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Gender disparity in literacy in Uttar Pradesh: a spatial analysis

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Literacy, being one of the most important demographic elements, is a crucial indicator used to measure human progress towards development. It acts as a catalyst for social progress, maximising return on investment in almost all developmental initiative areas. Moreover, female education contributes significantly to raising the state's standard of living. This study delves into the prevalent gender disparity in literacy rates within Uttar Pradesh, India, with a particular focus on the enrolment of girl children in elementary schools. It assesses the spatial variation in gender disparity in literacy across the 75 districts of Uttar Pradesh and finds a correlation between enrolment of girl children (x) and total elementary schools (y) across the districts. The Sopher Disparity Method is used to determine the spatial variation of gender disparity in literacy. Jaunpur, Bhadohi and Mathura are the states with the highest gender disparity level in literacy, while Amroha and Kanpur Nagar account for the lowest disparity level. The dot method is used to show the distribution of total number of elementary schools per district in Uttar Pradesh, presenting that Baghpat, Gautam Buddha Nagar, Mahoba, Shrawasti and Bhadohi are the districts with the lowest concentration of elementary schools, while Azamgarh, Bijnor, Sitapur, Hardoi and Jaunpur are those with the highest concentration. A correlation coefficient of 0.89 has been found between elementary schools and girl child enrolment, which shows a strong positive association. The research highlights the cultural, socio-economic, and infrastructural barriers that impede the enrolment and retention of girl children in elementary schools. By examining existing policies and their impact, the study aims to provide insights into the complexities of gender-based educational disparities. Furthermore, it explores the role of societal norms and economic constraints in shaping the educational landscape for girls in Uttar Pradesh. The ultimate goal is to inform targeted interventions that address the root causes of gender disparity in literacy, fostering a more inclusive and equitable educational environment in Uttar Pradesh.

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Introduction

Literacy is a bridge from misery to hope. It is a tool for daily life in modern society. It is a bulwark against poverty and a building block of development, an essential complement to investments in roads, dams, clinics, and factories. Literacy is a platform for democratisation and a vehicle for the promotion of cultural and national identity. Especially for girls and women, it is an agent of family health and nutrition. For everyone, everywhere, literacy is, along with education in general, a basic human right. Literacy is, finally, the road to human progress and the means through which every man, woman, and child can realise his or her full potential. (Annan, 1997).

The Human Development Index, Sustainable Development Goals, Global Gender Gap Report, and almost every other index of human development worldwide measure literacy as one of its indicators. It is a key demographic element and an essential tool for measuring human progress towards development. It catalyses social advancement, enhancing the yields on investments made in nearly every development initiative area, notably population control, health, sanitation, environmental degradation and women's empowerment in marginalised regions. In contrast, illiteracy strips a person of their dignity, promotes ignorance, poverty and mental isolation, and hinders the development of free and open democratic processes, economic development, political maturity and social advancement. Literacy is also one of the indispensable prerequisites for individual empowerment. The 1948 Universal Declaration of Human Rights, which affirmed that everyone has a fundamental right to education, recognised literacy as a basic human right. Indian planners have also acknowledged the influence of education on the country's economic and social development. As independent India was left with an unfortunate inheritance of widespread illiteracy with inadequate educational resources, education has been prioritised as an area of concern by the government. According to the first post-independence census in 1951, only 9 per cent of women and 27 per cent of men in India were literate. There has since been significant progress in literacy, with the literacy rate rising from 18.33 per cent in 1951 to 74.04 per cent in 2011. However, this progress is marginal in comparison to global standards. In addition to education and literacy, bridging regional and social disparities was on the UN's agenda. Attaining a higher literacy rate and reducing the gender gap in literacy were the two most critical literacy programme goals for the Government of India's Planning Commission. According to estimates, a sizable portion of the world's illiterate people live in developing nations, where women make up an astonishing majority (Stromquist, 1992). To achieve gender equality and empowerment, the objectives of Sustainable Development Goals 4 and 5 directly guarantee inclusive, equitable and high-quality education for all women and girls. In the context of female education in India, researchers in recent years have developed a substantial body of empirical studies indicating how education can encourage greater capabilities, such as the freedom to participate in economic and political processes, the use of new technologies, the ability to protect oneself from exploitation (legal, economic, sexual), the exercising of personal mobility, the attainment of higher social status and improved child and maternal well-being (King and Hill, 1993). Lower literacy affects women's understanding of their health requirements, making it more difficult for them to seek available services to improve their well-being (Rustagi, 2004). India is home to 272.9 million illiterate people, with the majority (about 53 per cent) concentrated in the five states of Uttar Pradesh, Bihar, Andhra Pradesh, Rajasthan and West Bengal. The majority of illiterate people live in Uttar Pradesh (51.4 million people), which accounts for roughly 19 per cent of all illiterate persons nationwide. Singh (1998), in his attempt to provide a succinct summary of the development of female literacy in India since the turn of the 20th century, noted that it will be difficult to address the basic educational demands of the millions of female illiterates. According to the 2011 India census, Uttar Pradesh's literacy rate stood at 67.88 per cent, of which males accounted for 77.28 per cent, with females accounting for only 57.18 per cent. The data show the prevalence of large educational gender differences, which tend to create gender disparity both in households and in society at large.

Existing research shows that the religious nature of society, in addition to its socio-economic structure (Deshpande, 2007) and the educational discrepancy between females and males when it comes to school accessibility (Lavy, 2008), have a direct impact on regional and socio-economic development worldwide (Siddiqui and Yadav, 2005). A comparative analysis of the patterns and nature of illiteracy disparities among various population segments at the state level was conducted by Kundu and Rao (1986), who contended that, regardless of social groupings, urbanisation and metropolitanisation have a distinct impact on diminishing the gender gap. Kingdon (2002) aims to examine whether the unequal treatment of sons and daughters by families is a possible explanation for the gender gap in educational attainment in developing nations while also attempting to explain the gender discrepancy in educational attainment in India. She discovered that family background, money, opinions, individual talent, age at marriage, and the calibre of the elementary school attended were the most significant influences on women's educational success. Bano (2017), while studying gender disparity in the literacy level of the Awadh Region of Uttar Pradesh, finds that due to the slow rate of infrastructure development, the northern half of the Awadh region presents a considerably poorer picture of literacy equality and acknowledges the pace of improvement indicating the spread of literacy across the districts. Yadav (2009), in their study of district-wide variations in literacy rates and educational facilities in Uttar Pradesh, discovered that districts in the northwest and southwest have high literacy scores, whereas southern, southeastern, and northern districts have lower literacy levels. According to the observed trend, both male and female literacy rates have shown an upward trend; however, male literacy has consistently outpaced the female literacy rate. The literacy rates of men and women continue to differ substantially. Among the primary objectives of the Millennium Development Goals was to ensure that all children, regardless of gender, grow up in an environment where education is available. Later, the global education development strategy, as expressed in Goal 4 (SDG 4) of India's 2030 Agenda for Sustainable Development, aspires to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. The nation's greatest resource is its children, and India is a country of stark contrast, especially in rural areas where the majority of the population lives in poverty and is vulnerable, but also has a variety of cultural traditions (Cheema, 2011). Local sociocultural practices may be significant when deciding whether to enrol a child, particularly girls, in primary educational institutions because social and cultural factors vary by region of India (Jencks, 1972; Mingat, 2007; Shavit and Blossfeld, 1993). Attaining primary education results in increased productivity, economic prosperity, social advancement, and poverty reduction; however, in developing nations, the education system is likely to be hampered by political factors, capacity limitations of the state, poor administration, an insufficient delivery system, poor governance, poor community information, and corruption and leaks (Azam and Kingdon, 2015). Individual, household, and parental education are key factors in school enrolment, especially for girls. It has been reported that parental education increases the possibility of

a child's enrolment, although mothers' education is relatively more relevant in increasing the enrolment of girls in public elementary schools (Dostie and Jayaraman, 2006). The enrolment level is also affected by regional, residential, and social group differentials. This is why a significant gender difference is observed in non-public school enrolment in India, which is more than the national average among children living in northwestern and northern states (Maitra et al., 2016). In an intriguing assessment (Dreze and Gazder, 1997) from an informal field study comparing the effectiveness of public schools against private schools in rural UP, private schools showed a high attendance rate, a lower dropout rate, and a large domination of male students. Biradar and Jayasheela (2007) found that there is still a significant illiteracy rate among SCs/STs in India and a wide difference in literacy between SCs/STs and non-SCs/STs. Such a gap results in unequal access to better work opportunities, meagre pay, the prevalence of poverty, health risks, and powerlessness. One of the fundamental purposes of the educational system is to ensure that students enrol in and attend school. The Indian government has taken several actions to ensure that every child gets access to education, at least at the basic level. The District Primary Education Programme, which served as the foundation for the 2000 launch of Sarva Shiksha Abhiyaan, was started by the Indian government in 1993–1994 to achieve universal primary education. India has made great advances in past few years towards near-universal enrolment in elementary education through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha), the Right to Education Act, Mid-Day Meal, Mahila Samakhya, National Programme for Education of Girls at Elementary Level (NPEGEL), Strengthening for Providing Quality Education in Madrassas (SPQEM), and Kasturba Gandhi Balika Vidyalaya. In Uttar Pradesh, schemes like 'Beti Bachao Beti Padhao', 'Padhein Betiyan Badhein Betiyan', 'Operation Kayakalp', Adult Literacy Programmes aim to collectively emphasise the importance of education and literacy and also focus on enhancing the quality of education to ensure better learning outcomes for all. Previous education policies have primarily addressed issues of equity and access in their implementation. The National Policy on Education 1986, as updated in 1992 (NPE 1986/92), included a pending agenda that is accurately addressed in the New Education Policy 2020. The Right of Children to Free and Compulsory Education Act 2009, which established the legal foundation for attaining universal elementary education, was a significant advancement since the previous policy in 1986–1992. The NEP 2020 aims to minimise dropout rates while creating holistic, integrated, flexible, enjoyable, and engaging learning. In addition to NEP 2020, schemes such as the new India literacy programme, each one teach one programme, smile twin-e-learning programme, PRAGYATA, and many more aim to create a world-class educational structure, including its governance and regulation, to build an innovative system with an emphasis on India's customs and value systems that is in line with the ambitious goals of modern contemporary education, incorporating SDG 4, as in Indian thought and philosophy, the pursuit of knowledge (Jnan), wisdom (Pragyaa), and truth (Satya) have always been considered the ultimate aim of humanity (NEP, 2020).

The national and state governments of India have made numerous attempts to improve the accessibility and standards of education. However, the country's social, geographic, and economic diversity causes variety in advancement. Even though overall enrolment has grown over time, gender disparities and inequalities in access to basic education continue to be major issues for the Indian economy. Jindal et al. (2019), while determining the factors affecting total enrolment in elementary schools, found a positive correlation between total enrolment and population in the age group of 6–10 years, enrolment in government elementary schools, good classroom conditions, playgrounds in schools, schools providing mid-day meals, and the allocation of a greater percentage of GDP to the education sector. This implies that total enrolment increases with an increase in the following factors. At the same time, while talking about the relationship between total enrolment and learning outcomes in elementary schools, they found that students' learning outcomes are not significantly affected by the gross enrolment ratio, and many other qualitative factors are important for better learning outcomes. Mehta (2019), while analysing the pattern of enrolment in UDISE 2016–17, reports that even though the Gross Enrolment Ratio (GER) and Net Enrolment Ratio (NER) are quite significant at the primary education level, contrary to the upper primary level of education, regardless high transition rate from primary to upper primary level of education. The education system in India is 'funnel-shaped' and keeps getting narrower as aspirants move towards higher education, implying lower enrolment rates at each stage of the education system. Grade-based dropout rates in the primary grades also show that Grade V has the highest dropout rate (10.99 per cent), which is higher than Grade VIII's dropout rate of 9.30 per cent. Additionally, the recent sharp fall in enrolment in primary courses would eventually prevent upper primary, secondary, and higher secondary enrolment from increasing in the years that followed. The greater the linkage between the stages of education, the better is the outcome of the education system. Thus, neither the aim of universal primary nor elementary-level education is likely to be attained in the near future unless the effectiveness of the primary education system is greatly enhanced. Without such, we might not have made progress towards realising the Universal Secondary Education objective.

Objectives

The objectives of this study were as follows:

1. To assess the spatial variation in gender disparity in literacy across the 75 districts of Uttar Pradesh.
2. To establish a correlation between enrolment of girl children (x) and total elementary schools (y) in 2011–12 in the 75 districts of Uttar Pradesh.

Research questions

1. What is the trend in literacy at national and state levels?
2. What is the spatial pattern of gender disparity in the state of Uttar Pradesh, which constitutes approximately 17 per cent of the total population?
3. What is the spatial distribution pattern of elementary schools in the districts of Uttar Pradesh?
4. How do we examine the issue of gender differential enrolment in elementary schools?

Materials and methods

Site description. The state of Uttar Pradesh, which stretches from 23°52' to 30°28' north and 77°3' to 84°39' east, is a portion of the Ganga Plain. It has 2,40,928 sq. km. area. The state has 166.2 million residents, making up 16.4 per cent of the nation's population, although covering only 7.5 per cent of the country's total land area, according to the Census of 2001. The state's population was 199.8 million in 2011, with a decadal growth rate of 20.2 per cent (Census of India, 2001). A total of 829 people per square kilometre live on this fertile plain, which is more than twice the national average of 382 people. Located in the

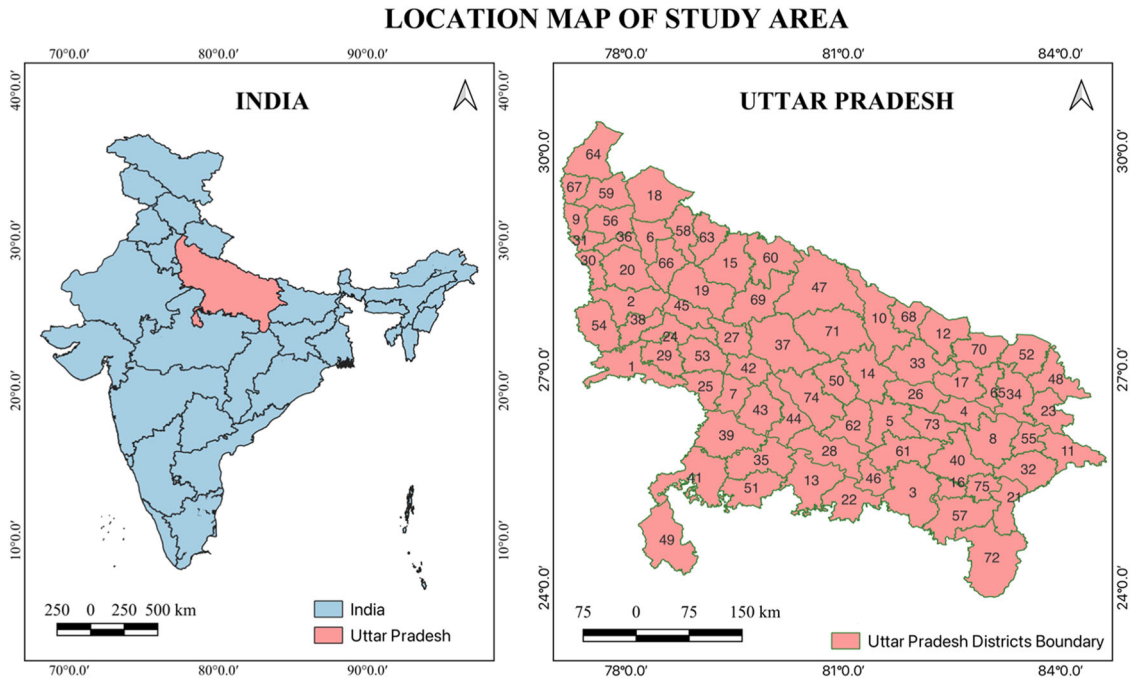

Fig. 1 Location map of the study area. The map on the left shows India in which the state of Uttar Pradesh is marked in a different shade. The map on the right side shows the state of Uttar Pradesh, which has the districts numbered in accordance with Table 1.

north-central region of the nation, the state is adorned by the Ganga and Yamuna rivers. The state of Uttar Pradesh is divided into 18 divisions and 75 districts, with Lucknow serving as the state capital and Prayagraj as the judicial capital. The location map of Uttar Pradesh is shown in Fig. 1, and the districts are numbered according to the serial numbers given in Table 1. (Fig. 1).

Datasets and methodology. This study was conducted using secondary data. The secondary data used in this study were primarily obtained from publications related to the Indian Census. For analysing the data on the total number of district-wise schools and girl child enrolment, the district report card (2012), for the year 2011–12 elementary education in India, published by the National Institute of Educational Planning in India, was used. Furthermore, journals and working reports are reviewed for shaping the study of geographical identity. To measure the relative disparity between the two groups, the Disparity Index developed by David V. Sopher (1974) used a specific time period. It can only be used when the values of the variables are expressed in terms of percentages. If X1 and X2 represent the respective percentages of the value of the variables in Groups 1 and 2, the disparity index (D) is:

$$D = Log\left(X2/X1\right) + Log\left[(Q - X1)/(Q - X2)\right]$$

where $X2 \geq X1$ (X2 should have a higher value than X1) and $Q = 100$.

In our study, X2 was considered for males, and X1 was considered for the female literacy rate.

In the case of perfect equality (i.e., no disparity) the value of D will be 0. With the rising value of D, the disparity rises. For example, a score of 0 means zero disparity, and as we go towards a higher value, the disparity keeps on increasing. Sopher's disparity index is useful for measuring the relative disparity. Descriptive statistical techniques and simple cartographic presentations were used to analyse the data. ArcGIS and MS-EXCEL were used for mapping and calculations, respectively.

Result and discussion

Trends in literacy rate. Census data reveal significant differences in the country's literacy rates between states and districts. India's population increased from 56.69 billion in 1971 to 121 billion in 2011. Additionally, the literacy rate has increased from 18.33 per cent in 1951 to 74.04 per cent in 2011. According to Fig. 2a, there was a difference in the literacy rate between 1991 and 2001, which was over 13 per cent more than it had been during the previous five decades. Since independence, Uttar Pradesh's literacy rate has increased significantly, rising from 12.02 per cent in 1951 to 69.72 per cent in 2011 but never exceeding the national average. Males improved by around 60 percentage points (from 19.17 per cent to 79.24 per cent) during this shift, whereas females only changed by 55 percentage points (from 4.07 per cent to 59.26 per cent) during the same period. The gender gap in literacy in Uttar Pradesh has significantly decreased according to the last two censuses. From 1991 to 2001 and 2011, the gender gap decreased from 30.45 percentage points to 26.6 percentage points. Although the gender gap in literacy has decreased in Uttar Pradesh, it is still more than the 2011 national average of 16.68. According to the census 2011, the gender gap is steadily decreasing, as a result of rising parallels between the rates of development of educational infrastructure and facilities, social awareness, and socioeconomic status of people at the national and state levels.

Spatial pattern of gender disparity in literacy across districts of Uttar Pradesh. In Uttar Pradesh, the literacy rate varies greatly among the districts. In the state's districts, Gautam Buddha Nagar had the maximum literate population (80.12 per cent) according to the 2011 census. Kanpur Nagar (79.65 per cent), Auraiya (78.95 per cent), Etawah (78.41 per cent), Ghaziabad (78.07 per cent), Lucknow (77.29 per cent), Varanasi (77.05 per cent) and Jhansi (76.37 per cent) are other districts that closely match this statistic. Shravasti (46.74 per cent), Bahraich (49.36 per cent), Balrampur (49.51 per cent), Badaun (51.29 per cent), and Rampur (53.34 per cent) had the lowest literacy rates. Ten districts have literacy rates that are higher than 75 per cent but at the same time, while analysing the pattern of female literacy only one

Table 1 Gender disparity in literacy in districts of Uttar Pradesh.

S. NO	DISTRICT	SOPHER DISPARITY INDEX	S. NO	DISTRICT	SOPHER DISPARITY INDEX
1	Agra	0.42	39	Jalaun	0.48
2	Aligarh	0.45	40	Jaunpur	0.54
3	Allahabad	0.48	41	Jhansi	0.53
4	Ambedkar Nagar	0.42	42	Kannauj	0.39
5	Amethi	0.46	43	Kanpur Dehat	0.4
6	Amroha	0.17	44	Kanpur Nagar	0.23
7	Auraiya	0.41	45	Kasganj	0.42
8	Azamgarh	0.45	46	Kaushambi	0.45
9	Baghpat	0.5	47	Kheri	0.35
10	Bahraich	0.34	48	Kushinagar	0.5
11	Ballia	0.47	49	Lalitpur	0.46
12	Balrampur	0.38	50	Lucknow	0.27
13	Banda	0.48	51	Mahoba	0.44
14	Bara Banki	0.33	52	Mahrajganj	0.52
15	Bareilly	0.35	53	Mainpuri	0.44
16	Bhadohi	0.54	54	Mathura	0.54
17	Basti	0.44	55	Mau	0.43
18	Bijnor	0.34	56	Meerut	0.37
19	Budaun	0.37	57	Mirzapur	0.45
20	Bulandshahr	0.53	58	Moradabad	0.3
21	Chandauli	0.47	59	Muzaffarnagar	0.41
22	Chitrakoot	0.45	60	Pilibhit	0.4
23	Deoria	0.53	61	Pratapgarh	0.51
24	Etah	0.48	62	Rae Bareli	0.43
25	Etawah	0.43	63	Rampur	0.3
26	Faizabad	0.39	64	Saharanpur	0.35
27	Farrukhabad	0.37	65	Sant Kabir Nagar	0.48
28	Fatehpur	0.41	66	Sambhal	0.36
29	Firozabad	0.42	67	Shamli	0.41
30	Gautam Buddha Nagar	0.48	68	Shrawasti	0.4
31	Ghaziabad	0.4	69	Shahjahanpur	0.34
32	Ghazipur	0.5	70	Siddharthnagar	0.43
33	Gonda	0.41	71	Sitapur	0.36
34	Gorakhpur	0.49	72	Sonbhadra	0.44
35	Hamirpur	0.49	73	Sultanpur	0.46
36	Hapur	0.25	74	Unnao	0.36
37	Hardoi	0.41	75	Varanasi	0.41
38	Hathras	0.51			

UTTAR PRADESH: 0.41 (SDI) For literacy rate, the population aged 7 and above is only considered in India.
Source: Census 2011; Author's Calculation.

district which is Kanpur Nagar (75.05 per cent) has a literacy rate above 75 per cent and is followed by Lucknow (71.54 per cent) and Gautam Buddha Nagar (70.82 per cent). The same districts that account for the lowest literacy rate overall account for the lowest female literate population i.e., Shrawasti (34.78 per cent), Balrampur (38.43 per cent), Bahraich (39.18 per cent), Badaun (40.09 per cent) and Rampur (44.41 per cent). According to census data, Uttar Pradesh's overall literacy rate has dramatically increased since its independence, leading to a gradually declining gender literacy gap. The gender gap in literacy is anticipated to narrow in the future due to the rising literacy rate. Consequently, this gives females a better opportunity to shine in the spotlight of literacy.

Using Sopher's Disparity Index the author identified the spatial patterns of gender disparity in literacy in Uttar Pradesh in 2011 as shown in Table 1. Districts were regarded as the best analytical units. There are 75 districts in Uttar Pradesh. Based on the male-female literacy patterns, five categories of disparity were established according to the sopher-disparity index methodology as shown with the help of choropleth map in Fig. 3:

a. *Very Low Disparity*: 0.16 to 0.27
b. *Low Disparity*: 0.27 to 0.37
c. *Moderate Disparity*: 0.37 to 0.43
d. *High Disparity*: 0.43 to 0.48
e. *Very High Disparity*: 0.48 to 0.54

Uttar Pradesh has a gender disparity score of 0.41 and lies in the category of moderate gender disparity in literacy, with a literacy rate of 67.68 per cent, among which 77.28 per cent are males and only 57.18 per cent are females. The district with the least gender gap is Amroha, and the district with the most gender disparity is Jaunpur. Table 2 shows the categorisation of districts according to the Sopher index.

a. Very Low Disparity (0.16 to 0.27)—The districts with very low gender disparity include districts of Amroha, Kanpur Nagar, Hapur, and Lucknow. Only four out of the 75 districts in the most populous state of India show a low disparity in literacy, which explains the alarming situation. Amroha had the lowest gender gap with a 0.17 SDI score and a 62.36 per cent literacy rate, with males having 66.73 per cent and females with 57.61 per cent. Although the gender gap is minimal in Amroha, the low literacy rate is worrisome. Hapur, in this category with an SDI value of 0.25 and a literacy rate of 85.05 per cent with males (88.69

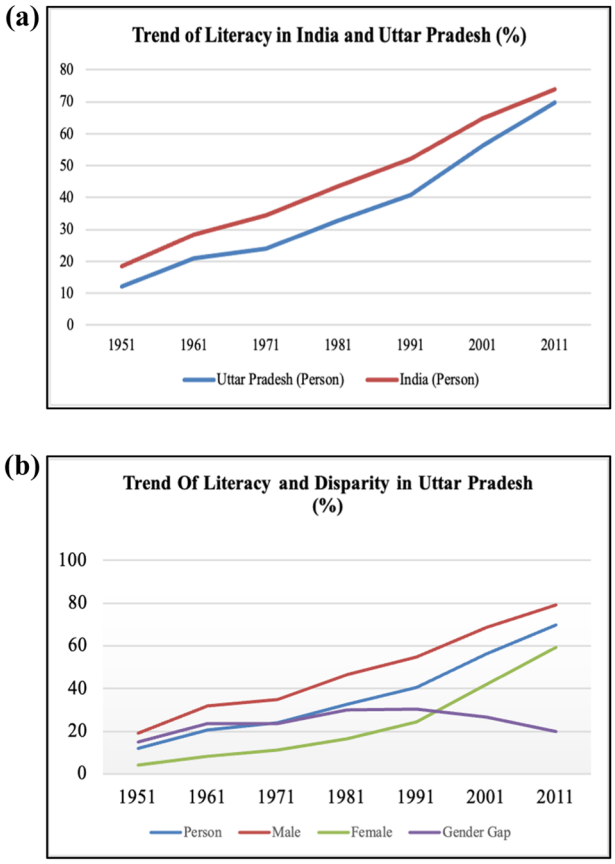

Fig. 2 Trend of literacy rate. a shows the trend of literacy rate in India and Uttar Pradesh from 1951 to 2011. It shows that the literacy rate for India has improved from 18.33% in 1951 to 74.04% in 2011, whereas for U.P, it increased from 12.02% in 1951 to 69.72% in 2011. **b** shows the gender disparity trend in literacy from 1951 to 2011, where the gender gap in literacy was found to be 15.1% in 1951 and peaked at 30.45% in 1991. However, the gap narrowed to 19.98% in 2011.

per cent), and females (81.42 per cent) is the best performer when looking through the overall perspective of literacy. Kanpur Nagar has an SDI of 0.23. Lucknow, the capital city of Uttar Pradesh, has an SDI score of 0.27, with a 77.29 per cent literate population, of which 82.56 per cent are male and 71.54 per cent are female. The district's higher levels of urbanisation and a greater number of educational institutions may have contributed to the modest improvement in the education system.

b. Low Disparity (0.27 to 0.37)—The low disparity districts include Rampur (0.30), Moradabad (0.30), Barabanki (0.33), Bahraich (0.34), Bijnor (0.34), Bareilly (0.35), Saharanpur (0.35), Kheri (0.35), Sambhal (0.36), Unnao (0.36), Sitapur (0.36), Budaun (0.37), Farrukhabad (0.37) and Meerut (0.37). Among these low-disparity regions, Meerut and Saharanpur had the highest total and female literacy rates of 72.84 per cent and 70.49 per cent, respectively. There were 15 districts in this category. Most of these districts are situated close to areas with high female literacy rates. This demonstrates how the desire and need for education spread from highly literate places to lower social strata.

c. Moderate Disparity (0.37 to 0.43)—There are 22 districts with moderate literacy disparities. The districts having moderate gender disparity in literacy include Balrampur (0.38), Kannauj (0.39), Faizabad (0.39), Kanpur Dehat (0.40), Shrawasti (0.40), Pilibhit (0.40), Ghaziabad (0.40); Gonda, Hardoi, Muzaffarnagar, Shamli, Varanasi, Auraiya, Fatehpur all with SDI of 0.41; Firozabad, Kasganj, Agra and Ambedkar Nagar with a score of 0.42; Mau, Rae Bareli, Etawah and Siddharthnagar having SDI value of 0.43. Auriya, Etawah, Ghaziabad, Kanpur Dehat and Varanasi have the highest literacy rates with 78.95 per cent, 78.41 per cent, 78.07 per cent, 75.78 per cent and 75.60 per cent.

d. High Disparity (0.43 to 0.48)—20 districts fall in the high disparity category. Basti (0.44), Sonbhadra (0.44), Mahoba (0.44), Mainpuri (0.44), Azamgarh (0.45), Chitrakoot (0.45), Aligarh (0.45), Kaushambi (0.45), Mirzapur (0.45), Amethi (0.46), Sultanpur (0.46), Lalitpur (0.46), Chandauli (0.47), Ballia (0.47), Sant Kabir Nagar (0.48), Banda (0.48), Allahabad (0.48), Jalaun (0.48), Gautam Buddha Nagar (0.48), Etah (0.48) are the districts with the high disparity in literacy. Gautam Buddha Nagar has an exceptionally high literacy rate of 80.12 per cent but the male-female difference is huge with males at 88.06 per cent and females at 70.82 per cent. Kaushambi, Lalitpur, and Sonbhadra had the lowest literacy rates of 61.28 per cent, 63.52 per cent and 64.03 per cent respectively.

e. Very High Disparity (0.48 to 0.54)—The districts having very high gender disparity in literacy are 14 in number including Gorakhpur and Hamirpur with 0.49 SDI; Baghpat, Ghazipur and Kushinagar with 0.50 SDI; Pratapgarh at Hathras with a score of 0.51; Mahrajganj (0.52); Jhansi, Bulandshahr, and Deoria (0.53); Mathura, Bhadohi and Jaunpur with highest disparity score of 0.54. Economic sluggishness, in addition to other disadvantages such as a lack of educational infrastructure, physical impediments, and low awareness, the rural character, and the predominance of agricultural labourers have a significant influence on this aspect.

The author's observation is that the general trend is that the districts of Gorakhpur, Faizabad, Pratapgarh, Allahabad, Jaunpur, Chandauli, and Deoria form clusters of high female literacy rates in the Purvanchal region. In the western region of the state, which is made up of the districts of Saharanpur, Etah, Bijnor, Mahamaya Nagar, Baghpat and others, there is a consistent range of districts with high female literacy rates due to the spread of education from higher literate areas to those in the hierarchy of lower order. Average female literacy is observed in the pockets in the northern part of Uttar Pradesh, namely in the districts of Aligarh, Mathura, Muzzafarnagar, etc., in the northwestern region, and Sant Kabir Nagar and Basti in the eastern area. The areas with exceptionally low levels of female literacy are divided into two small pockets: one of the compact areas is found in the upper northern belt, where the districts of Moradabad, Rampur, Bareilly, Badaun, and Kanshiram Nagar share the Uttarakhand border, and another falls inside the same belt that borders Nepal and includes Gonda, Siddharthnagar, Balrampur, Bahraich, etc. Physiographic challenges might be one of the underlying reasons for low literacy in the border state discussed above.

Spatial distribution of elementary schools (class 1–8) In Uttar Pradesh. According to the 2011 Census, any person aged seven and above who can read and write is considered literate. Elementary schooling (class 1–8) is the foremost basic step for any person to attain literacy because it lays the groundwork for all subsequent learning. Most of the increase in literacy rates must come from increased access to elementary schooling. Elementary education enables children to read and write. According to a recent estimation by the UNESCO (2016), Institute of Statistics, the number of out-of-school children in India is as high as 6.5 million, which is much higher than the official figures. More schools must be constructed in specific places, and some that currently only offer

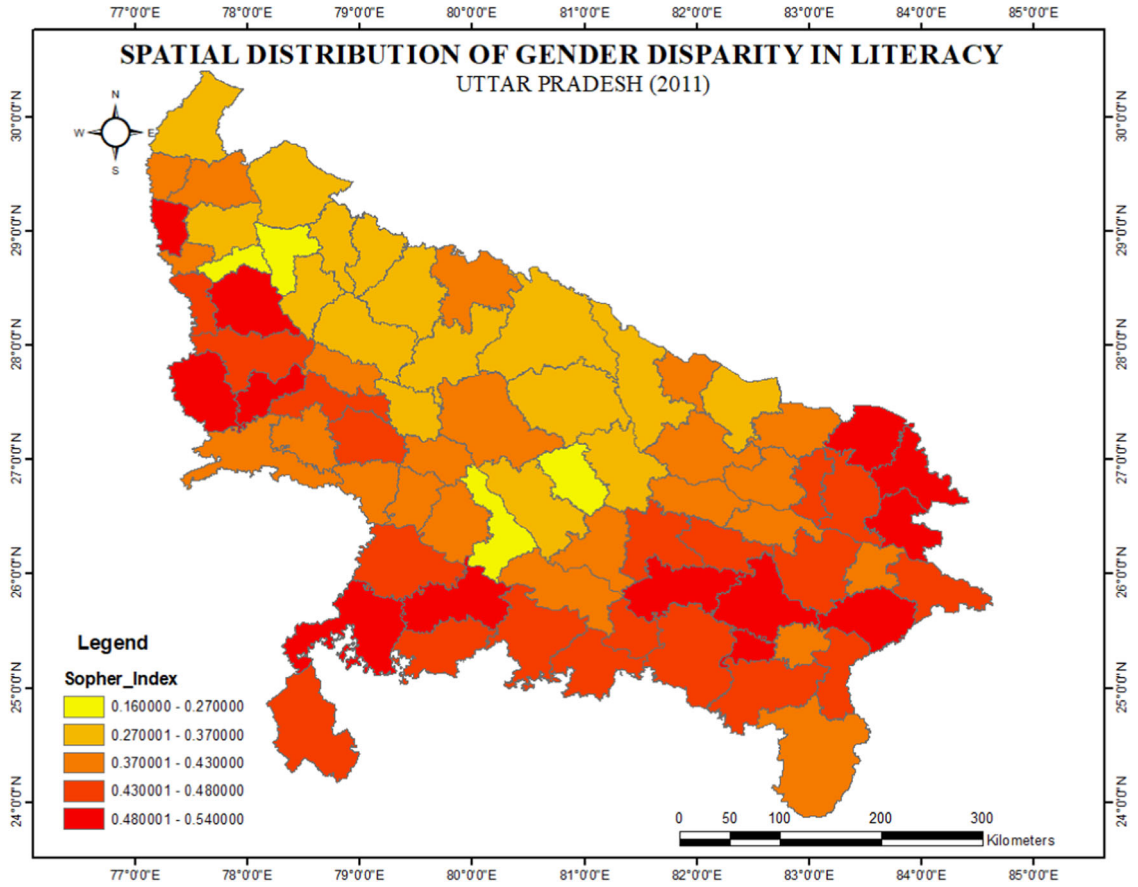

Fig. 3 Map showing spatial distribution of gender disparity in literacy across districts of Uttar Pradesh. The disparity is shown under 5 categories according to the Sopher disparity index, namely, very low disparity, low disparity, moderate disparity, high disparity and very high disparity, and the districts are categorised on the basis of SDI value.

Table 2 Categorisation of districts for gender disparity in literacy across districts of Uttar Pradesh according to Sopher Index.

CATEGORY	DISTRICTS
VERY LOW DISPARITY (0.16 to 0.27)	Amroha, Kanpur Nagar, Hapur, Lucknow
LOW DISPARITY (0.27 to 0.37)	Rampur, Moradabad, Barabanki, Bahraich, Shahjahanpur, Bijnor, Bareily, Saharanpur, Kheri, Sambhal, Unnao, Sitapur, Budaun, Farrukhabad, Meerut
MODERATE DISPARITY (0.37 to 0.43)	Balrampur, Kannauj, Faizabad, Kanpur Dehat, Shrawasti, Pilibhit, Ghaziabad, Gonda, Hardoi, Muzzafarnagar, Shamli, Varanasi, Auraiya, Fatehpur, Firozabad, Kasganj, Agra, Ambedkar nagar, Mau, Rae bareli, Etwah, Siddharthnagar
HIGH DISPARITY (0.43 to 0.48)	Basti, Sonbhadra, Mahoba, Mainpuri, Azamgarh, Chitrakoot, Aligarh, Kaushambi, Mirzapur, Amethi, Sultanpur, Lalitpur, Chandauli, Ballia, Sant Kabir nagar, Banda, Allahabad, Jalaun, Gautam buddha nagar, Etah,
VERY HIGH DISPARITY (0.48 to 0.54)	Gorakhpur, Hamirpur, Baghpat, Ghazipur, Kushinagar, Pratapgarh, Hathras, Mahrajganj, Jhansi, Bulandshahr, Deoria, Mathura, Bhadohi, Jaunpur

lower primary classes might need to be updated to offer a complete elementary education cycle. It would be necessary to conduct a more methodical school mapping effort to ensure access to upper primary school courses. Additionally, the location of infrastructure needs to take equity issues into account to help people overcome social and geographic hurdles. Therefore, the authors attempted to examine the spatial distribution of elementary schools across the districts of Uttar Pradesh to study the relationship between the total number of elementary schools across the districts of Uttar Pradesh and literacy variations across the districts (Table 3).

The authors showed the concentration of elementary schools across the districts of Uttar Pradesh using the dot method map as shown in Fig. 4.

Baghpat (1080), Gautam Buddha Nagar (1080), Mahoba (1232), Shrawasti (1403) and Bhadohi (1411) are the districts with the least concentration of elementary schools (class 1–8) in Uttar Pradesh. Azamgarh (4583), Bijnor (4710), Sitapur (4857), Hardoi (4869) and Jaunpur (5220) have the highest concentration in elementary schools (class 1–8) in Uttar Pradesh.

At present, according to the district elementary education report card for 2011–12, the enrolment of classes 1–8 is 35047979, of which 17023141 are girls accounting for 48.57 per cent of the total enrolment. Establishing the correlation between enrolment of girl children (x) and total elementary schools in 2011 (y) in 75 districts of Uttar Pradesh shows a strong positive correlation ($r = 0.89$).

Table 3 Distribution of Elementary Schools (class 1-8) and Girl Child Enrolment (class 1-8) in the district of Uttar Pradesh.

DISTRICT	TOTAL SCHOOL (1-8)	GIRL CHILD ENROLMENT (1-8)	DISTRICT	TOTAL SCHOOL (1-8)	GIRL CHILD ENROLMENT (1-8)
Agra	3963	340371	Jalaun	2361	145470
Aligarh	3669	270649	Jaunpur	5220	499395
Allahabad	4580	479551	Jhansi	2093	176779
Ambedkar Nagar	2919	268057	Kannauj	1933	169853
Amethi	N / A	N/A	Kanpur Dehat	2555	120066
Amroha	2588	218360	Kanpur Nagar	4328	344224
Auraiya	2219	126820	Kasganj	1813	121726
Azamgarh	4583	459357	Kaushambi	1730	132442
Baghpat	1080	86195	Kheri	3937	394144
Bahraich	3549	271133	Kushinagar	3214	330229
Ballia	3057	264423	Lalitpur	1661	128450
Balrampur	2092	181437	Lucknow	3622	447369
Banda	2230	172560	Mahoba	1232	86098
Bara Banki	3214	259418	Mahrajganj	2909	240206
Bareilly	3709	331491	Mainpuri	2990	171592
Basti	2663	15971	Mathura	2281	205697
Bhadohi	1411	154890	Mau	2458	183174
Bijnor	4710	419050	Meerut	2593	235344
Budaun	3529	285166	Mirzapur	2717	235567
Bulandshahr	3338	243761	Moradabad	4205	446505
Chandauli	1772	188975	Muzaffarnagar	3794	312846
Chitrakoot	1550	106259	Pilibhit	2273	175720
Deoria	3161	274641	Pratapgarh	3771	315226
Etah	2410	173781	Rae Bareli	2352	164872
Etawah	2721	153148	Rampur	2474	241164
Faizabad	2928	228625	Saharanpur	3637	265671
Farrukhabad	2173	156195	Sant Kabir Nagar	1800	152641
Fatehpur	3406	224483	Sambhal	N / A	N/A
Firozabad	2550	190324	Shahjahanpur	3859	279966
Gautam Buddha Nagar	1080	93086	Shrawasti	1403	91008
Ghaziabad	2138	247284	Shamli	N/A	N/A
Ghazipur	4513	368985	Siddharthnagar	2561	232609
Gonda	3271	289771	Sitapur	4857	503175
Gorakhpur	3684	311870	Sonbhadra	2199	175064
Hamirpur	1648	105332	Sultanpur	2644	223096
Hapur	N / A	N/A	Unnao	3816	241650
Hardoi	4869	418682	Varanasi	1904	248503
Hathras	2170	205499			

Source: District Report Card, Elementary Education in India, 2011-12.

Although education investments have been relatively successful in increasing enrolment, greater enrolment demands increased resources to maintain quality at any given level of efficiency (Verspoor, 2008). Improving the quantity dimensions of education is meaningless if quality dimensions are ignored. In studies carried out in developed countries, it is determined that the quality of learning is found in what they refer to as "effective schools," which are distinguished by: strong instructional leadership, a clear and focused mission, safe and orderly schools, an environment of high expectations for success, frequent monitoring of students' progress, favourable home-school relations, and opportunities to learn (Edmonds, 1981; Kirk and Jones, 2004; Daggett, 2005; Lezotte, 2010). The following seven correlates of effective schools are potent markers of effective settings in which all students can learn, regardless of socioeconomic position or ethnicity (Lezotte, 2010). The relationship between educational level and poverty appears to be intertwined. International studies by UNESCO (2006) and the World Bank (2009) discovered an immediate correlation between low literacy levels and poverty. The World Bank (2009) states that poor regions continue to lack access to income, basic commodities and services. According to UNESCO (2011), sub-Saharan Africa, South Asia, and West Asia are the poorer parts of the world with the lowest literacy rates. Historically, in India, girls have had almost no access to school for more than 300 years. Only a small number of upper-caste and upper-class girls had received home schooling. At that time, literacy among girls was considered dishonour. The idea of allowing girls to attend school never crossed parents' minds. A superstitious belief that a girl trained to read and write would quickly become a widow after marriage was believed to be prevalent in the majority of Hindu families. Slowly and steadily, due to government interventions and awareness in society, education accessibility to girls has evolved tremendously, from treating educated women as dishonour to nearly universal girl child enrolment in elementary schools. The primary enrolment rates in India are currently very close to universal, which is a significant silver lining in the otherwise dark cloud of education. The Right to Education (RTE) Act of 2009 in India states that every child between the ages of 6 and 14 has a fundamental right to education and that no child may be held back, expelled, or

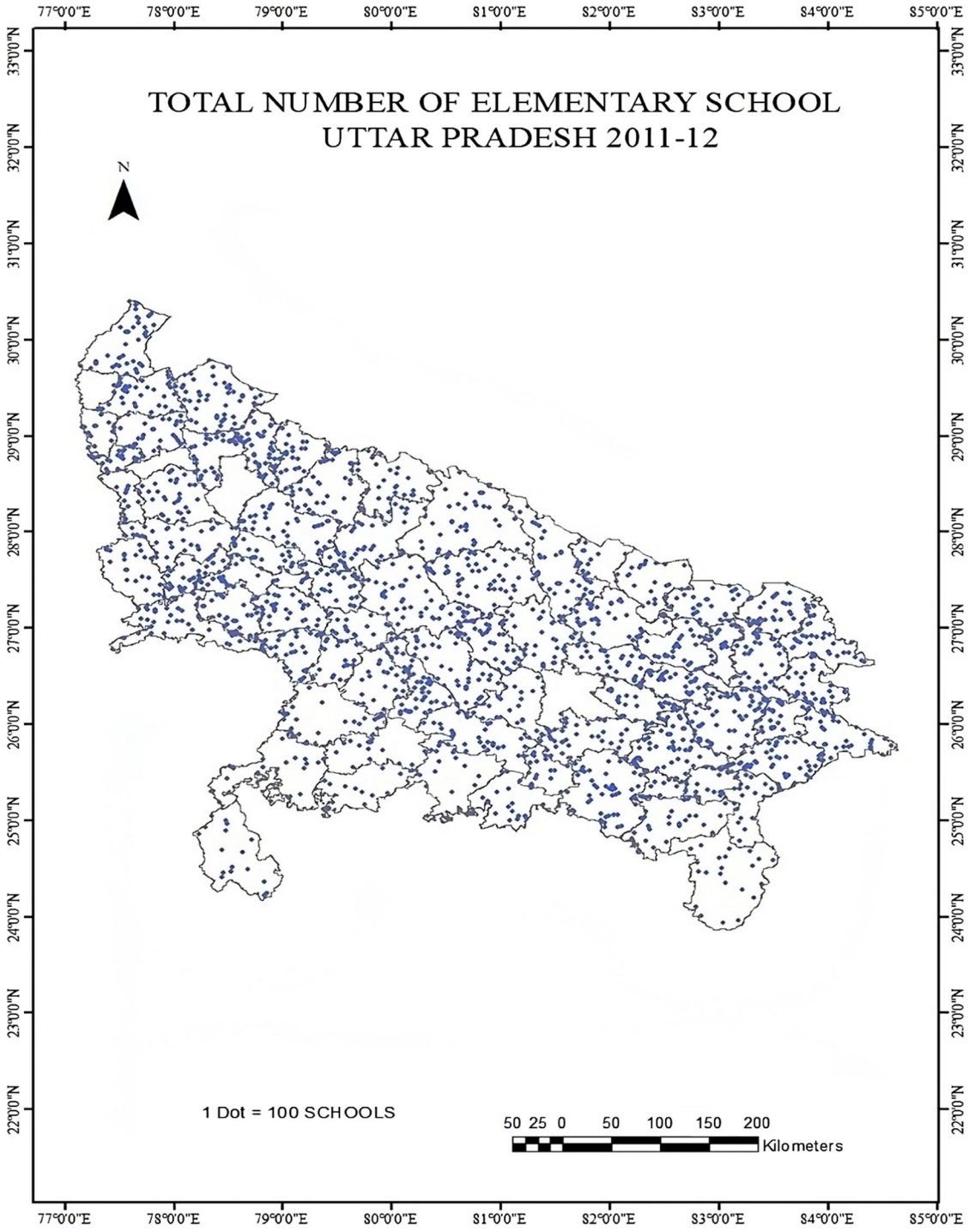

Fig. 4 District-wise distribution of elementary schools in Uttar Pradesh (2011–2012). Map shows the distribution pattern of schools with help of dots where 1 dot represents 100 schools.

forced to take a board test before completing their elementary education. This has helped explain why elementary school enrolment rates are currently over 98 per cent. Although after touching a 100 per cent gross enrolment ratio, concerns have been raised about the quality of learning in primary schools. Very few students could actually read and perform simple math. According to the Annual Status of Education Report 2012, only 47 per cent of pupils in grade 5 were proficient readers of texts at grade 2 level. However, around 25 per cent were capable of handling division problems, which is a grade 4-level ability. In addition, demonstrating how this learning gap in the early years of education tends to widen over time is the fact that 76 per cent of Grade 8 pupils read at Grade 2 levels. Very low levels of learning achievement in both primary and secondary schooling point to an inadequate quality of education. Kingdon (2007) examined the schools' accessibility in terms of enrolment and attendance rates. Measures of quality education include literacy rates, the availability of resources, levels of student achievement, and teacher involvement. Additionally, schools' supplies and facilities are inadequate, and teacher absenteeism is extremely significant.

According to the various studies reviewed, factors such as the very high prevalence of out-of-school (OoS) children, high

dropout rate and low school retention rate due to various social factors like deprivation of girl child education due to the patriarchal nature of society (Gitonga, 2009), negative parental attitude towards educating daughters (Hickey and Startton, 2007), preconceived notions about division of work at home where girls are expected to fetch the water, look after their younger siblings, assist their mothers with cooking and cleaning (Sivakumar, 2012), child marriage, cultural beliefs, poverty (Alabi and Alabi, 2014) or infrastructural factors like feminine facilities in schools, distance from home, availability of transport, availability of mid-day meals, female teachers in schools (Latha, 2014; Shahidul and Karim, 2015), the accessibility of girls to schools is adversely affected. The Prime Institute of Health Sciences has found a positive correlation between household income and school attendance. Many parents, especially in large families with financial restrictions, enrol boys in schools instead of girls. The paucity of the required number of teachers and quality issues in teaching is also responsible for the actual representation of enrolment in the state.

Therefore, the intervention of the government and various stakeholders in society is necessary to provide support and remedies so that when the aforementioned factors are tackled, only the actual benefit of setting up elementary schools would be favourable for the remarkable improvement of the female literacy rate in Uttar Pradesh, both quantitatively and qualitatively.

Conclusion

This study sheds light on the Uttar Pradesh literacy rate trends as well as the degree of gender literacy discrepancy and the spatial distribution of elementary schools across the districts of Uttar Pradesh, establishing a correlation between the enrolment of girls and total elementary schools. According to the study, there is a significant range of differences in male-female literacy among the districts of Uttar Pradesh. Looking at the literacy gap between India and Uttar Pradesh, the disparity continued to increase from 1951 to 1991 and reached 11.5 per cent. After 1991, the decline was seen to 8.56 per cent in 2001 and then further to 4.32 per cent in 2011. Thus, from the data, it is found that as of 2011, Uttar Pradesh was only slightly below the national average. While talking about the temporal variation of gender disparity in the state of Uttar Pradesh, the same trend is seen in finding the gap between national and state literacy rates. The gender disparity in Uttar Pradesh increased continuously until 1991 and rose to 30.42 per cent after which it declined to 26.6 per cent in 2001 and 19.98 per cent in 2011, which is still more than the national average of 16.68 per cent in 2011. While discussing about the spatial pattern of the gender gap in literacy across the 75 districts of Uttar Pradesh in 2011, it is found that the U.P, as a whole, lies in the category of medium disparity, but district-wise variations are huge. The districts with the least gender gap were Amroha, Lucknow, Kanpur Nagar, and Hapur with the least variation between the male and female literacy rates. Those with the maximum disparity are Deoria, Mathura, Bhadohi, and Jaunpur. The state of Uttar Pradesh shows a trend towards a significant increase in higher female literacy rates. While analysing the distribution pattern of elementary schools across the districts of Uttar Pradesh, Baghpat, Gautam Buddha Nagar, Mahoba, and Bhadohi are the districts with the least number of elementary schools. The same districts lie in the category of high to very high gender disparity in literacy levels, except for Baghpat, which lies in the category of moderate disparity. The districts with the maximum number of elementary schools are Jaunpur, Hardoi, Sitapur, and Bijnor with the exception of Jaunpur, which lies in the category of low-to-moderate disparity. By taking into consideration enrolment in primary schools from a state-specific view from 2011–12 to 2016–17, a decline in primary enrolment is revealed, out of which more than 27 per cent decline in enrolment is contributed alone by Bihar, followed by Uttar Pradesh (25.79 per cent). In other words, it is observed that about 53 per cent of the total decline in primary enrolment is contributed solely by Bihar and Uttar Pradesh (UDISE 2016–17). This has an impact on whether enrolment at the secondary level of school increases in the years that follow. A high positive association ($r = 0.89$) was found between the number of elementary school enrolments (x) and the enrolment of female students (y) in 2011 (y) in 75 districts of Uttar Pradesh. This shows that the number of schools positively affects girls' enrolment in Uttar Pradesh, and at present, the state is close to attaining universal GER in elementary education. However, there are many lacunae while observing a real picture. The quality of education and the pseudo enrolment of girl children, where the girl is enroled in school just for name's sake, but is attaining negligible education because of the patriarchal division of work, helping the mother with domestic as well as outside work, taking care of younger children, etc. The correlation between enrolment of girl children and total elementary schools shows that the state's actual level of literacy can be attributed to many factors, including a negative parental attitude towards educating daughters, insufficient school infrastructure, accessibility to schools, unfavourable daily attendance rates, a lack of the necessary number of teachers, and problems with teaching quality. The current state of education also faces major challenges, such as a lack of adequate infrastructure, low government expenditure on education (less than 3.5 per cent of GDP), and a pupil-teacher ratio of 24:1 at the national level for elementary schools, according to the Unified District Information System for Education UDISE (2017). Other factors include a very high prevalence of out-of-school (OoS) children, high dropout rates, and low school retention rates. Various studies show that there is a favourable correlation between lesser female literacy and social variables such as patriarchy, accessibility issues, and low mobility. Economically, the region's poverty and poor engagement of women in economically productive activities are to blame for the greater gap between the literacy rates of men and women.

To tackle these issues, a few recommendations should be taken into consideration such as providing a supportive learning environment, strengthening the education-nutrition nexus, essential preschool requirements for children, quality trained teachers, efficient teacher training, rationalising teacher recruitment and placement, supporting girl child-friendly schools, encouraging creative pedagogies, scaled-up monitoring of learning outcomes, bi/multilingual education based on the mother tongue until class V, and encouraging community participation.

Therefore, the government must complete short-term and long-term strategies to reverse the system and utilise the energy of the youthful population to attain the correct gender-wise educational performance. This pattern supports the idea that, while government support, expansion of educational resources, and raising awareness in rural areas have a good impact, they must be well implemented to ensure that progress can continue in the future as well. Additionally, the quantitative study emphasises the necessity of taking more proactive measures to reduce gender disparities in Uttar Pradesh.

Contribution

This study outlines the gender disparity in literacy across Uttar Pradesh and provides insight into the status of elementary education in the state. Such an outline of the paper will help us look forward to the future perspective of the education system. The study can be replicated at national and state levels, even by taking into account various differentials such as regional, residential, and

social groups. This will lay a roadmap for academicians and policymakers for the analysis of future perspectives on education concerning gender differentials. The dot map representation of elementary schools in the study can also lay the foundation for the creation of geodata-based management of elementary schools with the help of remote sensing tools, in which details of schools in terms of establishment year, location, enrolment level, number of teachers, pupil-teacher ratio (PTR) and dropout rate of the state can be made available through a single click.

Limitations

The last census in India was conducted in 2011–12. Therefore, the issue of finding recent district-wise data for the study was a challenge that is why the data for establishing the correlation between total elementary schools and girl child enrolment was taken for the year 2011–12 to maintain comparability while analysing the gender disparity in literacy district wise in the state of Uttar Pradesh. However, the author, through various pieces of literature has tried to give an idea of the present situation as well. Second, since Uttar Pradesh is the largest state with 75 districts, a discussion of all three educational stages would be quite lengthy. Therefore, only elementary schools are taken into consideration in this paper. Consequently, a different study can address the other two stages of education i.e secondary and higher, providing an overview of Uttar Pradesh's education level.

Data availability

All data generated or analysed during this study are included in this published article [and its supplementary information files]. The datasets analysed during the current study are available in the Census of India repository and District Report Card 2011–12 elementary education in India published by the National Institute of Educational Planning. (1) https://censusindia.gov.in/census.website/data/census-tables (2) http://udise.in/Downloads/Publications/Publications%20201112/DistrictReportCards2011-12II.pdf.

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Author contributions

Sakshi: (First author/corresponding author) conceptualisation, formal analysis, methodology, and writing—original draft. SB: (Second author/contributing author) validation, methodology, supervision, writing—review & editing. All authors substantially contributed to the article and approved the submitted version.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Additional information

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