KBK regions, as most research examines these areas in isolation. This limitation prevents a comprehensive understanding of the unique strengths and challenges inherent to each region. Furthermore, while digital transformation is increasingly shaping education, the role and adoption of ICT tools in enhancing teaching-learning practices remain underexplored, especially in under-resourced areas like KBK. Additionally, existing research has not sufficiently addressed the interplay between teacher quality, employment types, and socio-economic representation, which significantly impact educational outcomes. Infrastructure, a critical determinant of academic performance, is another underexamined area, with limited evidence linking specific facilities such as electricity access and digital tools to measurable improvements in student engagement and performance. By addressing these gaps, this study seeks to contribute to the growing discourse on educational equity in Odisha.

The objective of the present study is to make a comparison between KBK and non-KBK district as well as public school and private schools; rural school and urban school on the basis of various educational parameters like teachers' quality, student enrolment and academic achievements, the infrastructure facilities, computer facilities, utilization of computer applications, and the use of various online communication and collaboration tools in schools teaching-learning practices. This study concentrates on the intricacies of elementary school education at the micro-level, offering a detailed examination of individual schools. By gathering firsthand information directly from school personnel, the study ensures a nuanced understanding of on-ground realities. Each school was thoroughly assessed, with pertinent details meticulously recorded on a per-school basis, enabling a robust comparative analysis that addresses the critical gaps identified in existing literature.

The structure of the paper is outlined as follows: Section 2 includes the data and methodology which includes sampling preparation and protocol for data collection. Section 3 discusses the main findings. Section 4 covers the conclusion and policy implications.

2. DATA AND METHODOLOGY

2.1. Sampling preparation, and protocol for data collection

The research was carried out in 88 schools spread across 32 villages within 4 blocks of Angul district and 40 villages within 2 blocks of Kalahandi district in Odisha. Face-to-face methods were employed for data collection during the survey period from January 2022 to March 2022, utilizing a questionnaire written in English. In Kalahandi, out of the 51 schools surveyed, 43 were government-operated, 4 were government-aided, and 4 were privately owned. Conversely, in Angul, the selection consisted of 26 government schools, 7 government-aided schools, and 4 private schools out of a total of 37 schools. Moreover, in Kalahandi, 43 schools were chosen from rural areas and 8 from urban areas, while in Angul, 24 schools were selected from rural regions and 13 from urban locations. A survey consisting of 28 questions has been developed for each school. These questions cover various aspects such as basic school characteristics, student-teacher information, school infrastructure facilities, and information on ICT usage. Rigorous attention was paid to adherence to the allotted time frame, proper documentation, and quality control to ensure the reliability and consistency of the collected data.

2.2. Method of data collection

Prior to initiating data collection at the school level, permissions were secured from the respective District Education Officer and Block Education Officer of each district/block. This study enlisted the assistance of a select group of schoolteachers who played a vital role in facilitating the data collection process in Kalahandi and Angul districts. These teachers served as valuable intermediaries, introducing us to the respective headmasters of the targeted schools. Their involvement was instrumental in establishing a rapport and earning the necessary cooperation from the school authorities. The collaborating teachers effectively conveyed the purpose and significance of the survey, articulating its objectives and the positive impact it could have on understanding the educational landscape. This collaborative approach not only streamlined the process of obtaining permissions but also fostered a sense of trust and transparency between us and the school communities. Through their introductions and explanations, this study was able to navigate the data collection process with a greater degree of understanding and support from the local educational stakeholders. The survey data includes information of school basics, student and teacher information, infrastructure facilities, ICT provisions in teaching-learning from the academic years 2016-17 to 2020-21.

3. FINDINGS

3.1. District profile and school basic information

Kalahandi District

Kalahandi is a district located in the southwestern part of Odisha, India. There are 1,576,869 people living in the Kalahandi district as per the 2011 Census. There are 787,101 men and 789,768 women among them. Kalahandi has a sex ratio of about 1003 females per 1000 men, which is higher than the Odisha state average. In the Kalahandi district, the total literacy rate is 59.22. Of those who are literate, 71.9 are men and 46.68 are women. There are 1639 primary schools, 792 upper primary schools and 413 secondary schools in the district (UDISE+ 2017-18) and 51 of them surveyed (elementary level school). Of these 51 schools, 8 schools are located in urban areas, 43 are in rural regions. There are 43 government schools, four are government aided and four private schools (see Table 1). Since Kalahandi's general level of development is far lower than that of other Odisha districts, the district is coming under KBK district (District statistical handbook Kalahandi, 2018).

Table 1: Location and management wise number of schools

	Government	Government aided	Private	Total
Rural	37	4	2	43
Urban	6	0	2	8
Total	43	4	4	51

Source: *Angul district*

Angul district is situated in the eastern part of India, within the state of Odisha. It is a non-KBK district. It serves as a major industrial hub in the state, hosting industries related to coal, bauxite, and steel. Angul district had a population of 1,273,821. The sex ratio stands at 942 females per 1,000 males. The average literacy rate is 75.70, with male literacy at 84.75 and female literacy at 68.64. There are 1004 primary schools, 668 upper primary schools, 272 secondary schools (U-DISE+, 2017-18). The pupil teacher ratio is 20:1 for primary, 24:1 upper primary and 18:1 secondary school. In the survey, the distribution of schools is based on governance (Government, Govt-aided, Private) and locations (Rural, Urban). In the Angul district surveyed 24 schools were surveyed in rural areas, out of these schools, 18 are government, five are government-aided, and one is private schools. Urban areas have a total of 13 schools, with eight government, two government-aided, and three private schools. Combining rural and urban there are a total of 37 schools, comprising 26 government, seven government-aided, and four private schools (see Table 2).

Table 2: Location and management wise number of schools

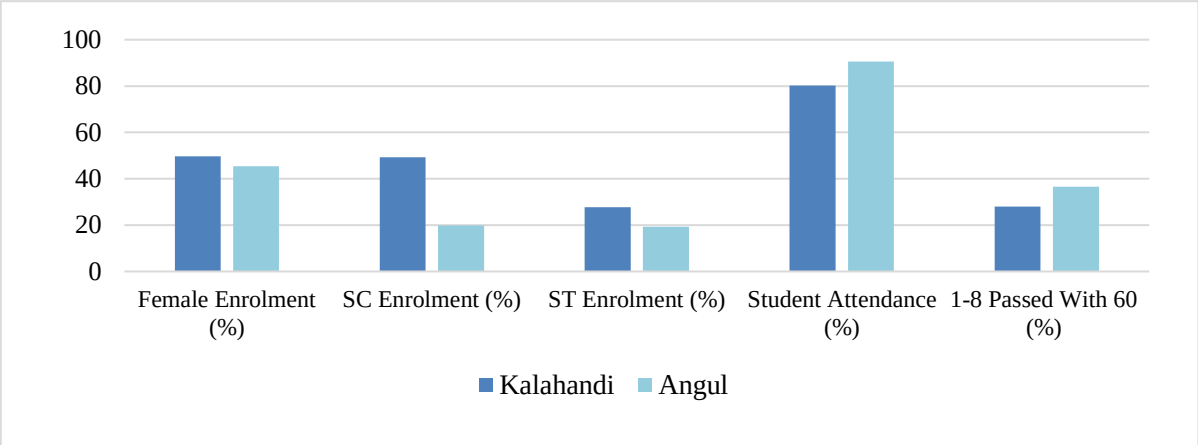
Location	Government	Government aided	Private	Total
Rural	18	5	1	24
Urban	8	2	3	13
Total	26	7	4	37

Source: Primary data

3.2. Student enrolment, attendance, and their academic performance

In terms of enrolment, Angul (Non KBK) district surpasses Kalahandi (KBK). The average total enrolment in Kalahandi stands at 168.87, with a nearly equal distribution between male and female student enrolment. Whereas the Angul district has a slightly higher average total enrolment of 171.54. However, female enrolment is slightly low as compared to Kalahandi.

Figure 1: Enrolment, attendance and academic achievement of Kalahandi and Angul district



Source: Primary data

Kalahandi showcases higher enrolment of Scheduled Caste (SC) and Scheduled Tribe (ST) students as the ST and SC population is marginally higher as compared to Angul. The dropout rates are remarkably low in both districts, but Angul has performed well in this aspect. Angul has shown an impressive 90.55 percent attendance, while Kalahandi stands at 80.22 percent. In terms of academic performance, Angul takes the lead again, with 36.59 percent of students passing with a commendable 60 percent or more (Figure1). In summary, Angul excels in attendance and academic outcomes, while Kalahandi prioritizes inclusivity by enrolling more SC and ST students. Both districts contribute uniquely to Odisha's educational landscape.

Furthermore, the survey investigates the significance of the variations in student academic performance across public and private schools, rural and urban schools, and Kalahandi and Angul districts in Odisha (Table 3). Using the independent sample t-test and Kruskal-Wallis (KW) test, the study discovered that the district Kalahandi and Angul average student academic performance value differs significantly. In case of location wise comparison, the null hypothesis was accepted in both districts, indicating that there is not a significant disparity in academic achievement between rural and urban locations schools. In Kalahandi, the null hypothesis was accepted, but in Angul, it was rejected, suggesting that there was a substantial academic gap between the public and private schools in Angul. It shows that the status of student academic performance varies between KBK and Non-KBK districts in Odisha at elementary levels of education.

Table 3: Testing the significant difference of student academic performance between Kalahandi (KBK) and Angul (non-KBK) district

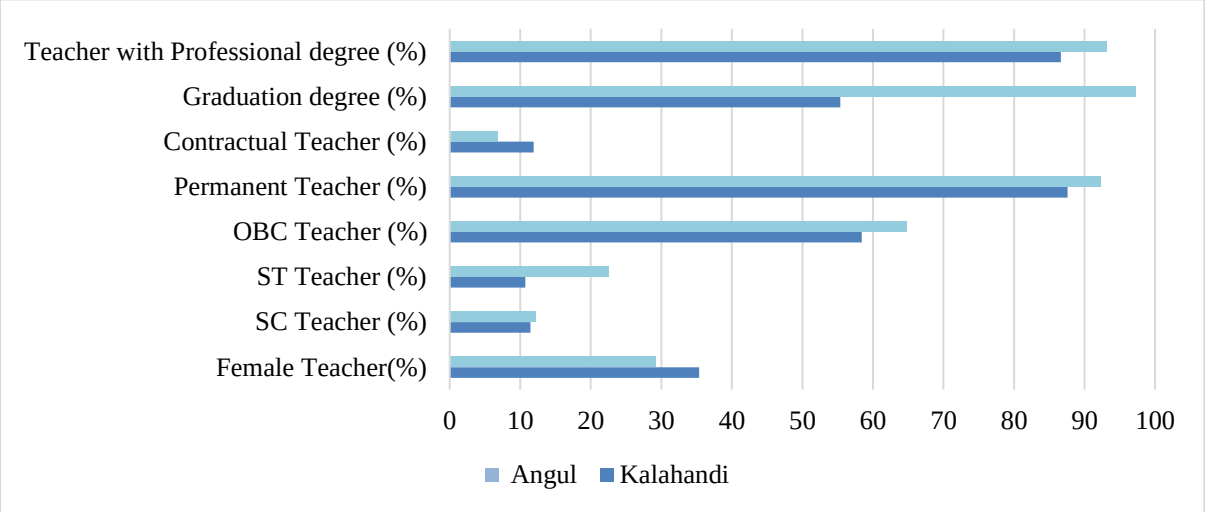
Null hypothesis(H_0)	t-statistics	p-value	Decision	KW-H statistics	p-value	Decision
Kalahandi						
Public vs. Private	0.96	0.929	Accept H_0	105.989	0.889	Accept H_0
Rural vs. Urban	0.251	0.808	Accept H_0	1.884	0.170	Accept H_0
Angul						
Public vs. private	-4.214	0.018**	Reject H_0	7.773	0.005**	Reject H_0
Rural vs. Urban	-1.365	0.190	Accept H_0	1.701	0.192	Accept H_0
KBK vs Non-KBK (Kalahandi vs Angul)						
Kalahandi vs Angul	-2.598	0.011**	Reject H_0	7.023	0.008***	Reject H_0
Notes: (***), (**), (*) represents results are significant at 1 percent, 5 percent,10 percent level of significance						

Source: Authors' calculations from primary data

3.3. Teachers' quality, employment type, and social representation

The survey found that a larger percentage of teachers in Angul (97.23 percent) have graduation degrees or higher qualifications compared to Kalahandi (55.38 percent) (Figure 2). This trend also holds true for teachers with professional degrees: Angul has a significantly higher percentage (93.13 percent) of teachers with professional degrees compared to Kalahandi (86.66 percent). The percentage of female teachers is lower in Angul (29.19 percent) compared to Kalahandi (35.38 percent). Higher percentage of SC and ST teachers in Kalahandi can be seen compared to Angul (SC: Kalahandi 11.45 percent vs Angul 12.22 percent, ST: Kalahandi 10.72 percent vs Angul 22.52 percent). This might reflect the local population demographics or targeted recruitment initiatives in Kalahandi. The percentage of permanent teachers is lower in Kalahandi (87.61 percent) compared to Angul (92.28 percent). Conversely, Kalahandi has a higher percentage of contractual teachers (11.88 percent) compared to Angul (6.84 percent). This suggests a higher reliance on temporary staff in Kalahandi, which may impact factors like teacher stability and school performance.

Figure 2: Teachers' quality, employment type, and social representation of Kalahandi and Angul district



Source: Primary data

Additionally, the findings of a hypothesis test that was used to evaluate the significance of the teacher quality index difference between the districts of Kalahandi (KBK) and Angul (non-KBK), using multiple comparisons based on school administration and location parameters (Table 4). The comparison between public and private schools in Kalahandi district shows that there is no significant difference in teacher quality index. However, there is a significant difference in teacher quality index between rural and rural schools in Kalahandi. In Angul both public and private schools as well as rural and urban schools are accepting the null hypothesis, implying no significant variation in teacher quality index. While comparing the Kalahandi vs Angul both the independent sample t-test and Kruskal-Wallis (KW) test show significant difference in teacher quality index. Hence, there may not be significant differences in teacher quality index in case of private vs. public and rural vs. urban schools within individual districts. But there is significant variation between the districts.

Table 4: Testing the significant difference of teacher quality index between Kalahandi (KBK) and Angul (non-KBK) district.

Null hypothesis(H_0)	t-statistics	p-value	Decision	KW-H statistics	p-value	Decision
Kalahandi						
Public vs. Private	0.028	0.979	Accept H_0	0.000	1.000	Accept H_0
Rural vs. Urban	-2.437	0.037**	Reject H_0	5.378	0.020**	Reject H_0
Angul						
Public vs. private	-1.379	0.249	Accept H_0	2.932	0.087	Accept H_0
Rural vs. Urban	-1.388	0.174	Accept H_0	2.899	0.089	Accept H_0
KBK vs Non-KBK (Kalahandi vs Angul)						
Kalahandi vs Angul	-6.417	0.000***	Reject H_0	26.203	0.000***	Reject H_0
Notes: (***), (**), (*) represents results are significant at 1 percent, 5 percent,10 percent level of significance						

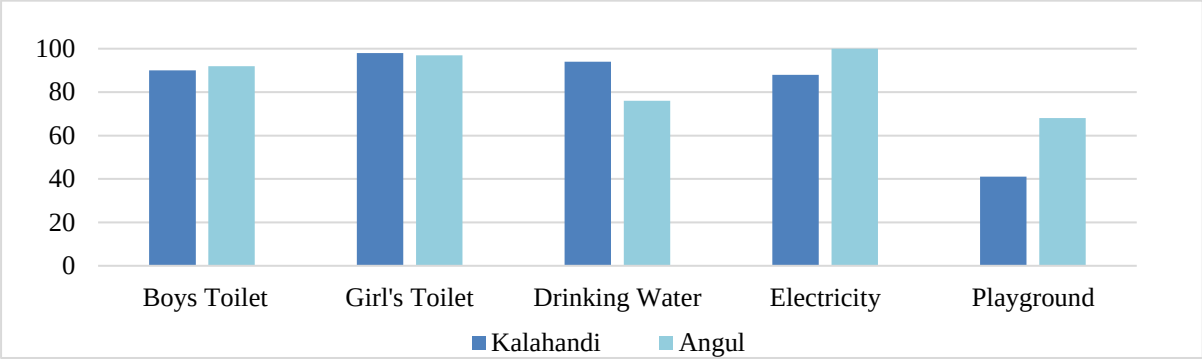
Source: Authors' calculations from primary data

3.4. Infrastructure facilities

Ancillary Facilities

The study found that both districts have a commendable number of girls toilets, with Kalahandi having a slightly higher number and both districts have a relatively good number of boys' toilets as well, with Angul having a slightly higher count. Schools in Kalahandi have a higher percentage (94 percent) of drinking water facilities available as compared to Angul (76 percent) (Figure 3). This indicates that Kalahandi may have a better infrastructure or management for providing clean drinking water to its schools. Angul has an outstanding score for electricity, suggesting that most schools in the district have access to electricity. On the other hand, Kalahandi significantly lags behind in terms of access to electricity, only 88 percentage of schools have access to electricity. Angul has a significantly higher score for playground facilities compared to Kalahandi. This indicates that Angul schools likely have better outdoor playing spaces, which are important for the physical well-being of students.

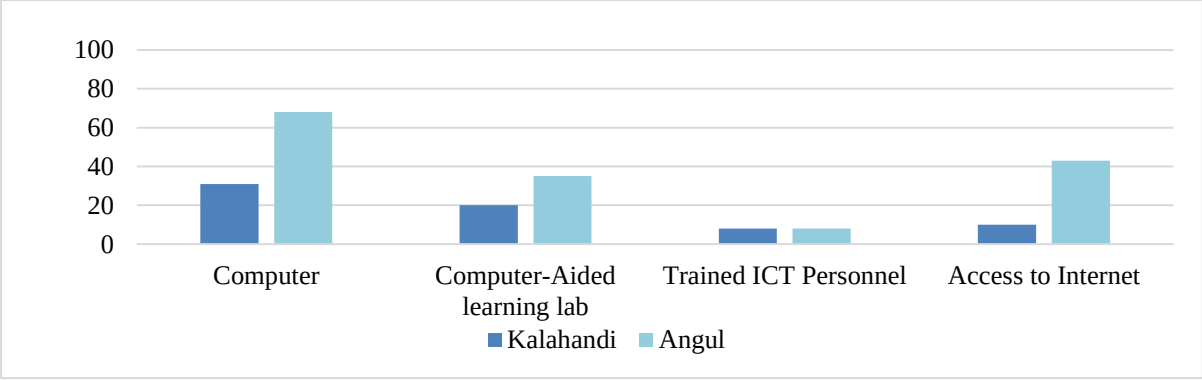
Figure 3: Toilet, drinking water, electricity and playground facilities of Kalahandi and Angul district



Source: Primary data

Angul has a significantly higher number of computers available in its schools (68 percent) compared to Kalahandi (31 percent). Angul also has a higher number of computer-aided learning labs (35 percent) compared to Kalahandi (20 percent). Both districts have the same number of trained ICT personnel (8 percent) (Figure 4). This suggests that the availability of trained personnel for managing and utilizing ICT resources is consistently very low across the two districts. Angul has a significantly higher level of access to the internet compared to Kalahandi.

Figure 4: Number of computer, computer lab, trained ICT personnel and access to internet facilities in Kalahandi and Angul district



Source: Primary data

This suggests that Angul may have better resources for integrating technology into education and indicates that students and teachers in Angul may have better opportunities for online learning and accessing educational resources available on the internet. Overall, Angul demonstrates a stronger presence and infrastructure for computer facilities and internet access compared to Kalahandi. This suggests that Angul may have a more advanced approach to integrating technology into education, potentially providing students with more opportunities for digital learning and skill development.

Table 5: Availability of computers

	Average No. of computer laboratories per School	Average No. of computers in the schools	Average No. of computers for students uses per School
Kalahandi	0.42	2.67	1.96
Angul	0.35	4.46	3.8

Source: Primary data

Physical Facilities

As per the survey for physical facilities available in both districts, both Kalahandi and Angul excel in providing essential school amenities such as blackboards, chalk-dusters, dustbins, and school bells (Table 6). Angul surpasses Kalahandi in providing staffrooms for teachers, musical instruments, and furniture, suggesting a potentially more enriching learning environment. Kalahandi could consider investing more in providing better facilities for teachers and enriching extracurricular activities to match the standards set by Angul. Both districts should continue prioritizing the maintenance and provision of basic school amenities to ensure a conducive learning environment for all students and teachers.

Table 6: Availability of physical facilities

	Black Board	Chalk & Duster	School Bell	Dust-Bin	Staffroom	Musical Instrument	Furniture
Kalahandi	100	100	100	100	47	25	80
Angul	100	100	100	92	73	68	97

Source: Primary data

During the survey regarding teaching material, it was observed that maps, globes, and charts are available in good numbers in both districts (Table 7). Kalahandi surpasses Angul in terms of availability of science and math kits suggesting Kalahandi offers batter opportunity for science and mathematical learning through the available equipment. Again, Kalahandi has a higher percentage in availability of games equipment, play materials, and books for library. Overall, Kalahandi has a good collection of educational equipment encouraging students to learn more productively.

Table 7: Availability of teaching facilities

	Maps	Globe	Charts	Play Materials	Games Equipment	Science Kit	Math kit	Book for Library
Kalahandi	100	100	96	100	100	98	92	100
Angul	100	100	97	92	97	86	70	86

Source: Primary data

The findings of a hypothesis test that compared the infrastructure index differences between Kalahandi (KBK) and Angul (non-KBK) districts based on school administration and location shows that public and private schools are significantly different in both the districts. However, rural-urban schools in Kalahandi show no significant variation in infrastructure index, whereas in case of Angul the null hypothesis is rejected for rural-urban. To compare Kalahandi and Angul districts, the data indicates significant differences in infrastructure index (Table 8).

Table 8: Testing the significance difference of infrastructure index between Kalahandi (KBK) and Angul (non-KBK) district

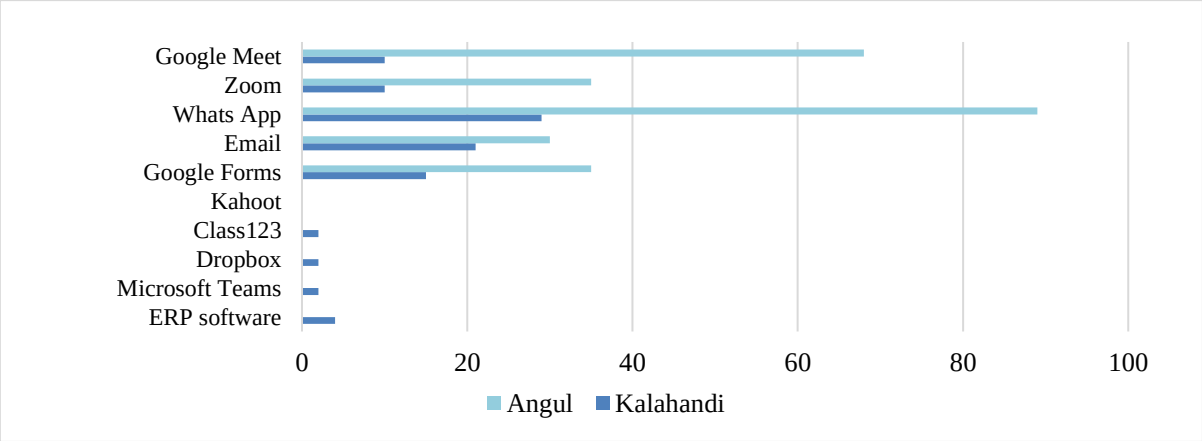
Null hypothesis(H_0)	t-statistics	p-value	Decision	KW-H statistics	p-value	Decision
Kalahandi						
Public vs. Private	-12.180	0.000***	Reject H_0	10.240	0.000***	Reject H_0
Rural vs. Urban	-1.000	0.345	Accept H_0	0.900	0.343	Accept H_0
Angul						
Public vs. private	-6.196	0.000***	Reject H_0	8.504	0.004	Reject H_0
Rural vs. Urban	-2.629	0.013**	Reject H_0	3.598	0.058*	Reject H_0
KBK vs Non-KBK (Kalahandi vs Angul)						
Kalahandi vs Angul	-3.137	0.002***	Reject H_0	9.804	0.002***	Reject H_0
Notes: (***), (**), (*) represents results are significant at 1 percent, 5 percent,10 percent level of significance						

Source: Authors' calculations from primary data

3.5. ICT techniques used for teaching-learning process.

Based on the findings of the survey, the data suggests Angul demonstrates a higher adoption of digital tools and software, especially for communication and virtual meetings, compared to Kalahandi (Figure 5). Kalahandi shows some adoption of ERP software, Drop Box, and MS teams but the percentage of usages such tools are comparatively very low. Electrification also has an impact on ICT usage and may be due to the comparatively poor internet and electricity infrastructure Kalahandi lags behind in ICT usage. Overall, WhatsApp, Google Meet, Email, Google Forms are the most popular software used by the schools in both districts. Meanwhile Kalahandi needs to focus on reaching out to students and enhance effective ICT methods for digital learning. State authorities need to develop dedicated software platforms to centralize the digital learning and digital content library for schools in Odisha.

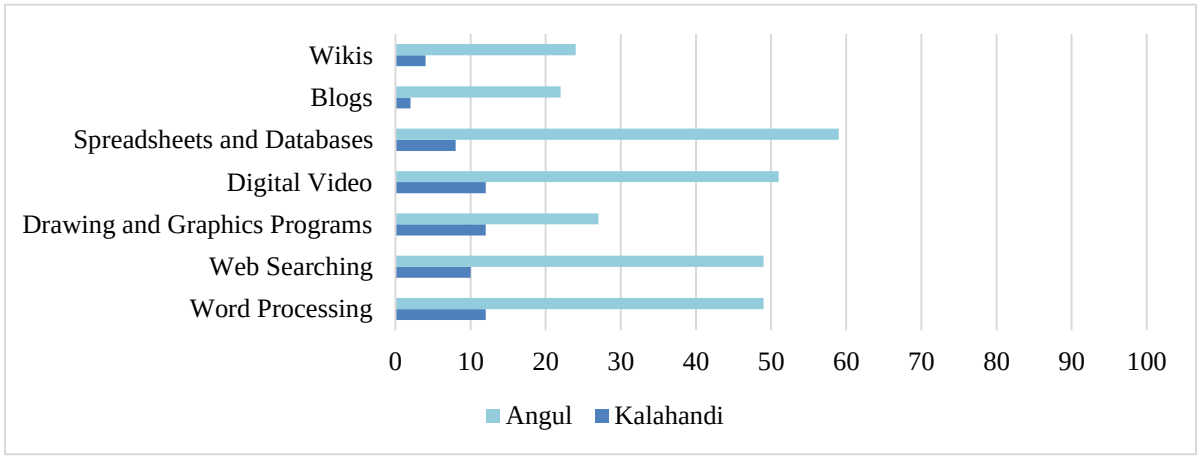
Figure 5: Usage of ICT software for teaching-learning process in Kalahandi and Angul district



Source: Primary data

As per the survey, Angul exhibits greater adoption and usage of digital tools and software compared to Kalahandi, it suggests a potential gap in digital literacy and integration of technology into education. Schools in the Angul district have significantly higher usages of software and methods such as spreadsheets, web searching, word processing and digital video (Figure 6). It suggests that the human capital employed in Angul might have received batter training in ICT tools and methods. As per data of trained teachers professional and percentage of teachers with graduation or above degree in Angul has a dominant position over Kalahandi. It also suggests Kalahandi needs to focus on training the teachers employed in the district.

Figure 6: Usage of ICT methods for teaching-learning process in Kalahandi and Angul district



Source: Primary data

4. CONCLUSION AND POLICY RECOMMENDATIONS

The survey aimed to assess basic information, infrastructure, teacher availability, teacher quality, student information like enrolment, attendance and academic performance, teaching-learning practices adopted by schools, and school resources of the two districts Angul and Kalahandi of Odisha state. Angul is the non-KBK district and Kalahandi is the KBK district. The findings of the survey indicate that first, Angul excels in attendance and academic outcomes, while Kalahandi prioritizes inclusivity by enrolling more SC and ST students. Second, a larger percentage of teachers in Angul (97.23 percent) have graduation degrees or higher qualifications compared to Kalahandi (55.38 percent). This trend also holds true for

teachers with professional degrees: Angul has a significantly higher percentage (93.13 percent) of teachers with professional degrees compared to Kalahandi (86.66 percent). The percentage of female teachers is lower in Angul (29.19 percent) compared to Kalahandi (35.38 percent). Higher percentage of SC and ST teachers in Kalahandi can be seen compared to Angul. The percentage of permanent teachers is lower in Kalahandi (87.61 percent) compared to Angul (92.28 percent). Third, both Kalahandi and Angul excel in providing essential school amenities such as blackboards, chalk-dusters, dustbins, and school bells. Angul surpasses Kalahandi in providing staffrooms for teachers, musical instruments, and furniture. During the survey regarding teaching material, it was observed that maps, globes, and charts are available in good numbers in both districts. Kalahandi surpasses Angul in terms of availability of science and math kits suggesting Kalahandi offers batter opportunity for science and mathematical learning through the available equipment. Again, Kalahandi has a higher percentage in availability of games equipment, play materials, and books for library. Overall, Kalahandi has a good collection of educational equipment encouraging students to learn more productively. Kalahandi significantly lags behind in terms of access to electricity and playground.

Fourth, Angul demonstrates a stronger presence and infrastructure for computer facilities and internet access compared to Kalahandi. Hence, Angul shows a higher adoption of digital tools and software, especially for communication and virtual meetings, compared to Kalahandi. Kalahandi shows some adoption of ERP software, Drop Box, MS teams but percentage of usages such tools are comparatively very low. Electrification also has an impact on ICT usage and may be due to the comparatively poor internet and electricity infrastructure Kalahandi lags behind in ICT usage. Last but not least, the study has looked into the significance of the variations in student academic performance, teacher quality and infrastructure across Kalahandi (KBK) and Angul (non-KBK) as well as public vs. private and rural vs. urban schools in each individual district. To test the significance, the independent sample t-test and Kruskal-Wallis (KW) test have been used. The results indicate that there may not be differences in rural-urban school and public-private school within individual districts, but there is significant variation exist between Kalahandi and Angul districts in terms of student academic performance, teacher quality and infrastructure facilities.

The study highlights the need to increase female teacher representation, especially in rural areas and private schools, to improve female student enrolment and reduce dropout rates. Expanding the 5T model to elementary schools can enhance collaboration, digital literacy, and transparency, requiring investment in infrastructure, teacher training, and curriculum adaptation. The lack of ICT-trained personnel, with only 8 percent of schools having such staff, calls for targeted recruitment, training programs, and a centralized digital learning platform. Government schools significantly lag behind private schools in ICT infrastructure, necessitating urgent investment to bridge this gap. The high pupil-teacher ratio (PTR) in Kalahandi (35.01) compared to Angul (20.62) highlights a teacher shortage, requiring immediate recruitment to meet RTE Act norms. Addressing these disparities through strategic policy interventions will help improve the overall quality and accessibility of elementary education in Odisha.

REFERENCES

1. *Alcott, B., & Rose, P. (2015). Schools and learning in rural India and Pakistan: Who goes where, and how much are they learning? Prospects, 45, 345-363.*
2. *Azim Premji Foundation (2004). Status of learning achievement in India, A review of empirical research. Bangalore retrieved from http://righttoeducation.in/sites/default/files/StatusofLearning AchievementsinIndia%5B1%5D.pdf.*
3. *Bakhla, N., Drèze, J., Paikra, V., & Khera, R. (2021). Locked out: Emergency report on school education in India. Road Scholarz.*
4. *District statistical handbook of Angul (2018). Directorate of Economics and Statistics Odisha.*
5. *District statistical handbook of Kalahandi (2018). Directorate of Economics and Statistics Odisha.*
6. *Donnelly, R., Patrinos, H. A., & Gresham, J. (2021). The impact of COVID-19 on education-Recommendations and opportunities for Ukraine. World Bank.*
7. *Fiske, E. B. (2000). Education for All: Status and Trends, 2000. Assessing Learning Achievement.*
8. *Goyal, S. (2007). Learning achievements in India: A study of primary education in Orissa. The World Bank.*
9. *India, O. (2020). Status report-Government and private schools during COVID-19. Retrieved on, 15, 2022. Available online: https://www.oxfamindia.org/sites/default/files/2020-09/Status%20report%20Government%20and%20private%20 schools%20during%20COVID%20-%2019.pdf*
10. *Odisha report education cannot wait act now. Atmashakti Trust.*
11. *Pandey, P., Goyal, S., & Sundararaman, V. (2010). Public participation, teacher accountability and school outcomes in three states. Economic and Political Weekly, 75-83.*
12. *Stafford Ocansey, T., & Sharma, A. (2020). Maharashtra Digital Schools Survey Findings Report (No. 24). ICT India Working Paper.*
13. *Talukdar, R. R. (2013). " Quality of Elementary Education among the tribal children of Meghalaya" an analytical study. Project Report submitted to NCERT.*
14. *UDISE+ (2017-18). School report card. Department of school education and literacy, Ministry of Education. GOI.*
15. *Wait, E. C. (2017). Why education cannot wait.*
16. *Zhang, Y., Postlethwaite, T. N., & Grisay, A. (2008). A view Inside Primary Schools: A world Education Indicators (WEI) cross-national study. UNESCO.*