in environmental and biomedical engineering rather than mechanical or electrical engineering (Ceci and Williams, 2011). This evidence suggests that preferences may outweigh aptitude, even among women who pursue STEM-related careers (Tai et al., 2006).

Materials and Methods

The main objective of the research is to indicate the correspondence between geographical location and the STEM profession preference of teenage girls. We will be investigating the career choices of teenagers by location, current STEM involvement, and future STEM interest.

We hypothesize that rural girls are more willing to choose traditional female careers than women in urban areas. Additionally, we think that rural students are overall less involved in STEM.

Our study consisted of 2 parts: survey and data analyses.

A survey was named "Survey regarding career choices". All research participants consented online to participate and signed an online document. Quantitative data was collected through an online survey consisting of questions regarding background information and STEM engagement. The aim was to survey the student body in cities and villages from June 25th to July 1st, 2022. Participants were given unlimited time to complete the survey on a Google Form anonymously.

Online survey was the most suitable tool due to how simple, practical, and economical it is to use as a data collection technique. However, online polls can suffer from two fundamental methodological flaws: it is impossible to accurately identify the population in which they are conducted, and respondents may choose to sample themselves out of bias. A study is only valuable if its findings can be generalized to a large population. Online survey results cannot be generalized and may thus be misleading if the survey population cannot be identified or if the sample is tainted by biased respondents. Thus our study method had some limitations.

The school students provided enough information for proper data analysis. The study did not have restrictions. Survey questions can be found in Table 1. Before analysis, each answer was carefully checked for completeness. Surveys with empty or incomplete responses were not considered.

The survey was distributed among two schools – Comprehensive school №80 and Comprehensive school of Sattar Yerubayev. The former is located in the city of Shymkent with a population of more than 1 000 000, while the latter is based in village Boralday with a population of 2000. Schools have a similar approach to education and a similar student body.

In the data analyses section, to identify the significance we used the statistical tool the two-sample t-test.

Table 1 – This table displays the exact questions asked in the survey.

Demographic questions	Career related questions
What is your year of study?	In what area do you see yourself when you are 30?
How do you identify yourself?	Not considering other factors like financial reward, in what area would you work?
Choose your school	Rate your likeness to be involved in STEM in future
	Rate your interest in STEM
	Rate your involvement in STEM related extracurricular activities

Results and Discussion

A total of 127 responses were collected. The survey consisted of two parts: demographic questions and career-related questions. Answers for the demographic section can be found in Table 2. According to it, the survey involved 66 females and 61 males (Table 2). Also, 50.4% of participants were from a city school, while 49.6% were from a village school (Table 2). 16.5% freshmen, 31.5% sophomore, 35.4% junior and 16.5% seniors participated in study.

Table 2 – Demographic distribution. Distribution of participants (n = 217) across different demographic characteristics, %

Demographic categories	Frequency	Percentage
Gender		
Female	66	52
Male	61	48
Grade level		
Freshman	21	16.5
Sophomore	40	31.5
Junior	45	35.5
Senior	21	16.4
School type name		
Comprehensive school №80 (urban school)	64	50.4
Comprehensive school of Sattar Yerubayev (rural school)	63	49.6

In our study, we found some interesting results. Urban females have significantly more STEM interest ($p < 0.0001$), future STEM involvement ($p = 0.0017$) and STEM extracurricular engagement rate ($p < 0.0001$) than rural women (Figure 1).

We also found that females who study in cities prefer STEM more than those who study in villages. According to Table 3, 27.3% of females from urban schools see STEM as their future working area compared with 6.1% of respondents from rural areas. However, the healthcare and education industries are the most popular for both groups of girls (30.3% and 51.5%) (Table 3.). It can be seen that girls from rural areas chose this area more compared to peers from urban schools (Table 3).

Additionally, compared with urban respondents, rural respondents, regardless of gender, reported significantly less desire to be involved in STEM in the future ($p < 0.0001$) and involvement in STEM-related extracurriculars (($p < 0.0001$) (Figure 1).

The gender gap of preference for STEM is small in both areas, while a significant gap is noticeable only in the interest rate in STEM in rural areas. Girls are reported to have significantly less interest in STEM than men ($p < 0.0001$). However, the STEM interest rate for males from urban and rural areas is about the same ($p = 0.1574$) (Figure 1).

Table 3 – Career choice comparison of rural and urban girls. This comparison was performed through a self-assessment that the participants performed. The percentage corresponds to the amount of participants choosing this area as their future professions.

	Female from urban school	Female from rural school
STEM	27.3%	6.1%
Healthcare and Education	30.3%	51.5%
Agriculture	18.2%	18.2%
Business	18.3%	18.2%
Others	6.1%	6.1%

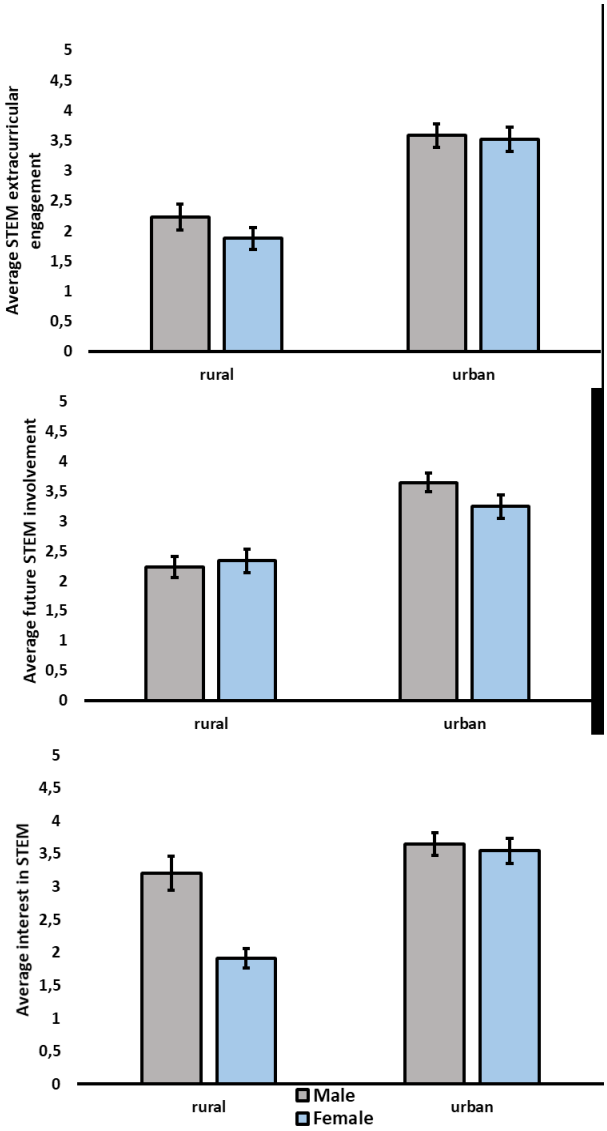

Figure 1 – Gender comparison of STEM involvement rate of urban and rural respondents. The figure compares urban and rural respondents' average interest in STEM, average future STEM involvement, and STEM extracurricular engagement rate. Data were collected through self-reports of participants. The error bars for the averaged data were presented

Our research investigated teenagers' dream careers regardless of factors like parents' insistence and financial rewards. We found that most rural females dream of careers in healthcare and education (69.7%). Most females from urban schools chose STEM as their dream job (Figure 2).

Results supported the hypothesis that geographical position affects women's preference for STEM. Women are less interested in STEM and see themselves less in the STEM industry than females in urban areas (Figure 1). Also, we witnessed females in rural areas choose traditional women-dominated jobs, such as teacher and healthcare professions (Table 3).

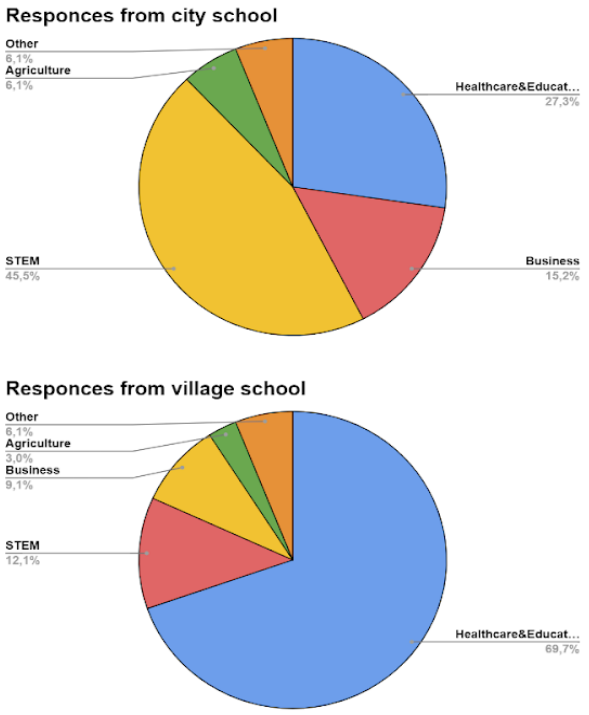

Figure 2 – Dream career choice of females according to their geographical area. Table 2 shows a summarization of the data collected on the dream career of girls. This includes the dream career categories and responses from urban and rural girls

Regarding the question about dream careers, 69.7% of urban females reported they would choose STEM-related professions, while more rural mates chose traditional female-dominated workplaces (Figure 2). We assume that parents' insistence, financial rewards, and stereotypes prevent urban girls from pursuing STEM.

Both genders in rural areas showed a low tendency to get involved in STEM-related professions (Figure 1). We speculate that the main reason men and women in rural areas choose less future STEM involvement is the lack of resources. Kazakhstan currently has a severe problem with rural schools providing education of a lower standard than metropolitan ones (Nurbayev, 2021). It is proven that there is a year of schooling disparity between students in rural and urban areas. This could be the reason for the low STEM extracurricular involvement of both genders in rural schools.

However, rural men were interested in STEM as urban males, while girls did not show this tendency. The stereotypical perception of STEM disciplines could be a reason for this gap.

In conclusion, rural girls prefer STEM less. Further studies should be designed to investigate the reasons for this.

This study addressed the gender inequality issue and helped to understand the reasons for it.

Conclusion

This paper examines the location's impact on the gender gap in STEM, providing evidence about the relationship between rural and urban students' interest for technical professions. The conclusions suggest that girls in rural areas are less interested in them than any other group examined in research. In addition, study reveals the education gap between rural and urban schools. In particular, rural schools offer less opportunities for STEM extracurriculars. Girls in rural areas mostly chose female-dominated professions. Therefore, more studies should be conducted to find more reasons for the gender gap in more areas and studie's results should be considered in educational policies.

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