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# EVALUATING QUALITY OF SECONDARY EDUCATION IN UZBEKISTAN

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**ABSTRACT:**

**The manuscript aims to measure quality of secondary education and investigate the key determinants of quality of education of secondary schools over the regions of Uzbekistan focusing on both rural and urban areas. The dependent variable is quality of education rather than quantity of schooling, while the examined independent variables, which are supposed to have significant influence on the quality of learning outcomes, included labor conditions in the nation, teacher quality, and context measurements. To accurately evaluate education quality of the students in public schools, enrolment rate of secondary school students to higher education are employed. The method used in this research is cluster analysis belonging to interdependent analytical technique and aims to mapping based on grouping of admission rate variable in secondary education in Uzbekistan in 2020. Data were analyzed using multivariate analysis of variance (ANOVA). The results from general linear model analysis revealed that among five independent variables tested, teacher quality measured in terms of high category teachers, female teachers, unemployment and poverty had a significant impact on education quality in terms of admission rate to universities, at a 95 % confidence level. Thus, they can be judged as the key factors for quality of learning outcomes achieved by secondary level students. On the other hand, student teacher ratio was unexpectedly found to have no statistically-significant relationship with quality of learning outcomes.**

**Keywords: enrolment rate, Secondary Education, quality of schooling, cluster, ANOVA.**

## INTRODUCTION:

A state's ability to grow over the years - its ability to advance real purchasing power, and reduce income inequality – is highly connected to the quality of learning outcomes in education. Therefore, it has been classified as one of the priorities of the United Nations' Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development. Quality of learning outcomes brings long-term economic growth and enhances well-being of individuals in nations (Hanushek and Woessmann, 2007; 2010). The basic mechanism behind this development is that education is a crucial to empowering economic efficiency by enhancing the value and productivity of human capital, in turn, it results in shifting poor individuals from poverty. Thus, the role of secondary education in strengthening the efficiency and intellectual resilience of human capital in nation is important and huge. High quality of education established in a nation guarantee the competitiveness of the state in international arenas. Hence, Roberts (2011) confirms that government's ability to prosper in developing and employing the skills and knowledge by improving learning outcomes of its citizens is strongly related to standard living conditions of

population. World has not witnessed any nation has gained stable economic growth and poverty reduction without making extensive investment in education system and human capital (Ozturk, 2011).

It is widely recognized that the purpose of education is to stimulate learning and assist individuals gain knowledge and develop cognitive and reading skills that can consequently enable them acquire better jobs not only to survive, but also to thrive. Hence, skills and intellectual capital are essential to improve productivity, incomes and access to employment opportunities, in turn, it leads nations to be sufficiently integrated with competitive and dynamic markets. Thus, public schools act as main actors in the development of those valuable skills. This study evaluates main determinants of quality of education of secondary schools in Uzbekistan. Evidently, providing high quality of education signify one of the core elements of growth that improve nation's capacity to effectively adapt and catch advanced technology to ensure higher quality of living.

The World Bank removed Uzbekistan from the list of low-income countries, reclassified it as a lower-middle income nation in 2011 (Borgen Project, 2011). Population live below the national poverty line has been decreased from 30% to 11.4% since 2001. Proportion of employed population below US$ 1.90 PPP a day constitutes 19.7% in 2019 (ADB, 2019). This implies Uzbek government is contributing sustained progress toward development through implementing number of reforms for promoting education across regions. Even though Education has risen to 97% as of 2019, admission of graduates of secondary schooling in Higher Education is very low in a number of regions of Uzbekistan, someone can assume that quality of teaching and learning on those schools are also lagging. It is noteworthy that quality of education and poverty alleviation have a reciprocally strengthening relationship with each other. Low quality of learning outcomes is associated with income poverty, at the same time, it is impossible to overcome education poverty without sufficient earnings (Tilak, 2005).

Besides that, a vast literature has appeared on educational quality in recent years, examining factors that help improve education and proposing ways to promote better learning in schools. In a search for the factors that promote quality, countries' programs as well as the literature increasingly emphasize teachers, schools, and communities as the engines of quality, with teacher quality identified a primary focus.

Regarding to the quality of education, there are many components concerning the issue of viewing the school as a system. Policy system of schools, the teachers, and the pupils alone are not entire solution that lead to education quality explanations. The United Nations International Children's Emergency Fund has offered a framework for education quality consisting of four scopes as follows:

1. Learner characteristic measurement: capability, experience, Socioeconomic background, place of domicile, health condition, gender, etc.
2. Contextual measurement: sociocultural and religious aspects, labor market conditions in a society, public resources, globalization, peer-affect, time spent in class and for homework;
3. Input measurement: quality of learning and teaching such as teaching methods, teaching and learning materials, assessment, feedback, class size, teachers, facilities, principals, etc.
4. Output Measurement: literacy, numeracy, creative and emotional skills, values and social benefits.

In accordance to case studies from UNISEF, this study will focus on economic and

labor market conditions in the society, teachers, and teacher-student ratio depending on data availability.

To conclude, this study examines the main components of quality of education including teacher quality, poverty, student teacher ratio, and unemployment rate that influence the quality of learning outcomes of upper-secondary schools' students.

**Theoretical and Empirical underpinnings of research study:**

**The importance of secondary education in Uzbekistan:**

Undertaken research is focused on the upper secondary education schools, which is one of the crucial actors in Uzbek education. Hence, Education for All (EFA) initiative have driven an education reform agenda pivoted on enhancing quality of learning outcomes in secondary education to achieve human development goals and economic competitiveness within nations (King, McGrath, Rose, 2007; Lewin 2008, 2015; UNESCO, World Bank). Secondary education is treated as an intermediary stage between primary and tertiary education, which develops necessary skills, aptitudes, social values, technological know-how, and advances learners analytical thinking ability before they step into higher education or labor market.

Particularly, General Secondary education in Uzbekistan comprised nine years' compulsory education from 1st grade to 9th grade, until new reforms were undertaken in 2017. In the 2017-2018 academic year, secondary education prolonged to 11 years with multiple pathways to enter industry or higher education. Learners in 11 grade can take vocational training to gain experience in practical training and skills. Still students can choose to continue their studies in academic lyceums, as well. Largely, enrolment in secondary education upsurges, it necessities to enhance the quality of national secondary curriculum. Rapid changes in technology, results in changes in global economies and diverse national labor markets, in turn, it pushes for more appropriate and adequate curricula content and integration of information and communication technologies as a module and as a learning instrument. Thus, in all nations Secondary education is widely recognized as a tool for stable nation building and social unity (Buckland, 2005; Sommers, 2002; World Bank). Similarly, Uzbek authority is also implementing well planned and sufficiently resourced projects to create an environment where learners can achieve knowledge and skills which enable them participate actively in economic and social life, contribute their effort to remain peaceful and democratic society. Uzbek Government is highly committed to promote education system not only by issuing laws, but also supporting the sector by monetary aids. Particularly, public spending of government on education sector was US$2.94 billion, where around 56% of total spending was reclaimed by GSE, followed by Vocational Education (nearly 20%), pre-school system (11%) and higher education sector (close to 5 %) (Stat.uz, 2017). This high amount of spending on GSE can be explained the huge number of enrolled children, teachers and other school facilities in that sector. Heavy investment constitutes spending of US$5.6 million on the production of textbooks for grade 11, US$ 2.5 million on equipping 489 classrooms for applied studies, US$ 51 million on building and reconstruction of schools (Ministry of Finance, 2018).

However, efficacy in public spending on GSE is not satisfactory in terms of Gross Enrolment rate (GER). Budget expenditure on GSE constitutes 3.57% of GDP, which is relatively higher compared to other countries such as in Kazakhstan it forms 2.04 % of GDP with 113% GER, in Finland education spending derive 2.7% of GDP with a GER of 152% (World

Bank, 2020), while in Uzbekistan this indicator is slightly lower at 97%. Apart from this, very few students get admission into universities. Admission in higher education is almost 10 % in the nation, while in Kazakhstan enrollment rate is 50%, while this rate is 83 % in Austria, and it constitutes 87 % in Finland (World Bank, 2020). Indeed, under this research I tend to detect and evaluate main determinants that affect the quality of secondary education. Hence, this paper contributes government to implement mechanisms to control educational progress in relation to Sustainable Development Goals 4 targets by 2030 committed by UN Member states in 2015. Besides that, the need for accurate, updated and comparable data on quality of education has never been urgent, with the prospects of Action Strategy (4.4) 2017-2021 for the development of Uzbekistan. Education system does not function effectively unless policies, approaches and funding are constructed on the original foundations of data.

**Literature Review on Education Quality:**

Educational quality has always been implanted within nations' policies and programs. A more recently established way of focusing on quality emphasizes the content, conditions and relevance of education. This way to quality concentrates on procedures in school activities and interactions between school and other stakeholders ranging from students to society. The main concentration is given to the process in which inputs cooperate at secondary schools form the quality of learning (Carnoy and de Moura Castro, 1995; Muskin and Aregay 1999; UNISEF 2015, World Bank 2015).

Thus, Harvey (1995) developed a framework for quality by drawing five goals for education that outline the view of quality within individual systems. Education quality can be viewed as followings:

a) As exceptionality where excellence is the perspective of quality that derives education,
b) As consistency which requires equality in schools and classrooms across the system,
c) As fitness-for-purpose in which students are taught for determined roles by stressing instructional specialization,
d) As value for money, education has always rewarded individual and nations' investments in knowledge, quality is considered as the extent to which education carries value for money,
e) As transformative power that promotes positive social change in societies (Kubow and Fossum, 2007).

Highlighting the substance nature of quality of education, Scheerens et al (2011) defined quality of education in terms of student achievement and controllable school inputs that has impact on student learning outcomes. He has shifted the focus from number of years schooling to the complex integration of inputs, processes and outputs related to enhanced model of learning. Thus, classroom and school related concerns have taken attention of scholars and governments as a driver of quality. USAID funded Community Schools Activities Program (CSAP) carried out by Prouty and Tegeng (2000) pointed out that CSAP schools' authorities considers developed teacher skills, enhanced relationships and positive attitude between instructors and learners, learners with learner's main factors effecting performance of schools. Authors asserted that increased learning time for learners while decreasing workload and size of classroom groups help to achieve higher quality in students' learning outcomes. Therefore, the growing accent on quality of education was sketched in a study by Muskin (1999) that provides general two theoretical pivotal spots. First view of evaluating the quality of learning outcomes, predominant in both the research society and

governmental authorities, refers the link between 'inputs' and 'outputs'. Here, inputs include several factors ranging from infrastructure, resources of the schools to family and socioeconomic conditions such as quality of school surroundings, textbooks, teacher salaries, curriculum, and learners' health and well-being. While the output comprises students results on assessments and examinations. Under this first approach, it is tending to detect inputs most highly related to favorable learning outcomes. However, it is very uncompanionable on the practices of school and classroom through which inputs desired level of outputs have been achieved (Muskin, 1999). Second focal point of identifying quality of education is evaluation of efficiency of schools. Efficiency of the system can be measured both internally and externally by the rates of graduates and productivity of school graduates, respectively. Efficiency of school graduates itself can be measured based on admission rate in higher education, wages or economic yields accompanying with individuals' skills and capabilities achieved in schools. However, this approach has been criticized due to having insufficient explanation about what derives quality of learning outcomes, what factors boost learners to stick to classroom and obtain valuable knowledge and respect (Hannushek and Woessmann, 2012).

The Education for All report provides a framework with measurements for comprehending, supervising, and enhancing quality of learning outcomes. These dimensions are very crucial for policy makers in understanding and organizing various variables facilitating quality of education, teaching and learning environment. They are followings (UNESCO, 2004):

1. Students background and characteristics highly influence quality of education while including learners' ability, readiness for school, hard-working and diligence.
2. Context dimension also considerably affects quality of schools as it comprises socioeconomic and cultural status, labor market characteristics, teacher quality, salary and experience of teachers, parents' endorsement, and public resources.
3. Techniques and methods employed in teaching and learning are also crucial in quality assurance. This component includes learning time, teaching techniques, assessment and feedback, class size.
4. Output dimensions or outcomes are final indication of quality of education. It can be assessed by literacy, numeracy and critical and creative skills obtained during study period in school.

As it has been noticed above discussion, quality of education is a multi-dimensional concept as it can be defined in various ways, all lead us to the same track, mostly associated with fitness of use and satisfaction of necessities of strategic communities including governments, parents, principals, teachers and learners. Accordingly, quality of performance of schools can also be measured applying several kind of indicators depending on each schools' interests and objectives.

**Quality of Education and Poverty:**

Many researchers have been accompanied to study the relationship between poverty and education returns (Bowman 2010, Denison 2008, Psacharopoulos, 1998, Hanushek and Woessmain 2010). There are a variety of outcomes and variation in the literature on the theoretical and empirical context of poverty and education analysis. Particularly, educating women in a nation is one of the valuable and efficient investment in developing countries ( Hill.M.A., & King.E.M (1995), Enhancing girls' learning outcomes generates a number of potential benefits for poor families such as improved health and nutrition in families, lower

mortality rate and enriched school attainment of children.

Therefore, empirical evidence at both micro and macro levels enlightens the causation between education, economic prosperity and poverty. Number of studies show that people with more years of education earn more income compared to those who has less years of education, with the rate of return differing with high level of education (Behrman, 1999). The high quality of learning outcomes gained by human capital leads to higher overall productivity of nation's capital due to the fact that highly educated individuals are more likely to innovate, therefore, positively affect others' productivity whom they interact (Lucas, 2008, Perotti, 2008). Especially, the education and skills of human capital in developing nations positively affect the nature of its production and subsequently influence the composition of its trade. Wood (2009) argue that even 'unqualified' employees in contemporary plants basically require the literacy, numeracy, and discipline, which are obtained in primary and lower secondary school.

We can see the positive and strong effects of high returns to primary and secondary education in modern agriculture sector. Birdsall's findings (2003) assert that Thai farmers with additional four years of schooling are three times more productive in adapting modern fertilizer and inputs compared to those have less schooling attainment. Similarly, empirical outcomes driven by Jamison and Moock (2004) reveal that seven years of school attainment improve productivity of wheat production by more than 25%, efficiency of rice cultivation by 13%. Apart from this, the role of education in technology industry is important. The study conducted in clothing and engineering sectors of Sri Lanka demonstrated that abilities and learning outcomes of employees and managers resulted in faster rate of technical change and technological capability of companies (Deraniyagala, 2005).

In above discussion the importance of secondary education on reducing poverty has been reviewed. Therefore, it is also important to identify how poverty shapes educational outcomes, processes. Education is the main field which is highly affected by poverty.

Studies originating from progressive waves of the international literature review have constantly revealed that socioeconomic factors have a strong, persistent and determined impact on student achievement (Ryan & Adams, 2007; Hoddinot J, Lethbridge L, Phipps S, 2007). Thus, Phipps and Lethbridge (2007) examined income and child outcomes in children 4 to 15 years of age. Research outcomes shown that, higher incomes are associated with better outcomes for students in their schooling years. It is important finding that cognitive and school components are highly effected by poverty, followed by behavioral and health metrics, while smallest affect revealed for social and emotional measures. Another study carried out in USA by Brooks-Gunn and Duncan (2007) demonstrated that socioeconomic disadvantage and other components related to poverty negatively affect cognitive development and academic performance of students. Like a crystal, thrilling and insistent poverty has negative impact on individuals, American studies revealed strong causation effects between learning outcomes and socioeconomic factor. Parents with low income are not only more likely to have their kids born before the predetermined time, but these early born children are also excessively at higher risk for school failure compared to children with the same neonatal chronicle from higher income families (McLoyd V.C, 1998). Similarly, above mentioned associations between socioeconomic measures and students learning outcomes has been justified by several International Assessment Studies. Thus, the

Progress in International Reading Literacy Study (PIRLS) evaluated broad literacy skills of grade 4 children in 35 nations, while the Program for International Student Assessment (PISA) cognitive skills (Math and Science) and reading abilities of 15-year-old students in 43 students. These two different studies found out significance link between school outcome and socioeconomic disadvantage in all states. This relationship is considered as a 'socioeconomic gradient'.

Therefore, Longitudinal studies delivered in the US have been vital in representing some of the key elements in producing and maintaining poor achievement. The study compared the academic development curve of pupils during the academic year and during the summer holiday, and their findings prove that schools or students' misachievement in their academic life is the only and main guilty, instead, families and communities are main factors affect to students' achievement. This result powerfully supports the notion that schools are main actors in developing cognitive skills, but it also requires a constant support of parents and communities for underachieved and disadvantaged students.

**Education quality and teacher quality:**

There are several multiple factors that derive favorable learning outcomes, the most important of which is increasingly recognized to be quality of teachers and teaching (Lewin and Stuart, 2003; UNESCO, 2004, 2006, 2010; USAID 2012). Accordingly, EFA report (2005) apprehends what happens in the classroom, the influence of teacher and her methods in teaching as one of the main elements in improving students' engagement and learning outcomes. Quality improvement process depends on how teachers conduct classes, how s/he deliver the information to students. Hence, policy makers, researchers all focus on teacher quality and learning. Within this subsection, we trace the growing emphasis on teachers in achieving learning outcomes. In the past teachers received information on how to conduct the session from centralized authorities (Graig et al.1998), however this way of teaching is not valid anymore, in a technology oriented environment, there is need to advocate constructivist and active learning approaches for teachers to achieve significant positive changes in student learning process. Teachers have to engage in continuous learning and advance in professional development programs in order to become reflective practitioners who create active learning environment where students acquire knowledge via problem solving, critical thinking and higher order thinking skills (Lieberman 1995). The stress on teacher empowerment has developed from several roots. One of them related to 'Reflective practitioner' concept which is associated with the 'action research' (Hiebert et al, 2002). Under this concept teachers are professionals who are capable of reflecting classroom situation, and making number of classroom management and instructional decisions. Even though dialogue at national, school and community levels should define the qualities that education system pursues in good teachers, a list of generally held abilities of perspective teachers have been developed (Chesterfield and Rubin, 1997; Craig et al. 1998; Darling-Hammond and McLaughlin,1995; Fenstermacher and Richardson, 2000; Fredriksson 2004; Heneveld and Craig 1996; Lieberman 1995; Tatto 2000; UNESCO 2005). Teachers should be rich in skills and knowledge in a range of teaching techniques, able to reflect on teaching practice and learners' responses, in turn, able to modify teaching and learning approaches considering learners' abilities, skills and background, must understand the curriculum of the module and its purposes, should be able to provide instructions in a fluent language, should possess the abilities to manage classroom effectively, handle problems smoothly, ability to work with others

and could construct rapport with teachers, students and community.

Turning to empirical literature on linkage between teacher quality and student learning outcomes, vast of research findings confirm the importance of teacher quality on education quality. Thus, Anderson (1982), Hoy (1990) and Tarter (1995) has asserted that teachers' satisfaction, commitment and attitude toward teaching and learning are dependent on several social economic factors. Whatever the factor derives teacher quality, according to authors, students' achievement is consequently affected by teachers' ability to teach. Based on the findings of Hoy and Sabo (1998), we can indicate that teacher integration and collegial behavior has a moderate influence on learners' achievement. There is a strong evidence that student achievement is highly associated with facilitators' professionalism, proper attitudes and commitment to learners, satisfaction in teaching process (Tschannen-Moran et al. 2006; Darling-Hammond, 2000; Heck, 2009; Maria,2009).

As we highlighted in above discussion, productivity of teachers has a crucial place in education which is evaluated based on quality of teachers and how teachers instruct. However, there are external ingredients that influence teachers' productiveness like the number of students per teacher and gender of instructor. Number of pupils per teacher is generally associated with class size and it is predominantly believed that small sized classes feed a better teaching and learning. This concept has been devoted by many nations such as the USA, European states, China, Japan, and they implemented policies to lessen their class sizes (Blatchford & Lai, 2012). Evidently, many developed countries have shortened the average class size. For example, over the decade between 2000 and 2010, Portugal has reduced secondary education class size by 33.9%, this figure constitutes 27% for Spain, 20% for Japan, 17% for South Korea, and 13.2% for the USA (OECD, 2012). Particularly, the STAR project that is implemented by the Tennessee State Department and CSPAR project which is undertaken in the United Kingdom are vital studies that demonstrate the significance of class size on students' academic achievement. The STAR project exhibited that primary and secondary school students in small size classes with 13-17 students had significantly higher test scores compared to their counterparts in usual classes with 22-25 students (Word, Jahnston, Bain, Fulton, Zaharias, 1985-1990). The CSPAR project is non-experimental longitudinal research study that also traced primary school students for eleven years to detect the effect of student-teacher ratio on academic achievement. Thus, the study revealed that class size considerably influences the academic success of learners (Blatchford, 2012). However, some researchers found out that lower student teacher ratio cannot be single element that encourage academic achievement, indeed, classroom process, students' engagement, classroom activities are main factors that ensures higher learning outcomes within schools (Croll & Hasting, 1996, Johnson, 2011). Thus, the factors behind the students' admission rate to higher education in Uzbekistan has not been studied much, even though it is a quite significant examination for all secondary education students as this exam is the main determinant for being admitted to Universities. Hence, I decided to examine the relationship between student-teacher ratio and different admission rates.

Moreover, I confidently state that filling the teacher gap is not sufficient to straighten students' achievement. Teachers' enlightenment and skills, how they teach, is equally important. In addition to these key ingredients, gender inequalities in the teaching personnel also need to be treated as a critical issue. There is a strong evidence prove that

positive educational outcomes, especially in girls' academic achievements are positively associated with the presence of female practitioners. In point of fact, UNISEF's investigations demonstrate that STEM subjects' teachers in secondary schools of some nations are almost exclusively male practitioners. Statistically, female teachers constitute only 3.3% of math facilitators in Togo, 3.7% in Chad, and 5.5 % in Cote d'Ivoire (Robert Jenkins, 2021). These discrepancies may cause a cycle of limited attendance of girls in STEM. The main reason behind this outcome is that vast of school students see their women teachers as their advisor and role models, especially students in primary and lower secondary schools.

**Methodology:**

**Data collection and Data Analysis:**

In this study, the data and information came from secondary sources, namely, data are taken from Ministry of Public Education and Ministry of Finance. All of the independent variable data related to secondary school are taken from Ministry of Public Education, while the data related to socioeconomic factors such as individuals with income less than $ 5.5 per day, and unemployment rate are taken from Ministry of Finance.

**Dependent Variable:**

**A Measure of Quality of education indicator:**

Majority of early empirical studies on human capital thickened on quantity of schooling – the number of years of education pupils accomplished. It is very straightforward and easily measured, and getting data on years completed over the period and across regions and nations are readily obtainable. Economists asserted that people with more schooling typically make more income than those with less schooling years. However, quantity of schooling attained is very raw and unpurified measure for the quality of skills and abilities pupils gain. Particularly, it is not appropriate measurement for comparison purposes of human capital over different societies and regions. Employing average schooling years as a proxy for education measure utterly presume that a year of schooling brings the same expansion in knowledge and cognitive skills regardless of education system adapted and implemented by schools. This apathy of cross-nation, in this paper, cross-region divergence in the quality of education is the main shortcoming of such quantitative estimation. Pretty comprehensibly, the average pupil in Surkhandaryo Region does not achieve the same amount knowledge in any year of schooling s/he attained as an average student in Tashkent. Ignoring quality of divergence in education significantly omits the true urgency of education in well-being of societies. However, large-scale evidence on knowledge development and cognitive skills designates that a wide range of factors outside of school, called as non-school factors – family, peers, relatives, genotype, labor market conditions, have a strong and positive impact. Discounting these non-school factors brings another element of measurement error into the development analysis.

Based on the above-mentioned discussion, I have decided to classify samples in to clusters using admission rate of secondary school students in Higher education in 2020.

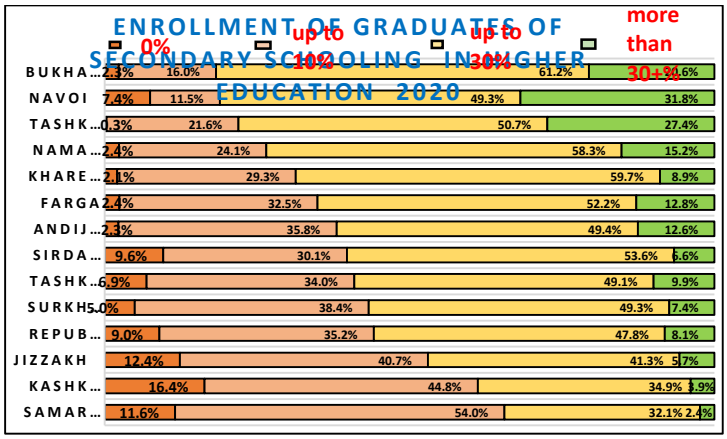



Figure 2: Admission rate to higher education across regions of Uzbekistan in 2020

Source: Ministry of Public Education (MoPE)

In our data, university enrollment rates were presented in four dimensions. Preliminary results showed that none of these individual categories produced significant results for analyzing educational quality. Since all four categories mean one indicator, we cannot exclude any of them for assessing educational quality. Nevertheless, we decided to divide the regions into groups based on all four dimensions using cluster analysis.

Cluster analysis in Data Mining involves classifying samples into groups (clusters) based on information found in the data that describes the samples and their relationships. Samples belonging to one cluster must be similar to each other and be as dissimilar as possible to samples belonging to other clusters. In this study, the Calinski-Harabasz method (Calinski & Harabasz, 1974) was used to estimate the optimal number of clusters in the dataset.

The Calinski-Harabasz Index is calculated by dividing the variance of the sums of squares of the distances of individual objects to their cluster center by the sum of squares of the distance between the cluster centers. The higher the value of the index, the better the clustering model. The formula for Calinski-Harabasz Index is defined as:

$$CH_k = \frac{BG_k}{WC_k} \cdot \frac{N-k}{k-1}$$

where

k - the number of clusters;

N - the number of observations;

$BG_k$ – between group dispersion matrix;

$WC_k$ – the within-cluster dispersion matrix.

Clustering models are distance-based algorithms that use a distance metric to measure similarity between samples and form clusters. Consequently, features with greater distance will have a greater impact on clustering. Thus, standardization before clustering algorithm leads to better, more efficient and more accurate clustering results (Mohamad & Usman, 2013). In this analysis, we proposed Z-score as a standardization tool that gives more accurate and efficient results in k-means. All the clustering calculations were made using the well-known software MATLAB[].

In order to determine the number k of clusters the value of $CH_k$, has been calculated for different numbers of clusters, from 2 to 20. The graph shows that the highest Calinski - Harabasz value is observed with five clusters, indicating that the optimal number of clusters is five where $CH_5$, has its maximum value($CH_5 = 135.8$), indicating that a reasonable cluster structure has been found.

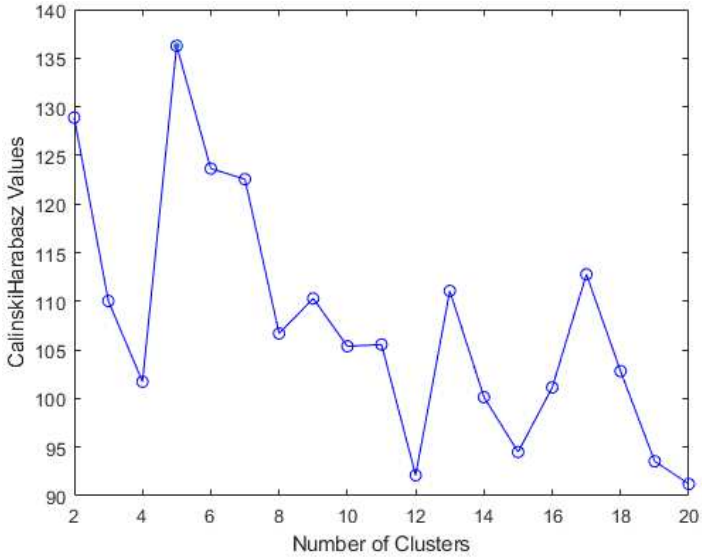



Figure 3. The Calinski- Harabasz index values.

By applying the optimal number of clusters, k-means cluster analysis can be performed. k-means stores 5 centroids for cluster identification. A point is considered to belong to a particular cluster if it is closer to the centroid of that cluster than the others. Since it is impossible to illustrate clusters in four dimensions, 3d scatter plots were used to demonstrate five groups of clusters separated by different colors that are close to their centroids.

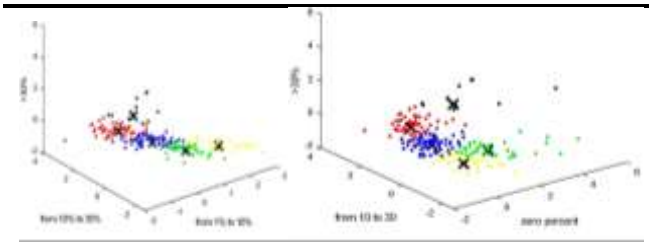


Figure 4. K-means in three dimensions

Based on the values of cluster centroids, we can classify clusters and use clusters as a proxy for the level of enrollment of high school students in institutions of higher education.

Table 1. Cluster centroid locations

| | 1 | 2 | | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Zero percent** | 1.22 | -0.32 | | -0.31 | -0.82 | -0.82 |
| **From 1% to 10 %** | 0.60 | 1.58 | | -0.03 | -1.02 | -1.67 |
| **From 10% to 30%** | -0.78 | -1.24 | | 0.34 | 0.84 | -1.25 |
| **>30%** | -0.61 | -0.61 | | -0.39 | 0.58 | 3.10 |

In table 1, the middle of a cluster which is also known as the multi-dimensional average – cluster centroid locations are represented. A centroid itself is a vector that contains one number for each variable, where each number is the mean of a variable for the observation in that cluster. For each cluster, we obtained various distance measures between the cluster centroid and the observations within the cluster. The final centers reflect the characteristics of the typical case for each cluster and there are following outcomes figured:

- Regions with no admission to higher education in cluster 1 tend to be the highest.
- Regions where percentage of graduates of secondary school entered to universities is between 1% and 10% in cluster 2 tend to be high point.
- Regions with 10-30% admission rate in cluster 4 tend to be moderate
- Regions where more than 30% of graduates of secondary education in cluster 5 tend to be elevated.

**Independent Variables:**

**Poverty rate** is measured as income below USD 5.5 per day Poverty is baffling, deep-rooted and large-scaled actuality all around the world. Over than 700 million people live on less than US$ 1.90 a day (World Bank, 2020). It is a sharp truth that half of the poor are children which 70% of them constitutes the people aged 15 and over without schooling or with some foundation education inequality.

**Student-teacher ratio by education level:**

To measure teacher workloads and human resource allocations in secondary education and to give a general indication of the average amount of time and individual attention a pupil is likely to receive from teachers. Since well-qualified teachers (A qualified teacher is one who has at least the minimum academic qualifications required for teaching their subjects at the relevant level, all teachers who graduates universities bachelor and master degrees) play a key role in ensuring the quality of education provided, the student/teacher ratio is considered an important determinant of learning outcomes and an indicator of the overall quality of an education system. This ratio is calculated as following:

Indicator = (number of pupils)/ (number of teachers)

Thus, the growth of the school-age population differs across regions and poses additional challenges to the education system. When considering the current student–teacher ratio in general secondary education (GSE) schools in the city, which at 29:1 is the highest in the country, versus a national average of 18:1 (Based on author's calculation)

Female teachers, high category teachers and unemployment rate in regions are also selected as independent variables while considering their significant role in students' achievement.

**Conceptual Framework for Education Quality:**

Based on the literature review, relationship between regressand, i.e., education quality, and regressors, i.e., teacher quality (categories), student-teacher ratio, unemployment and poverty rates were created. Several hypotheses are set based on the given framework:

$H_0$ = Education quality is neutral: It does not depend on given independent variables

$H_1$ = Female teachers have significant influence on students' achievement

$H_2$ = High Category teachers have significant influence on students' achievement

$H_3$ = Income less than $ 5.5 per day has significant influence on quality of learning outcomes

$H_4$ = Unemployment rate has significance influence on education quality

We used multivariate analysis of variance (MANOVA). and descriptive statistics to test the hypotheses. Accordingly, four hypotheses were derived and tested for their validation so that behavior, relationships or characteristics of secondary schools in Uzbekistan could be explained reasonably, which will assist local administrators and policy makers in making proper decisions regarding education quality improvement.

**RESEARCH RESULTS:**

**Descriptive Statistics Analysis:**

We can see that there are no notable differences in the independent variables across clusters. All of them are statistically significant with lower standard deviation.

| | Cluster_sorted | Mean | Std. Deviation | N |
|---|---|---|---|---|
| Unemployment rate | 1,00 | 9,2637 | ,32792 | 40 |
| | 2,00 | 9,0372 | ,50650 | 28 |
| | 3,00 | 8,9651 | 1,57974 | 72 |
| | 4,00 | 8,7386 | 1,37897 | 53 |
| | 5,00 | 7,9897 | 1,40880 | 10 |
| | Total | 8,9267 | 1,26000 | 203 |
| Lower than 5.5$ | 1,00 | ,3242 | ,21104 | 40 |
| | 2,00 | ,3623 | ,20839 | 28 |
| | 3,00 | ,2928 | ,19189 | 72 |
| | 4,00 | ,3295 | ,19034 | 53 |
| | 5,00 | ,2302 | ,18798 | 10 |
| | Total | ,3151 | ,19789 | 203 |
| High category | 1,00 | ,0302 | ,01047 | 40 |
| | 2,00 | ,0326 | ,00955 | 28 |
| | 3,00 | ,0352 | ,01436 | 72 |
| | 4,00 | ,0374 | ,01329 | 53 |
| | 5,00 | ,0362 | ,01518 | 10 |
| | Total | ,0345 | ,01298 | 203 |
| Female teachers | 1,00 | ,6135 | ,13891 | 40 |
| | 2,00 | ,7050 | ,10764 | 28 |
| | 3,00 | ,7178 | ,10528 | 72 |
| | 4,00 | ,7658 | ,09914 | 53 |
| | 5,00 | ,8136 | ,09820 | 10 |
| | Total | ,7127 | ,12385 | 203 |
| Student-teacher ratio | 1,00 | 11,2689 | 1,95163 | 40 |
| | 2,00 | 14,4437 | 3,15004 | 28 |
| | 3,00 | 11,8786 | 2,48557 | 72 |
| | 4,00 | 12,5910 | 3,33863 | 53 |
| | 5,00 | 11,9313 | 4,85615 | 10 |
| | Total | 12,3009 | 3,01547 | 203 |

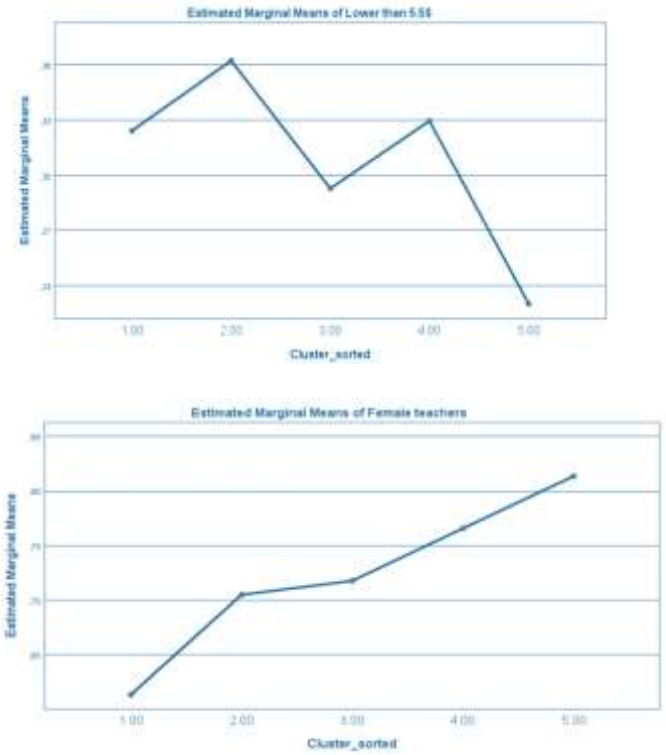
MANOVA was used to determine if there were statistically significant association between the five independent variables. As illustrated in table 2, the results reveal that there was significant difference in the mean unemployment and student-teacher ratio across the groups, p<0,00.

Table 2 Result of the MANOVA analysis

Tests of Between-Subjects Effects

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[c] |
|---|---|---|---|---|---|---|---|---|---|
| Corrected Model | Unemployment rate | 15,646[a] | 4 | 3,911 | 2,539 | ,041 | ,049 | 10,155 | ,712 |
| | Lower than 5.5$ | ,185[b] | 4 | ,046 | 1,182 | ,320 | ,023 | 4,729 | ,367 |
| | High category | ,001[c] | 4 | ,000 | 2,084 | ,084 | ,040 | 8,335 | ,613 |
| | Female teachers | ,648[d] | 4 | ,162 | 13,099 | ,000 | ,209 | 52,394 | 1,000 |
| | Student-teacher ratio | 189,834[e] | 4 | 47,458 | 5,706 | ,000 | ,103 | 22,822 | ,979 |
| | Unemployment rate | 10004,048 | 1 | 10004,048 | 6493,372 | ,000 | ,970 | 6493,372 | 1,000 |
| | Lower than 5.5$ | 12,243 | 1 | 12,243 | 313,759 | ,000 | ,613 | 313,759 | 1,000 |
| | High category | ,152 | 1 | ,152 | 922,430 | ,000 | ,823 | 922,430 | 1,000 |
| | Female teachers | 67,568 | 1 | 67,568 | 5460,172 | ,000 | ,965 | 5460,172 | 1,000 |
| | Student-teacher ratio | 19941,424 | 1 | 19941,424 | 2397,390 | ,000 | ,924 | 2397,390 | 1,000 |
| Cluster_sorted | Unemployment rate | 15,646 | 4 | 3,911 | 2,539 | ,041 | ,049 | 10,155 | ,712 |
| | Lower than 5.5$ | ,185 | 4 | ,046 | 1,182 | ,320 | ,023 | 4,729 | ,367 |
| | High category | ,001 | 4 | ,000 | 2,084 | ,084 | ,040 | 8,335 | ,613 |
| | Female teachers | ,648 | 4 | ,162 | 13,099 | ,000 | ,209 | 52,394 | 1,000 |
| | Student-teacher ratio | 189,834 | 4 | 47,458 | 5,706 | ,000 | ,103 | 22,822 | ,979 |

The results of the analysis pointed out that poverty rate which is less than 5.5 USD per day, high category teachers, female teachers and unemployment rate have a statistical significance ($p < 0.05$). Poverty rate inversely affected the admission rate as shown in the following figure.




It is an important finding of the study that poverty of parents whose income less than USD 5.5 per day, affects school students' academic performances in admission examinations to higher education. The study revealed that poverty establishes in lack of books to read, students over burdened with domestic duties and household tasks, home atmosphere unconducive for learning and inability to afford to pay for extra-session classes. Incapability of parents to buy books for their offspring to read results in serious setback for the students' academic performance. To support above asserted statement, Okeke (2002) confirmed that "the discrepancy in socio-economic status of parents also produce discrepancy at the rate parents encounter with material and financial necessities for their kids' academic success in school. Also, the children from poor households are often over burdened with domestic drudgery, especially, to help their parents to earn income. Apart from that, most household atmosphere of the poor is not advantageous for learning. Poor households are not sufficient in terms of income to buy comfortable reading table and chair; the children prepare their home tasks sitting on the ground. Similarly, they cannot afford to pay money for a private teacher to teach their underachieving kids after school. All in all, it negatively influences the child's academic achievement.

Besides that, first category teachers and female teachers have significant influence on school to achieve more than 30% admission rate to higher education. Thus, they can be judged as the key factors for quality of learning outcomes achieved by secondary level students. On the other hand, student teacher ratio was unexpectedly found to have positive relationship with education quality. Initially, we expected that lower student teacher ratio would result in higher educational outcomes in schools. However, we found a positive correlation between student teacher ratio and achievement ranking of areas in the transition to universities. The positive connection indicates that as the average number of students per teacher increases, a city gets a higher admission rate.

Our result contradicts the agreement which was discussed in the literature. This is, because, there is no consensus on what the best ratio of students to teachers should be at different pupils' ages, even though there is a wide agreement that teacher's satisfaction is increased with small sized classes, there is also some evidence demonstrating that disadvantaged students can benefit more in smaller classes.

All in all, our findings enable us to conclude that teacher quality, female teachers,

lower unemployment rate and alleviated poverty level play crucial role in achieving higher admission rate in higher education by the graduates of secondary schools.

**CONCLUSION:**

Education has long been regarded as an important driving force for economic and social development, an effective way to reduce poverty and promote prosperity. Thus, it is crucial to identify main elements of quality of education in a nation, to improve living standards of population. Among the potential key determinants, i.e., socioeconomic factors, teacher quality, school facilities being tested, it was found that education quality where the admission rate to higher education was used as a proxy for education quality, significantly depended on teacher quality, female teachers, unemployment rate and poverty level. However, the other key determinant, lower student teacher ratio is associated with lower rate of admission rate, which was unexpected. The results only indicate that at this stage of the country's conditions, it is more effective to promote the education quality in Uzbekistan through the improvement of teacher quality and educating more girls, reducing number of unemployed populations by creating favorable conditions to small and medium sized entrepreneurs to run their businesses. However, after implementing the strategies in this direction for some time, the educational situations and conditions will change as the education quality of the nation moves to a higher level. It will then be at that stage that employment and industrial and small business development might become a major player in lifting education quality.

**RESEARCH LIMITATIONS:**

I have employed school leavers' admission rate to higher education as a proxy for quality of secondary schools. However, it would have been achieved more accurate and reliable outcomes if average performance at standardized tests had been used as a proxy for the quality of education. Thus, cognitive skills component of human capital has to be concentrated and test-score measures of mathematics and English Language achievement must be considered as a measure of quality of learning outcomes. Application of measures of cognitive skills bears a number of possible advantages. First, they conquer discrepancies in the knowledge and skills that schools make great effort to achieve, in turn, connect the reputative outputs to further successful income distribution. Secondly, by highlighting aggregate upshots of education, we can integrate skills that might come from any source – families, schools, ability and society. Third, it enables us to inspect the importance of various policies, strategies intended to influence the quality sides of schools via permitting for diversity in achievements among pupils with divergent quality of schooling in spite of having same quantity of schooling.

Moreover, the study also shows how learning outcomes even among good performing districts fall to meet desired level of admission level. Hence, I need more data to explain the unsatisfactory state of learning. In turn, it leads me to gather and evaluate data on teacher motivation level, students' cognitive level, what kind of methods and interactive activities are used in the classroom and etc, in order to dig deeper into the issue.

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