

Disparity Mapping of Rural-Urban High School Teachers' TPACK Level

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Abstract. This study examines the disparity in Technological Pedagogical Content Knowledge (TPACK) levels among high school teachers, distinguishing between rural and urban settings within two regions on the Aceh East Coast, specifically Langsa City and Aceh Tamiang Regency. The research encompasses 560 teachers from both private and public high schools in Langsa City, an urban area, and Aceh Tamiang Regency, a rural area. Data is acquired through the test and questionnaire to capture teachers' TPACK levels. The data analysis used in this research is Global Moran's I and Anselin Local Moran's I to visualize patterns and disparities in teachers' TPACK levels. The research results reveal a significant disparity between urban (Langsa City) and rural (Aceh Tamiang Regency) areas. Langsa City has a random TPACK distribution pattern (Global Moran's I Index = 0,02438), while Aceh Tamiang Regency has a clustered pattern (Global Moran's I Index = 0,17018). This indicates that Aceh Tamiang Regency has higher disparities among high school teachers in TPACK levels compared to Langsa City. Then, Langsa City has better equality in the quality of high school teachers. Furthermore, analysis from Anselin's Local Moran's I reveals a concentration of teachers with the highest TPACK levels in the municipal district and teachers with low TPACK levels in the peripheral area. It can be found in both regions' hot and cold spots.

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1. Introduction

Education is the government's responsibility to improve the quality of human resources. Education should be considered a human capital investment for a better future of civilization (Trisnawati & Khoirunurrofik, 2019). The government funds public schools through taxes, but usage varies regionally, resulting in persistent disparity in educational quality (Ishii & Meke, 2022; Tayyaba, 2012). The disparity can be attributed to regional accessibility, differences in teacher quality (Corbett & Gereluk, 2020; Irawadi et al., 2020), educational policies (Ishii & Meke, 2022), and bureaucratic constraints (Burger, 2011). Teacher quality disparity reflects competence in teaching and subject mastery, demonstrated by the teacher's TPACK (Technological Pedagogical Content Knowledge) (Padmavathi, 2017). The teacher's TPACK level is crucial for the quality of education and learning in the classroom, particularly in addressing issues of inequality and high school education. A strong TPACK enables teachers to effectively integrate technology, pedagogy, and content knowledge, tailoring instruction to meet diverse student needs and reduce educational disparities. (Taopan & Drajadi, 2020). TPACK proficiency is crucial because teachers with high TPACK can engage students using diverse instructional strategies that cater to various learning styles (Corbett & Donehower, 2017), thereby enhancing educational outcomes and bridging the gap between privileged and marginalized students (Lee et al., 2020).

Teachers are the backbone of quality learning. Adapting teaching methods to individual needs and fostering

collaboration encourages intellectual curiosity and personal growth. The choice of methods has a significant influence on student outcomes. Engaging approaches, such as inquiry-based learning and hands-on activities, promote active participation and deeper understanding (McDaris et al., 2019). Outdated methods may hinder comprehension and disengage learners. Selecting appropriate teaching methods enhances comprehension, retention, and academic achievement, ultimately shaping student learning outcomes. TPACK is crucial for effectively implementing teaching methods, integrating technological, pedagogical, curriculum, and content knowledge (Goradia, 2018; Ningsih, 2019; Saubern et al., 2020). Teachers proficient in TPACK understand how to utilize technology to enhance pedagogy while effectively delivering subject-specific content. This holistic approach ensures that teaching methods are not only technologically sound but also pedagogically sound and aligned with the curriculum.

The conditions of the school environment and teachers' homes influence the level of teacher competence, both in academic and pedagogical aspects (Scardamalia et al., 1989). Teachers exhibit varying levels of TPACK proficiency, particularly when comparing urban and rural settings. In urban high schools, educators generally benefit from enhanced access to resources and training programs, resulting in elevated TPACK levels relative to those in rural areas. Furthermore, urban environments typically feature superior infrastructure, including reliable internet and technological tools, which support the integration of technology into educational methods

(Wilsonyudho, 2017). Additionally, urban schools may offer more professional development opportunities focused on technology integration (Ishii & Meke, 2022). Conversely, rural schools may face challenges such as limited access to technology, fewer professional development opportunities, and smaller budgets, which can result in lower TPACK levels among teachers (Sumida & Kawata, 2021). This inequality in TPACK levels can widen the digital divide, impacting the quality of education and opportunities for students in rural areas.

Langsa City and Aceh Tamiang Regency is one of the areas on the east coast of Aceh Province, Indonesia. These two areas, located side by side, exhibit significant differences in accessibility and development intensity (Ningrum & Ginting, 2020; Nurmalasari, 2023; Sahudra et al., 2022; Sintiya et al., 2019). This condition affects various aspects of people's lives, including education (Yakob et al., 2020). In the education sector, the gap in teacher competence is a significant issue that warrants study, particularly in terms of TPACK. The findings of this research are essential information for policymakers to develop education in Langsa City and Aceh Tamiang Regency. This research analyzes the TPACK gap for high school teachers in Langsa City and Aceh Tamiang. Studies show a significant gap in student achievement between rural and urban areas, reflecting differences in educational quality. Urban students often have better access to educational facilities, including libraries, modern labs, and technological support (Goh & Kale, 2016).

In contrast, students in rural areas often face limitations in terms of educational facilities and resources, which ultimately harm their academic achievement (Zhang, 2023). However, the most dominant factor in determining student achievement is not merely geographic location, but rather the quality of teachers and the academic resources available at the school (Othman & Muijs, 2013). Quality teachers are essential for student achievement in rural and urban areas. Skilled educators inspire students and nurture their potential, ensuring effective learning despite limited resources. Moreover, academic resources such as updated textbooks, relevant curricula, and access to technology enhance academic success.

This research aims to map the disparity between the quality of high school teachers in Langsa City and Aceh Tamiang Regency. This mapping produces hot spot and cold spot areas in the TPACK level aspect, which can be used to reduce the gap in teacher quality in rural and urban areas. This map is essential as initial data for infrastructure development in Langsa City and Aceh Tamiang Regency. Basic infrastructure, such as roads, internet coverage, and electricity, is the foundational capital for enhancing teacher competency. Teachers need access to these facilities to realize their potential in their homes.

Additionally, the results of this research can assist local governments in allocating education budgets, improving access to technology, and facilitating professional development training based on administrative areas, ensuring that regional development occurs uniformly. This research was conducted as a sustainable effort to improve the quality of education in rural areas. Even though the education participation rate in rural areas continues to increase, only a few of these students learn. This is because their learning experience is not as effective as that of students who attend schools in the city (Sutton et al., 2017). All students, regardless of their geographic location, should have equal opportunities to achieve high academic

achievement. The results of this research will not only enhance the quality of education in Langsa City and Aceh Tamiang Regency, but also contribute to creating educational equality in various regions through the application of geospatial science analysis.

2. Methods

Research Context

This research was conducted on high school teachers in Langsa City and Aceh Tamiang Regency, Aceh Province. This study investigates and maps the disparity in Technological Pedagogical Content Knowledge (TPACK) levels among high school teachers, differentiating between rural and urban settings within two regions. Langsa City (area 239.8 km²) has 65 urban villages with Langsa Kota Subdistrict as the municipal district (central government). Meanwhile, Aceh Tamiang Regency (1,957 km²) has 213 villages with Kualasimpang Subdistrict as the municipal district (central government). It should be emphasized that the unit of analysis for this research is the urban village or rural village. While not predominant, a teacher's residential environment influences the educator's quality, particularly regarding accessibility to the downtown, where professional teacher training is frequently conducted. Educators residing at considerable distances, compounded by inadequate road conditions, often encounter challenges in participating in training activities, resulting in lower participation rates compared to their counterparts living in the downtown area. Comparable scenarios can be observed in the availability of internet coverage, the proximity of bookstores, and electronic equipment stores that facilitate teachers' access to digital media literacy. This is done so that research can produce specific disparity information in the two regions. These two areas are close to each other but have different characteristics. Langsa City features robust urban characteristics. This region has dense settlements with economic sectors in trade and tourism. Meanwhile, Aceh Tamiang Regency has strong rural characteristics. This region is a large area with a low population density. The dominant economic sector is the extractive economy, namely fisheries and farming. Langsa City may have a better education system than Aceh Tamiang Regency, as it has more accredited high schools. The research is in Langsa City and Aceh Tamiang Regency, situated in the eastern coastal area of Aceh Province. Specifically, Langsa City has 9 high schools, while Aceh Tamiang Regency has 27 high schools. Figure 1 depicts the administrative location of Langsa City and Aceh Tamiang Regency, while Figure 2 illustrates the distribution of high schools in both regions.

The respondents involved in this research were 560 teachers from 36 schools. The selection of respondents employed a multilevel sampling approach. The researcher obtained data on teachers' addresses in Aceh Tamiang and Langsa from the Education Authority Branches (*Cabang Dinas Pendidikan*) in Aceh Tamiang Regency and Langsa City. There are 768 high school teachers in Aceh Tamiang Regency and 337 in Langsa City, as shown in Table 1. After collecting teacher addresses from both regions, the researcher selected two teachers from each village. In the final step, the researcher gathered the teachers' school information and collected data at the schools, both directly (offline) and indirectly (online through forms). Figure 1 shows the locations of Langsa City and Aceh Tamiang Regency. The data on the number of high schools in the two regions can be seen in Table 1.

Data Collection and Analysis

The research data analyzed in this study are the TPACK levels of high school teachers. Data were collected through two methods: direct and indirect surveys (online forms). The direct surveys were conducted at schools with limited internet access, mostly in peripheral areas with poor accessibility. Meanwhile, online forms are used in schools with good internet access, mostly in municipal districts or schools with reasonable accessibility. The instruments used are tests and questionnaires that assess teacher knowledge about TPACK, encompassing technology, pedagogy, curriculum, and content knowledge. Each component of TPACK is evaluated utilizing twenty test items and supplemented by ten questionnaire items. However, from these four kinds of knowledge, Mishra (2019) added one more critical knowledge component, namely context knowledge (XK), as shown in Figure 3.

Context knowledge concerns the constraints and situations of schools and institutions where teachers work. This knowledge holds an essential position in supporting teacher effectiveness and performance in the classroom, enabling adaptation to the school environment (Mishra, 2019). In this research, the data collected encompasses knowledge related to technology, pedagogy, curriculum, content, and context. Context knowledge was evaluated using 20 test items and 10 questionnaire items, resulting in a total of 150 instruments utilized for the five types of knowledge. The five types of knowledge will be analyzed comprehensively as essential information in mapping the disparity in teacher quality, particularly in terms of the TPACK level, within Langsa City and Aceh Tamiang Regency.

The technology aspect measures teacher knowledge in using digital media for classroom learning (Jaipal-Jamani & Figg, 2015). The pedagogical aspect measures the teacher's knowledge in educating students and conveying material effectively in class (Saubern et al., 2020). The curriculum aspect measures teacher knowledge about government regulations related to teacher duties (Hamid et al., 2018). The content aspect measures the teacher's knowledge about learning material scientifically (Bednarz et al., 2008; Yani & Mulyadi, 2022). Meanwhile, the contextual aspect measures the teacher's knowledge about the background conditions of

the school and students, encompassing economic and cultural aspects (Mishra, 2019). These five aspects are the basis for developing tests and questionnaires. The research instrument was filled out by respondents online. The collected data was analyzed using spatial statistics techniques, namely Global Moran's I and Anselin Local Moran's I. The formula used to carry out this analysis is as follows.

Global Moran's I formula (Anselin, 2019).

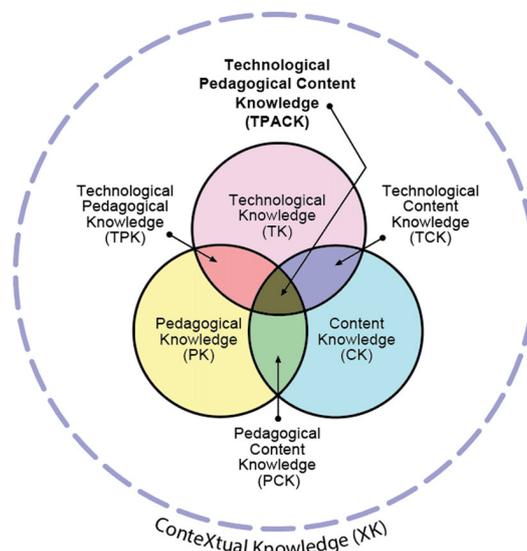
$$I = \frac{n}{S_0} \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} z_i z_j}{\sum_{i=1}^n z_i^2}$$

Anselin's Local Moran's I formula (Anselin, 2019).

$$I_i = \frac{x_i - \bar{X}}{S_i^2} \sum_{j=1, j \neq i}^n w_{ij} (x_j - \bar{X})$$

Those formula is used to analyze the spatial pattern of high school teacher TPACK disparities represented by 560 respondents in Langsa City and Aceh Tamiang Regency. The results of the Global Moran's I analysis indicate the distribution of teachers' TPACK levels in the research area, specifically whether they are dispersed, random, or clustered. This distribution form could show equity education in the research area (Anselin, 2019). Meanwhile, the results of the Anselin Local Moran's I analysis show the hot spots and cold spots of teachers' TPACK levels. Hot spots are areas with the highest TPACK rate compared to the surrounding area. Hot spots are interpreted as areas that have a positive influence on the surrounding area in terms of increasing teachers' TPACK.

Meanwhile, a cold spot is an area with a negative influence on the surrounding area. Cold spot areas are a top priority for policy intervention, enabling educational equality to be achieved in a region. The results of this analysis can produce information about educational development priorities, both in terms of infrastructure and human capital (Marliani, 2021; Santos-García et al., 2021a).



Source: Mishra (2019)

Figure 3. The TPACK Diagram with Additional Context Knowledge is called XK.

3. Result and Discussion

As a scientific discipline, geography is essential for analyzing educational issues, particularly disparities in teacher performance. It provides a framework for understanding how spatial factors impact teacher competence and professional development, particularly in relation to Technological Pedagogical Content Knowledge (TPACK). Although location factors may not directly influence the TPACK levels of high school teachers, they can account for the observed trend in which teachers with high TPACK levels cluster in one area, while those with low TPACK levels are concentrated in another region. This research aims to map the disparities in teachers' TPACK levels in Langsa City and Aceh Tamiang Regency. This mapping can provide information about educational quality inequality, allowing readers to focus on access to education for students in peripheral areas, ensuring they are not left behind compared to students in core regions (Rohmani, 2021). The research data analysis reveals differences in TPACK distribution among high school teachers in Langsa City and Aceh Tamiang Regency. The TPACK levels of respondents vary significantly between the municipal and other districts in both regions. In Langsa City, the TPACK score gap is low, indicating relatively even teacher quality. Conversely, Aceh Tamiang Regency shows a substantial gap between the municipal and other districts, highlighting notable differences in teacher quality across the region. More specific data about the average teacher's TPACK level can be seen in Table 2.

Table 2 presents the average scores in five TPACK categories: technology, pedagogy, curriculum, content, and context. The municipal district in Langsa City averages 56,88, while other districts average 47,44. In Aceh Tamiang Regency,

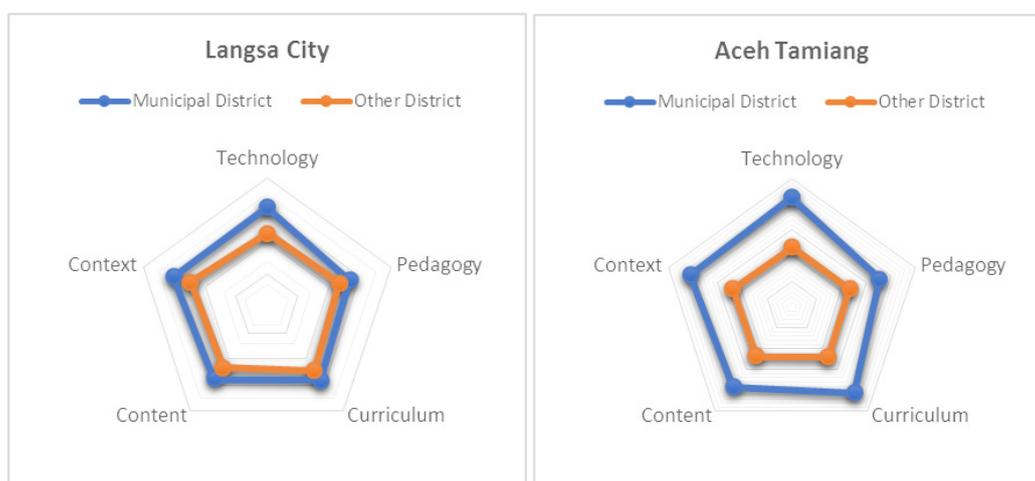
respondents scored an average of 79,28 compared to 47.24 in other districts. This highlights a significant gap in TPACK levels between the two regions. Figures 4 and 5 provide further clarity on the differences between municipal districts and other districts.

Based on Figure 4, the diagram reveals that the gap in respondents' TPACK levels in Aceh Tamiang Regency is larger than that in Langsa City. However, the average TPACK level in the Langsa City municipal district is lower than that of Aceh Tamiang Regency. The significant TPACK gap suggests a considerable disparity in teacher quality between the municipal district and the peripheral district. Meanwhile, the high maximum TPACK score of Aceh Tamiang high school teachers, compared to that of Langsa high school teachers, can be attributed to two factors. First, the demographics of Aceh Tamiang high school teachers are predominantly composed of individuals aged between 25 and 40 years. This demographic possesses greater digital technology literacy compared to teachers over 40 years. Younger teachers are generally more adept at adapting to digital technology. Thus, their capability to absorb new information, self-improve their skills, and discern valid information can enhance their TPACK abilities. Secondly, the active role of the government and schools in improving teacher competence is crucial. Governments that actively organize training for teachers typically cultivate educators who are more skilled and better prepared for teaching. Teacher training has a significant impact on teachers' self-confidence in their roles and enhances their classroom performance. However, this factor requires further validation in additional studies to yield accurate recommendations.

Table 2. Comparison of the average TPACK level of high school teachers between municipal districts and other districts in Langsa City and Aceh Tamiang Regency

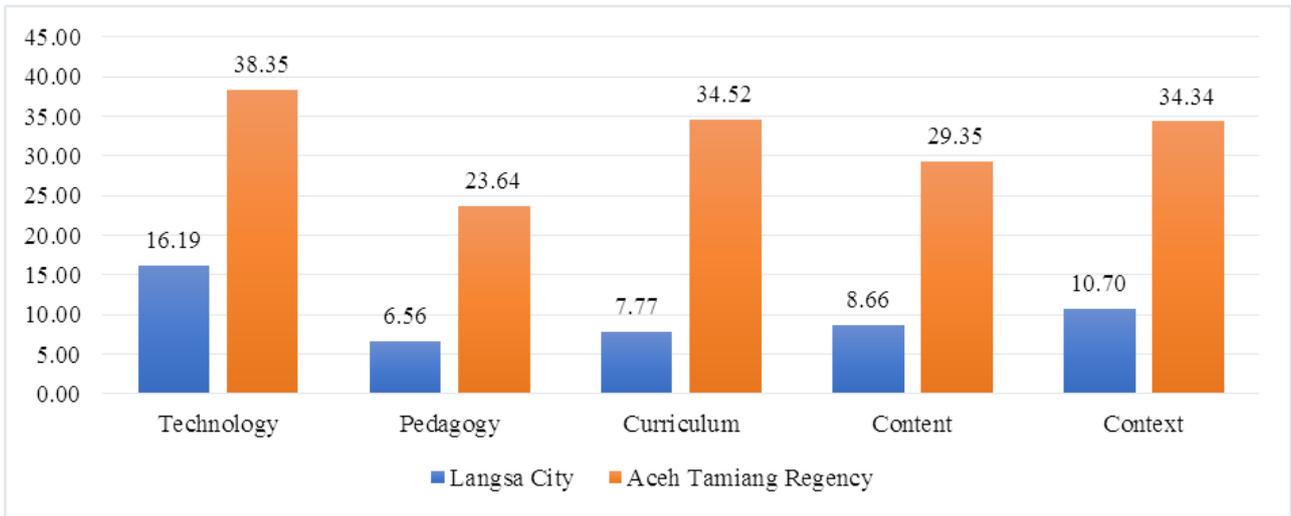
No	Name	Location	Technology	Pedagogy	Curriculum	Content	Context	Average
1	Langsa City	1 Municipal District	61,72	53,34	56,52	55,17	60,35	56,88
		2 Other District	45,53	46,78	48,75	46,51	49,65	47,44
2	Aceh Tamiang Regency	3 Municipal District	85,00	70,80	82,40	76,20	82,00	79,28
		4 Other District	46,65	47,16	47,88	46,85	47,66	47,24

Source: Research Analysis (2024)



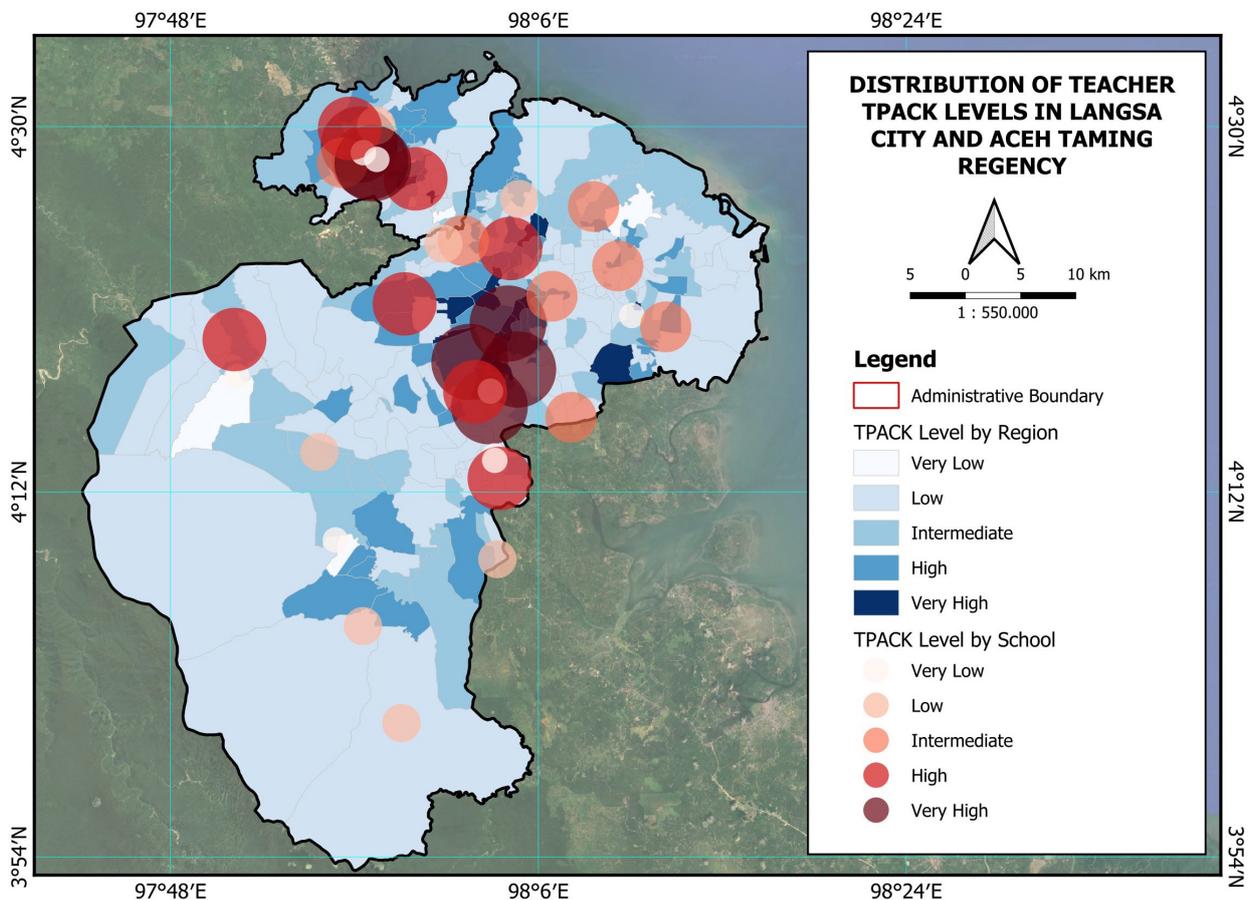
Source: Research Analysis (2024)

Figure 4. Radar Diagram of Respondents' TPACK Level between The Municipal District and Other Districts in Langsa City and Aceh Tamiang Regency.



Source: Research Analysis (2024)

Figure 5. The TPACK Scores Differ between Municipal Districts and Other Districts in Langsa City and Aceh Tamiang Regency.



Source: Research Analysis (2024)

Figure 6. High School Teacher TPACK Level Distribution in Langsa City and Aceh Tamiang Regency.

Furthermore, Figure 5 illustrates the difference in scores between high school teachers in Langsa City and Aceh Tamiang Regency. This score represents the gap between teachers with the highest TPACK score and those with the lowest TPACK score. It indicates that the difference in TPACK among high school teachers in Aceh Tamiang is greater than that among their counterparts in Langsa. This situation may arise from the uneven access to technology infrastructure in Aceh Tamiang. While Aceh Tamiang covers a significantly larger area than Langsa, it has a lower intensity of infrastructure

development. High school teachers in Aceh Tamiang residing in remote areas often encounter limited access to unstable or non-existent internet connectivity. In contrast, high school teachers in Langsa typically reside in areas with well-developed infrastructure and adequate, sometimes excellent internet access, which facilitates easier information absorption to support learning activities.

A total of 560 respondents' TPACK level had a score range between 0 and 100 and were categorized into five groups, i.e. (1) 'very low' group with a score range of 0 – 20; (2) 'low'

group with a score range of 21 – 40; (3) ‘intermediate’ group with a score range of 41 – 60; (4) ‘high’ group with a score range of 61 – 80; and (5) the ‘very high’ group with a score range of 81 – 100. Figure 6 shows the distribution of teachers’ TPACK levels by each urban village/village and TPACK level by school. According to Figure 6, two key insights emerge, i.e., the distribution of TPACK levels by region and school. The regional distribution reflects data based on the respondents’ locations, analyzed at the village or urban village level. In contrast, the school distribution captures data related to the respondents’ home base school. Presenting these two datasets allows for comparing the differing distribution patterns of TPACK levels using distinct methods. The regional TPACK distribution is represented through a gradient of blue colors, whereas the school TPACK distribution is illustrated using red circles. The size of each circle symbolizes the TPACK level at each school, with larger diameters indicating higher TPACK levels among high school teachers.

Figure 6 illustrates the distribution of high TPACK levels across municipal districts, specified by region and school. At the regional level, TPACK distribution data predominantly shows a concentration in dark blue areas. Similarly, at the school level, institutions with the highest TPACK levels are also centered within municipal districts, as indicated by the size of the circle symbol and the dark red color. Municipal districts, such as Langsa Kota District and Kualasimpang Kota District (refer to Figure 1), offer substantial accessibility to information, learning resources, and internet coverage, fostering an environment conducive to the enhancement of teachers’ Technology Knowledge (TK). This supportive backdrop enables teachers to explore, practice, and incorporate technology into their teaching practices. Geographical factors further enhance professional development opportunities for educators residing near downtown, where most training sessions, workshops, and seminars on TPACK and innovative learning typically take place. Conversely, teachers living in suburban areas often encounter obstacles in accessing these training opportunities due to geographical limitations, high transportation costs, and limited information. Consequently, these location-based challenges adversely affect their Pedagogical Knowledge (PK) and Content Knowledge (CK), particularly in relation to technology integration. The more adaptive environment in downtown, both residentially and within schools, benefits from centralized development, availability of experts, and a more vibrant teacher community. This dynamic environment encourages teachers to pursue independent TPACK development. In contrast, suburban educators face hurdles like inadequate learning resources, a sense of disconnection from technological advances, and financial constraints, all of which hinder their TPACK improvement efforts and diminish their motivation to enhance these skills.

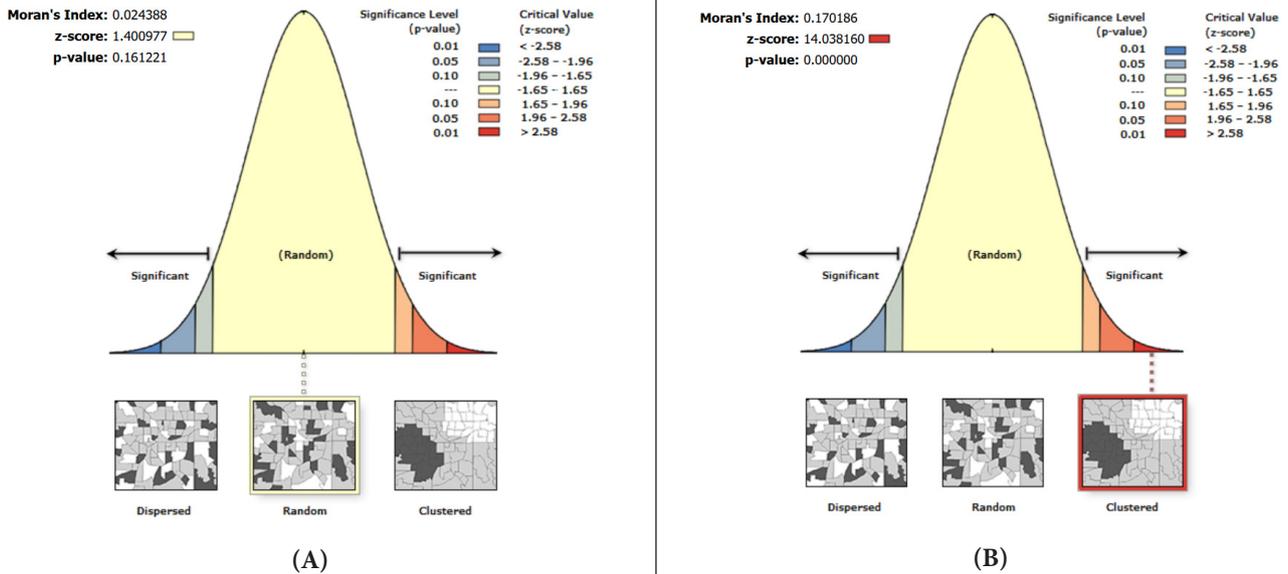
Furthermore, the distribution was analyzed using Global Moran’s I formula to test spatial autocorrelation. Spatial autocorrelation analysis was used to determine the distribution type of teachers’ TPACK level in Langsa City and Aceh Tamiang Regency. The results of the spatial autocorrelation analysis can be seen in Figure 7. Based on Figure 7, the TPACK of teachers in Langsa has a random pattern with a Moran’s Index of 0.024388. Meanwhile, teacher TPACK in Aceh Tamiang has a clustered pattern with a Moran’s Index of 0.170186. The random pattern in Langsa City indicates that Langsa has a more equitable distribution of teacher quality compared to Aceh Tamiang. Teachers in Langsa City generally

have better access to information sources and educational technology, which allows them to continue to improve their TPACK competencies independently and sustainably. Meanwhile, in Aceh Tamiang, teachers’ TPACK level tends to be clustered, namely around the municipal district. Municipal districts are areas with good accessibility and are supported by better educational facilities than peripheral areas. This affects the burden of development in the education sector. These areas, which tend to be more rural, may have inadequate infrastructure, limiting opportunities for teachers to keep up with the latest developments in education and technology. Apart from that, different socio-cultural backgrounds also play an important role. In some rural areas, there may be resistance to change and adoption of new technologies in educational practices, which hinders improving teacher TPACK.

The difference in size area between Langsa City and Aceh Tamiang Regency is significant. Langsa has a smaller area than Aceh Tamiang. This makes the distribution of educational resources in Langsa easier, more efficient, and more prevalent. With a smaller area, Langsa can more easily regulate and monitor the quality of education and ensure that all schools receive sufficient resources, including qualified teachers. In contrast, Aceh Tamiang, which has a larger area, faces greater challenges in distributing its resources. Aceh Tamiang must face greater geographic and logistical challenges, necessitating more comprehensive planning and investment to achieve educational quality parity. A larger area means that schools can be very far apart, making it difficult to ensure that all areas receive the same quality of education (Bakar, 2022). Then, there is the development inequality between municipal districts and peripheral areas in Langsa City and Aceh Tamiang Regency. Educational facilities in the municipal district of Aceh Tamiang are better compared to those in peripheral areas.

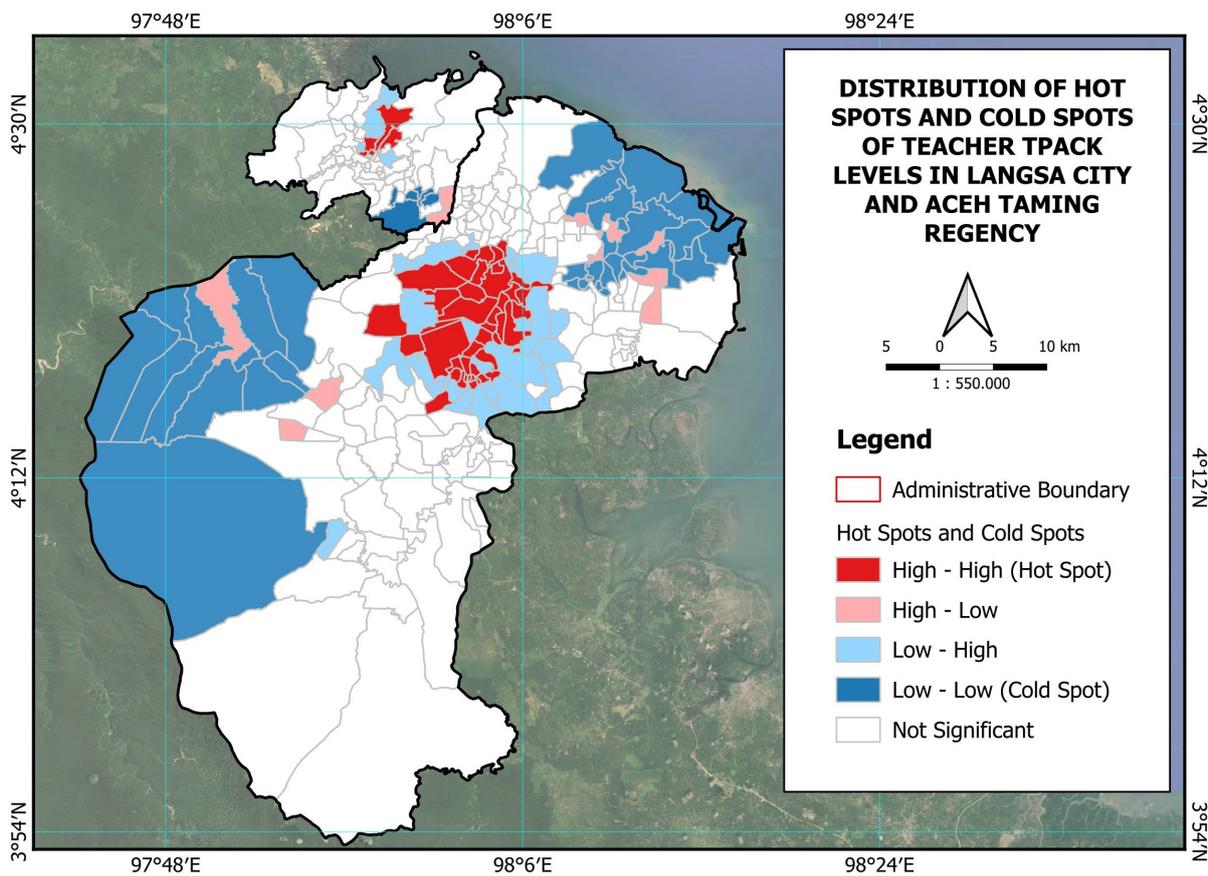
Meanwhile, Langsa City has a relatively even infrastructure development. This resulted in the concentration of Aceh Tamiang teachers with high TPACK in the municipal district. Meanwhile, the peripheral areas do not receive enough attention. Teachers tend to choose to teach in areas that have better facilities and easier accessibility. This results in a quality education gap between the municipal district and peripheral areas in Aceh Tamiang. Therefore, the area, geographical conditions, and quality of educational infrastructure strongly affect the disparities in educational quality.

Figure 8 shows the distribution of hot spot and cold spot areas for teacher TPACK levels. Based on this image, it can be concluded that the Langsa City and Aceh Tamiang Regency hotspot areas are located within the municipal district and its surroundings. Meanwhile, the number of cold spot areas in Langsa City is smaller than that of Aceh Tamiang Regency. Langsa City has 65 urban villages. This city has 5 urban villages as hotspot areas (approximately 7.6% of urban villages) and 6 urban villages as cold spot areas (approximately 9.2% of urban villages). Meanwhile, Aceh Tamiang has 213 villages with 39 hotspot areas (approximately 18.3% of villages) and 35 cold spots (approximately 16.4% of villages). Areas with white symbols have an average TPACK level and can change depending on the magnitude of the influence of hot spots and cold spots. For each region context, these two regions have the same characteristics in terms of the distribution of hot spots and cold spots. Both regions have hot spot locations in the municipal district and surrounding areas. It is essential to reiterate that a municipal district is a city or strict government location with optimal development conditions (Santos-García



Source: Research Analysis (2024)

Figure 7. Results of Spatial Autocorrelation Analysis using Global Moran's I. Figure (A) is the spatial pattern of TPACK high school teachers in Langsa City with a random pattern. Figure (B) is the spatial pattern of TPACK high school teachers in Aceh Tamiang Regency with a clustered pattern.



Source: Research Analysis (2024)

Figure 8. Distribution of Hot Spot and Cold Spot Teachers' TPACK Levels in Langsa City and Aceh Tamiang Regency based on Anselin Local Moran's I Analysis Results.

et al., 2021b). Meanwhile, the distribution of cold spots is in the peripheral area, which is the farthest from the municipal district.

The Aceh Tamiang District Government must improve educational infrastructure and human resources to achieve regional equality. This involves building school facilities,

laboratories, libraries, and ensuring access to technology. Adequate infrastructure creates a conducive learning environment. Additionally, enhancing human resources through systematic professional training for teachers is essential. Competent teachers can apply innovative methods to boost student achievement. The government also needs

to ensure that training programs are relevant to the latest technological developments and educational methodologies. Decentralization policies are crucial for enhancing equal access to quality education for all levels of society, including those remote rural areas (Lounkaew, 2013; Tayyaba, 2012). This policy can provide scholarships for teachers and offer exceptional support to those with low incomes. The Aceh Tamiang Regency government must prioritize remote, cold-spot areas. Budget allocations should focus on these areas to enhance educational facilities. The government must collaborate with the private sector and NGOs to accelerate equitable development and teacher training in underdeveloped regions areas.

Langsa City has less disparity than Aceh Tamiang Regency but still faces educational challenges. Areas with teachers exhibiting low TPACK levels exist. Enhancing education quality is vital for economic growth and social welfare, creating a more skilled workforce. Decentralization policies grant local governments broader authority to be responsible for their areas, including future economic development on natural and social capital (Wilonoyudho, 2017). The Langsa City and Aceh Tamiang Regency governments can address local education needs quickly and efficiently through decentralization. This enables schools to tailor learning activities to regional characteristics and potential, ultimately optimizing educational outcomes. (Melero, Hernández-Leo, et al., 2015). Decentralization policies not only strengthen the role of local government but also encourage active participation of local communities in the education process (Ezeudu & Ojih, 2014; Septyana et al., 2021).

The important thing this research recommends is that educational policy cannot be applied to every regional characteristic. Like other development sectors, the education sector must be built on local potential and decentralization policies that prioritize the interests of local communities (Canales & Maldonado, 2018; Susanto, 2021). Langsa City, which falls under the urban area category, has a priority in the infrastructure and educational facilities sectors. This priority needs to be maximized through policies focusing on learning technology innovation. Practical learning technology innovation will produce personalized adaptive learning methods for developing individual student potential. Students will learn knowledge and skills according to their respective potential. On the other hand, teachers will have no difficulty identifying and training this potential because adaptive learning technology is available at the school. Aceh Tamiang Regency, classified as a rural area, has a priority in terms of diversity and rich natural conditions. Local governments need to design local curricula to produce learning based on local potential. Furthermore, classroom learning should be developed following the characteristics of the surrounding environment. Students need to be taught and trained to recognize the environmental resources around them. Then, students are given the skills to utilize these resources. This type of learning is known as location-based learning, which aims to increase environmental awareness in students (Melero, Hernández-Leo, et al., 2015).

4. Conclusion

Geography, as a scientific discipline, plays a pivotal role in analyzing issues within the field of education, notably the disparities in educational quality, which are examined through the lens of teacher quality. The geographical approach

provides a framework for understanding how spatial factors influence teacher competence and professional development, particularly in the context of Technological Pedagogical Content Knowledge (TPACK). This study has delineated regions in Langsa City and Aceh Tamiang that exhibit either deficiencies or surpluses in the mastery of TPACK among high school educators, thereby elucidating the underlying reasons for the observed educational inequality. Disparities in education quality can be analyzed from the distribution of teacher quality. One component that can be used as an indicator is the TPACK level in high school teachers. Langsa City and Aceh Tamiang Regency exhibit distinct disparities in terms of the TPACK level among high school teachers. This is demonstrated through the analysis of TPACK data in the two regions using Global Moran's I and Anselin's Local Moran's I. The TPACK level gap in Langsa City tends to be smaller with a Moran's Index of 0.024388. This figure shows that the distribution of TPACK levels in Langsa City tends to be random. In Anselin and Local Moran's I analysis, Langsa City has a hotspot in the municipal district area. These findings suggest that disparities in TPACK levels persist in Langsa City. On the other hand, the TPACK level in Aceh Tamiang Regency has a clustered pattern with a Moran's Index of 0.170186.

This condition indicates a concentration of TPACK levels in the municipal district. The peripheral region of Aceh Tamiang has a very low level of TPACK. Aceh Tamiang Regency has a large area so this inequality can be seen very clearly. In the meantime, Langsa City possesses a significantly smaller geographical area, resulting in a more equitable distribution of teacher quality. This disparity can be attributed to several factors, including accessibility conditions, variations in educational facilities, and the availability of infrastructure for information and communication access. This study elucidates that the location of teachers' residences influences the extent of their TK, PK, CK, and TPACK. Teachers residing in peripheral districts are more likely to encounter challenges related to internet access and face limitations in participating in training sessions, which are often conducted in the downtown area. Conversely, educators living in municipal districts find it relatively easier to access professional training due to the proximity of their residences to training facilities. Consequently, the developmental status of a region significantly impacts the advancement of teachers' TPACK, both independently and collectively.

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