

Scale's impact in education system's performance: Cases in Draa-Tafilalet, Morocco

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ABSTRACT

This study aimed to apprehend the scale's role in education planning and performance. The national scale approaches tend to neglect local specificities. The relevance of the provincial and local scales is underlined in Draa-Tafilalet region (Morocco). By comparing the provincial data and indicators to study the education system's efficiency, we argue that these are pertinent scales to further understanding the needs, causality and key parameters of education. Collected data is analyzed using the data envelopment analysis (DEA). Useful indicators to compare the spatial variability of the education system's efficiency were produced and discussed at a provincial scale and interpreted considering the local socioeconomic characteristics in each province. The five provinces of the region (Errachidia, Ouarzazate, Tineghir, Midelt, and Zagora) are considered as adapted decision-making unit (DMU) in the study. The results show the provincial scale is relevant to apprehend the education system's performance. It is also important in education planning. The spatial differences in education efficiency at this scale show evidence of weak education impacts among rural populations in the recently created provinces such as Tineghir, Midelt, and Zagora. The criterion of education efficiency measured by DEA ranks Tineghir in the last position. This province needs special attention in planning and development.

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1. INTRODUCTION

The plethora literature on education's quality is multi-dimensional and focuses for example on its efficiency, its territorial equity, and what implementing strategies to serve the agenda 2030 of the United Nations in terms of sustainable development goals (SDG), mainly the goal SDG 04 [1], [2]. The education policies have evident impacts on societies and economies and often have been studied, managed, and planned at national scales [3]–[5]. However, at detailed scales (regional, provincial, or local scales) education's quality and efficiency are still facing major challenges, mainly in the middle-income countries and rural areas. Tremendous efforts have been done to develop education in these countries, but results remain critical as operational strategies often neglect the specific local realities and their social, economic, and

environmental characteristics. Their study is basic to implement adapted solutions and strategies for education policies' improvement and planning [6]. The literature produced on the schooling characteristics and impacts, mainly at the secondary level often argued the need of reforming the education policy [7]. These authors investigated the important role of the performance of the secondary school to ensure the success of students in their university the first year and confirm its main impact in preparing students for future challenges. The questions of expanding enrollment and education efficiency are often privileged as research themes [1], [8], [9]. The quality issues of education were discussed among other priorities [10]. Nevertheless, issues of education policy and its efficiency and equity under specific contexts in provincial and local conditions are still less studied.

The problem of what scales may be adopted for education's planning and managing is still unsolved, as most countries adopt macroscales and national levels to conceive programs and allow budgets. The regional and local structures when created are less autonomous and face financial challenges that reduce their efficiency in terms of resolving local and proximity problems. These problems are confirmed influencing the education's quality [11]. These authors used the term "segregation" to describe the rural challenges because in most studied cases teachers are deprived of the opportunities to do collaborative learning in schools. When plans are elaborated at national scales, these spatial and local specificities are often neglected.

Defining an adapted scale to study, plan and act for education's performance is a pertinent question in research and education policy development. As the concept of spatial scale is intrinsic to education quality and all geographical inquiries of the population, its relationships with other elements of the local context are basic to knowing the realities [12], [13]. In Morocco, for example, territorial inequalities in education caused structural deficits in economic and social development. Research by El Aoufi and Hanchane [14] used the term "objective inequalities" to describe how territorial vulnerability is important to consider in planning and developing capabilities and their achievements, including the population's access to education and basic health in addition to the households' income.

The Moroccan National Human Development Initiative (INDH), which focuses on social development, employment, and reducing poverty, launched programs that aim to reduce the observed territorial and socioeconomic inequalities at local scales [15]. It is supported by other programs in the public sector where education is a national priority to attain balanced and sustainable development. Although investments were huge in education on a national scale, the achievements were still modest in selected areas such as the marginal regions in the Atlas Mountains and the Sub-Sahara, including the Draa-Tafilalet region [16]. Instead of studying the education policies at a large scale (national level), it seems pertinent to consider their characteristics at a more detailed scale.

Several indicators including the performance in education are contrasted within regions and within the same region, at provincial scales. They underline the crucial problem of territorial targeting and how adequation between resources (inputs) and results (outputs) may be spatially achieved in terms of education's efficiency and how they may be measured. How this adequation may be used to improve territorial equity in the education strategies and policy? What is the best adapted scale to study, plan and manage the education policy? Morocco is formed of 12 regions, 75 provinces (called prefectures in agglomerated urban areas) and 1538 communes (urban and rural communes). In terms of decentralization, the regions are legally supervising the regional development, but their important surface and internal socioeconomic diversity underline the challenges of equity in budgets distribution and impacting projects selection and allocation, including in education. The communes are the smallest entities in the administrative subdivisions and have not sufficient budgets and human expertise to satisfy all needs of local population.

The proposed solution apprehended in this study considers the provincial scale as useful to apprehend these questions. It is an operational administrative unit because the provincial authorities' institutional competencies are large. They are in charge of territorial management and public services including education. The province framework is commonly considered a main decision-making unit (DMU). In this study, the benchmarking of the secondary schooling in different Moroccan provinces of the region Draa-Tafilalet, allowed a territorial profiling of provinces, that facilitates the apprehension of equipment inequalities and how local factors are influencing the education policy in the region. Therefore, alternative strategies may be implemented on the provincial scale.

2. RESEARCH METHOD

2.1. The geographic context

The Draa-Tafilalet region is marginal in position and located in southeastern Morocco as displayed in Figure 1. The geographic position and environmental context vulnerability are among the Draa-of-the-Tafilalet region. They do not facilitate the public equipment's proximity to the population and the quality of education services offered to communities. Rurality is dominant in the uplands, hills, mountain areas, and extended deserts. The important agglomerations are centered along the deep valleys of Dades, Todgha,

Gheris, and Ziz and in local depressions in the Atlas Mountain. Created in 2015, the region is still suffering from equipment and development deficits in its rural areas. The most equipped province in public administration is Errachidia. Table 1 shows the data of the Draa-Tafilalet region.

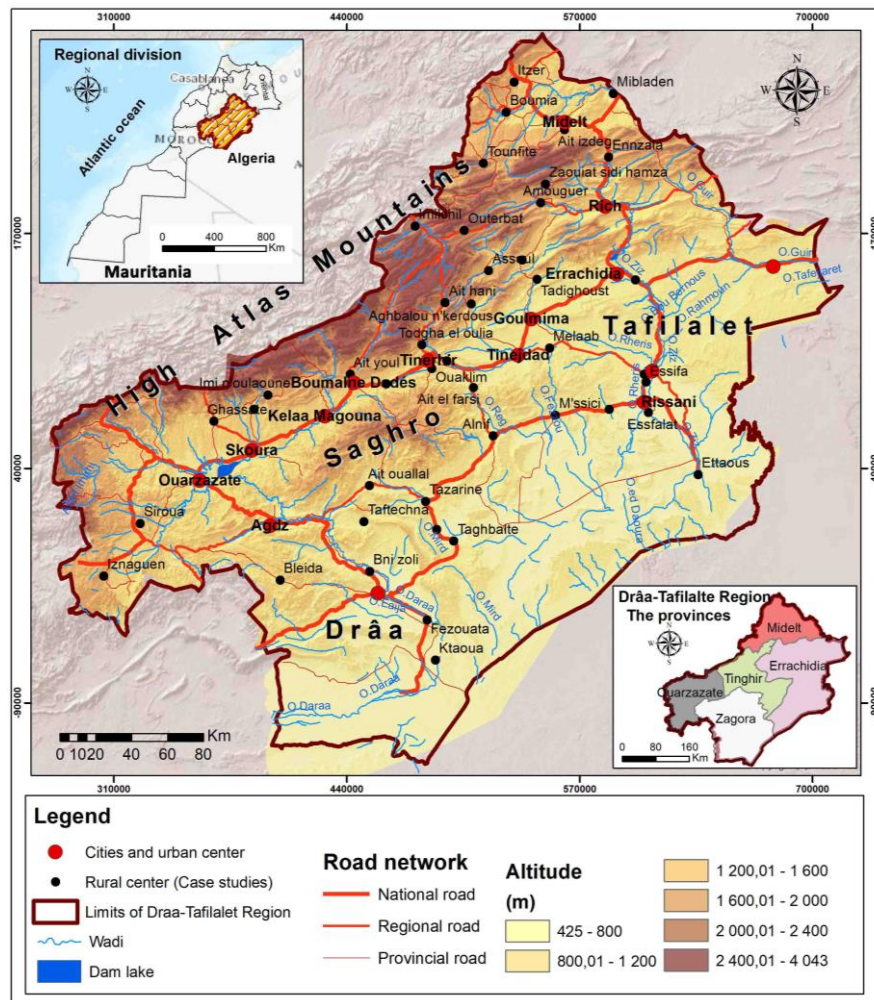


Figure 1. The studied area, five provinces of the Draa-Tafilalet region

Table 1. Selected monographic data of the Draa-Tafilalet region [16]–[18]

Provinces (DMU)	Area (km ²)	Population (2014)	Number of communes	Number of public institutions (2021)
Tinghir	12867	322 412	25	166
Midelt	11827	289 337	29	147
Errachidia	25326	418 451	24	218
Ouarzazate	11174	297 502	17	143
Zagora	23000	207 306	25	143

The global poverty ratio ranks the region among the three poorest regions in Morocco [16]. Based on the monetary indicator of poverty, the Moroccan Higher Commissariat of Plan considered the Draa-Tafilalet region to be the poorest in the country. Its education system is progressively developing due to public investments, mainly in rural schools’ building and human resources allocation, but deficits are still huge and the stressing socioeconomic factors favor national and international emigration from the region [19], [20]. The cycle of poverty produces social and spatial inequalities and the education system remains vulnerable. All over the world, where the links between poverty and education were studied, mutual incidences were confirmed [21]–[26]. However, in the Draa-Tafilalet region, spatial and local specificities appear in socioeconomic characteristics as shown in Table 2, and links between poverty and education

outcomes have to be compared between the provinces. The education system in the Draa-Tafilalet region is a part of the national system with regional governance under the responsibility of the Regional Academy of Education and Formation (AREF) locally represented by the Provincial Directions of Education. Each province had a provincial direction that supervise the education sector at its primary and secondary levels as seen in Table 3.

Table 2. Poverty and related indicators (in %) [16], [17]

Provinces (DMU)	Global poverty ratio	Monetary poverty indicator	Households' equipment in drinking water, electricity, and sanitation	Households' satisfaction with their housing conditions
Tineghir	26.2	14.4	18.00	21.4
Midelt	25.2	8.00	22.2	20.5
Errachidia	13.5	9.40	15.20	18.8
Ouarzazate	13.5	6.30	13.60	14.4
Zagora	27.8	16.10	14.02	24.7

Table 3. Secondary education public institutions and professors in the provinces of Draa-Tafilalet region [17]

Provinces (DMU)	Number of secondary education public institutions	Number of secondary teachers in public institutions
Tineghir	30	687
Midelt	17	525
Errachidia	38	942
Ouarzazate	21	551
Zagora	27	662

2.2. Methods

Several research questions were underlined since our preliminary investigation of the local education system in the Draa-Tafilalet region. The provincial scale is important to apprehend the differences between the education system's inputs and outputs. Comparing the education system's performance at this scale aims to underline the local realities and specific contexts impacting each province of the five units studied in the region. Each case must be understood and explained. They engender spatial change in education efficiency. Their indicators, causality, and factor apprehension in terms of the system's constraints and advantages produce useful elements in terms of planning prospective education priorities in this context. Questions of how allocated resources to education are adequate to achieve the system's efficiency and improve results (outputs), may be investigated to achieve progressive local education efficiency and reduce the spatial differences between the provinces. The question of territorial targeting is fundamental, mainly under scarce public budgets invested in these marginal areas.

The methodology adopted to apprehend the education system's efficiency at a provincial scale in this study is coupling results obtained from the data envelopment analysis (DEA) and a comparative data approach based on radar plots of education systems' factors in the studied provinces. Two major types of data were used in the analysis: i) Data from the National Census of Population and Habitat [16] completed by more recent statistics deduced from the provincial monographic; and ii) Statistics obtained from AREF Draa-Tafilalet. The first type is mainly composed of data related to the provinces' population, the public equipment, the socioeconomic parameters such as employment, activities and the education level of households for example. The second type of data is formed of statistics related to school numbers, teachers, students' repartition and gender, statistics of the baccalaureate results mainly in 2020 and 2021. The first type of data is mainly informing on about the contextual variables and the socioeconomic factors affecting the education system performance. The second type allows evaluation of the school's inputs (in terms of investments) and its outputs in terms of results, mainly in the baccalaureate level at secondary high school.

The parametric links between inputs and outputs were measured within the five provinces forming the Region Draa-Tafilalet (these provinces are Tineghir, Midelt, Errachidia, Ouarzazate, and Zagora). The comparison of the provinces' data to apprehend the education system's efficiency shows latent influences of local parameters that engender local differences in the education system's efficiency. The results are prominent in identifying spatial differences in education efficiency. They permit a discussion of the priorities in terms of decision-making and local education policy improvement. Taking into account the comparability conditions of variables (scale and periodicity) developed by Jonge, Veenhoven, and Kalmijn [27], we apprehend the five studied provinces in the region and obtained significant results.

A system's performance is generally evaluated by comparing the results (outputs) to input parameters (investments). Approaches adopted to study and measure this performance are multiple all over the world. The DEA is often preferred to compare performance in several sectors such as agriculture, energy, banking, and

education [28], [29]. These authors document its wide use both for purely methodological and real-world questions. The software tools development is supporting this evolution. The DEA is a non-parametric modeling technique also called frontier analysis. It is based on the use of linear programming and makes it possible to calculate the efficiency using inputs to produce the outputs [28]. The ratio (Thêta) produced for each observation is the result of dividing the weighted sum of the outputs over the weighted sum of the inputs. The calculations were carried out using the STRATA version 13 software. The software determines each observed province and efficiency rate (Thêta) and its ranking on the efficiency line (Rank). Provinces with a rate of 1 are comparatively and relatively efficient. Those with a rate below 1 are less efficient.

The DEA is elsewhere confirmed to be useful for apprehending education efficiency [1], [30]–[32]. Coupled with the profiling approach of education parameters in this study, the DEA produces useful data to compare the spatial variability of education efficiency in the studied provinces. The provinces are important administrative territories in the Moroccan education system as they have strong decision power to suggest projects and perspective actions to the Regional Academy of Education and Training, to elaborate its future programs. We, therefore, consider provinces as adapted DMU in the study. At the province's scale, the education system's performance is apprehended considering the system's outputs and its selected inputs. The outputs are expressed by the successful results in the baccalaureate (2020) and the importance (in %) of the high school education level of the population.

The system's inputs and their influencing factors in each province are considered. As confirmed elsewhere education and social context are mutually linked and impact each other [33] and their role in the transition to adulthood was confirmed [34]. In this study, the population number, the households' income, and other sociocultural factors are considered as influent variables on education. The importance of an active population, the importance of analphabet populations, and the basic equipment of households (drinking water and electricity) are among the influent factors that explain the results.

3. RESULTS AND DISCUSSION

3.1. Results

The comparison of provincial socio-economic data and the efficiency of the education system shows latent influences of external and local factors on the education system's efficiency. Useful elements in terms of decision-making and improvement of local educational policies were underlined in this study. Significant results were obtained from applying DEA in a constant return to scale model–input-oriented RTS (CRS)-ORT (IN) and are presented in Tables 4 and 5.

Table 4 shows the efficiency score estimated using the CRS-input-oriented DEA of secondary institutions in the five studied provinces of the region. The analysis correlated inputs in terms of the secondary institutions and the teachers with the outputs resumed by the baccalaureate results in 2020. The Thêta ratio obtained for each province allows a rational ranking where Midelt and Ouarzazate appear in the first place and Errachidia at the last position. Tineghir is in the fourth position. Due to the impact of education to reduce analphabets and increase the ratio of the educated population, these outputs were also considered as efficiency indicators and useful basis to rank the different DMU. Table 5 shows that Tineghir is in the last position and both Errachidia and Ouarzazate are in the first place, followed by Midelt and Zagora.

Table 4. CRS-input-oriented DEA efficiency results in Draa-Tafilalet region (2020)

Province (DMU)	Rank	Thêta
Tineghir	4	.811065
Midelt	1	1.0
Errachidia	5	.56467
Ouarzazate	1	1.0
Zagora	3	.844388

Options: RTS(CRS) ORT(IN) STAGE (2)

Table 5. CRS-input-oriented DEA efficiency results, analphabets, and population with high school level education (2020)

Province (DMU)	Rank	Thêta
Tineghir	5	.857451
Midelt	4	.934455
Errachidia	1	
Ouarzazate	1	
Zagora	3	.965436

To integrate the demographic differences and their potential impacts on the results, Figure 2 illustrates the provincial weight of the population in the region. The province of Errachidia is rapidly growing and has more than 418,500 inhabitants. Its administrative functions and economic activities are attractive. The other four provinces are closer in terms of population and each has a total of around 300,000 inhabitants as shown in Figure 2.

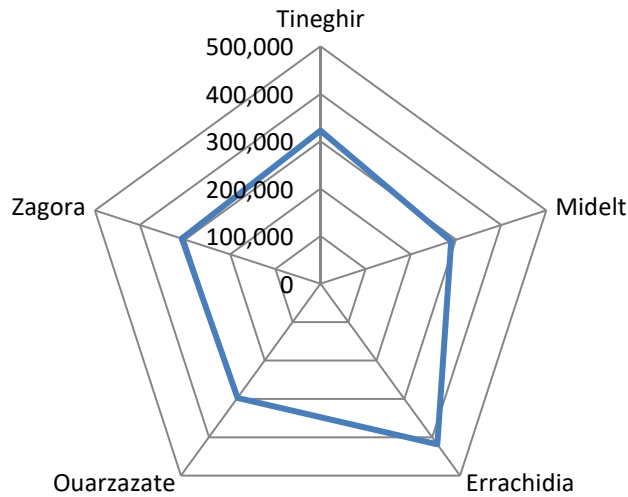


Figure 2. Distribution of the population in the provinces of the Draa-Tafilalet region

The province of Errachidia is rapidly growing and has more than 418,500 inhabitants. Its administrative functions and economic activities are attractive. The other four provinces are closer in terms of population and each has a total of around 300,000 inhabitants. The public investment in terms of education establishments contributes to meeting the needs of the population, and improves the educational rate of the population but can be conditioned in terms of performance and efficiency by other factors. Figure 3 shows the comparison of the provinces based on the distribution of the built high schools.

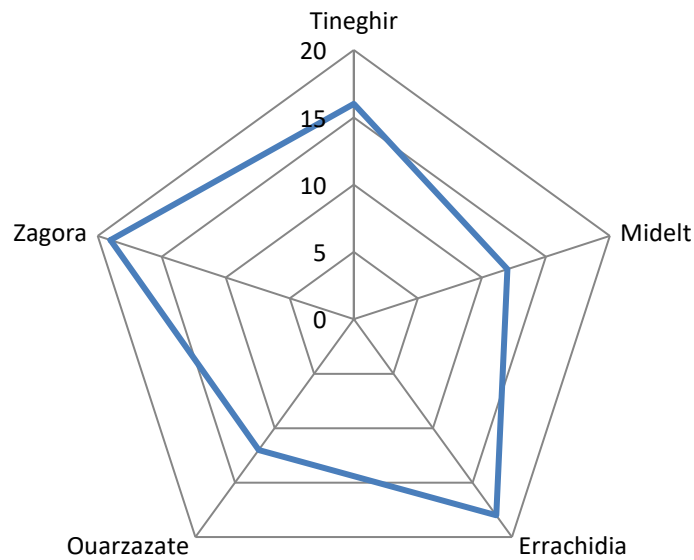


Figure 3. Distribution of the high schools in the Draa-Tafilalet region

The priority given to the province of Errachidia is due to its status as the capital of the region, and its largest demographic attractivity. But the government is engaging significant investment efforts in the newly created provinces such as Zagora to reduce the gap. Among the impacting factors on education results, is the importance of the active population in the area. Figure 4 shows the comparison between the provinces of the Draa-Tafilalet region.

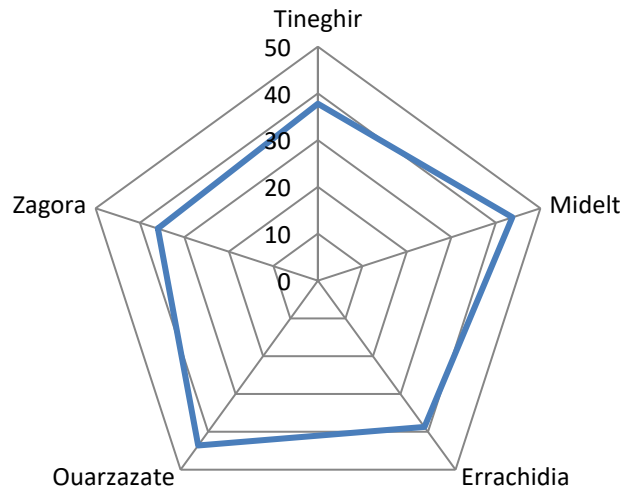


Figure 4. The active population of the provinces of the Draa-Tafilalet region (in %)

The provinces of Ouarzazate, Midelt, and Errachidia are in better positions. But knowing the local economy of these provinces, we may question the position of Midelt where rural economy (agriculture and forestry) is dominant. The problem of the equity lacking is often underlined within the rural population of this province and should be considered in discussing the education efficiency results in the area. The basic equipment of houses (mainly drinking water, electricity, and internet) is also important support to education. The access of households to this equipment improves the home working education and facilitates modern services for well-being and prosperity. Figure 5 compares the five provinces of the region in terms of houses' electricity equipment.

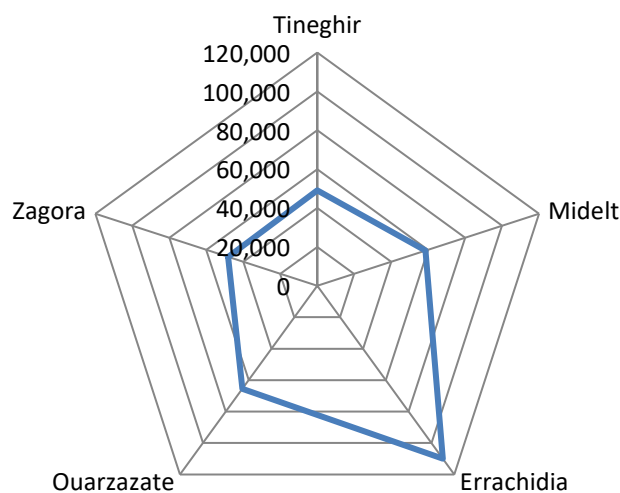


Figure 5. Number of houses connected to the electricity network in the provinces of Draa-Tafilalet region

The most equipped households with electricity among the five provinces are in Errachidia. Serious needs were noted mainly in Zagora and Tineghir. The importance of analphabets among the population aged 35 to 39 years in each province is another indicator of human development. It shows the school’s impact on the social environment. The comparison results of provinces in Figure 6 show the important proportions of analphabets in Zagora, Tineghir, and Midelt.

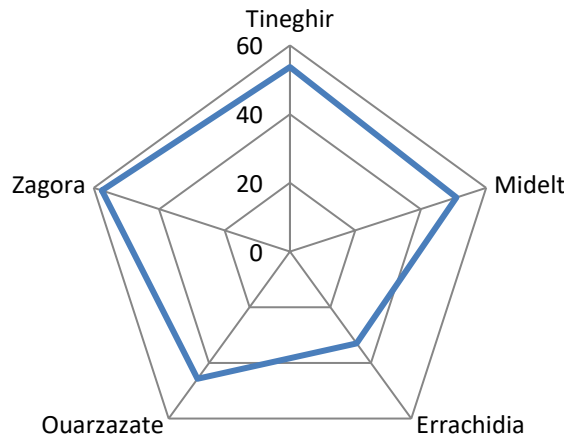


Figure 6. Analphabets (35-49 in age), in % of each province's population

Analphabetism is problematic as it limits the ability of individuals to understand and use the information to improve their income or even face unemployment. It reduces accessibility to training, professional development, and intergenerational transmission of experience. Oppositely an educated society favors innovation and encourages training and skills development. The importance of the population at the high school level is significant here. We compare the five provinces using this criterion as seen in Figure 7.

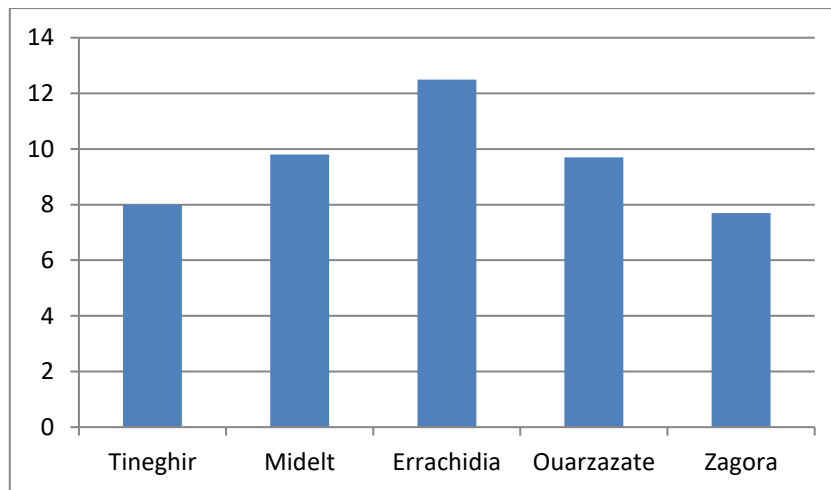


Figure 7. Population with high school education level at Draa-Tafilalet provinces

A major difference appears mainly between Errachidia and Zagora. Zagora and Tineghir have weak percentages of the population with a high school level. The various comparisons initiated between the studied provinces illustrate the differences noted in terms of influential educational parameters. They affect the system's outputs and efficiency. Among these outputs, we consider the number of high school student's success in the baccalaureate exam in 2020 as presented in Table 6.

Table 6. The rate of baccalaureate obtaining in Draa-Tafilalet region (2020 and 2021)

Provinces	Baccalaureate pass rate 2020 (%)	Baccalaureate pass rate 2021 (%)	Improvement (%)
Tineghir	78	85	7
Midelt	76	79	3
Errachidia	79	84	5
Ouarzazate	84	88	4
Zagora	83	87	4

3.2. Discussion

The results of this study give evidence of the scale's importance in evaluating and managing the education's needs, efficiency and performance. They support the evidence previously demonstrated by Suryani and Soedarso [35] and show that the spatial study of education may help in diagnosing and identifying prospective needs and planning actions. The spatial equity of education investments in education is a prerequisite to education's quality and should be considered in planning, investments and education policy's inputs [2]. Previous research in teachers' education recommended to seek quality at scale while comparing different policies in contexts [36].

The present study's results confirm the importance of contextualization in education performance and planning. We adopt it on a provincial scale. Our findings using both DEA analysis of education's efficiency and the comparative plots of key factors in education show the important differences between provinces in the Draa-Tafilalet Region. The causality and explanation factors were apprehended in the light of public investments in education and the socioeconomic status of households. They seem differently affect the outputs of the provincial education systems and their efficiency. These differences are partly linked to the historic administrative evolution in the area because the oldest provinces (Errachidia and Ouarzazate) have long benefited from public funding in education and therefore have a greater accumulation compared to the newly created provinces (Zagora, Tineghir, and Midelt). These inequalities show new priorities for future education action to attain the aimed equity and efficiency in education service. The ranking of education efficiency in the studied provinces using the "success in the baccalaureate" shows Midelt and Ouarzazate at first place and Errachidia at the last position. Tineghir is in the fourth position. The inputs in the last two provinces are not optimally used and the education system is less efficient.

The results of DEA in Table 5, present evidence of education impacts among the population, in terms of reducing analphabetism and rising the number of the population having high school level. Tineghir is ranked in the last position showing again its system's low efficiency. Further analysis of the comparative plot results including the socioeconomic factors, the equipment, and the household's income, for example, inspire other explanations and factors that may contribute to this situation. It is commonly accepted in the literature that all factors of the multi-dimensional poverty index [5] influence each other in a cycle process where a deprived household in one of the 10 indicators used to calculate this index, will also be deprived in others. In a decentralized context in Columbia for example, Melo-Becerra *et al.* [37] carried out an empirical analysis of inputs and outputs to estimate educational efficiency and conclude that unprepared local systems, deprived of national and regional financial support and expertise may face qualitative and quantitative education challenges. The education outcomes are also influenced by the socioeconomic variables because education performance is correlated with the social and economic development of the local context and vice versa. Education plays a major role in social integration [38], [39].

In North Africa including Morocco, Tunisia, and Egypt, it was argued that whether a person was born in a rural or urban area explains 30% of the inequality in school attendance and almost 50% of the inequality in access to sanitation [5]. Human and intellectual capital is also an asset of education. Differences in educational attainment as observed in the studied area, are influenced by this asset. It prevents poor people from becoming part of the high-productivity growth process and does not favor performance in the education system. The observed high ratio of analphabets and poor households in Tineghir confirms the fact that, for lack of resources, important populations could not invest in the development of their capacities and weakly focus on the demand for education. In this context, they could not acquire skills for the 21st century, that will be part of lifelong learning of the four C's (critical thinking, collaborating, creativity, and communicating) [5]. The future of education, mainly at the secondary level, will focus on skills, quality, and its indicators and measurement [40], [41].

In its benchmarking study of the educational systems in countries of similar development levels, the performance of a country in terms of school coverage is due to the public resources invested in its education sector, but demographic constraint and educational policies implemented and costs should be considered [4]. As a result, the Moroccan situation in terms of efficiency in the use of resources is unfavorable. Substantial public resources were invested but the country is less successful in education efficiency than many other countries, in opposition to what could be reasonably anticipated.

As demonstrated in the present study, the regional and provincial scales are not yet functional in terms of educational support and priorities targeting. In the African context, disparities in the education systems mainly at the secondary level, are extremely low internal efficiency due to the bad use of the existing scarce resources [42], [43]. As confirmed in this study, the case of the Draa-Tafilalet region shows major education disparities and education investments, inputs, and outputs differences between its provinces. Consequently, the education efficiency is also different as expressed by the baccalaureate results. The adopted scale of “provinces” in this analysis gives evidence of such disparities.

The education systems’ management will gain in changing the planning techniques, the low ability to manage schools, the didactic approaches, the contents of the curricula and reinforce the human development processes because a school is a part of its interactive ecosystem, and must be in perfect harmony with its components. The provincial and local scales are pertinent to apprehend the system’s specificities and therefore develop adapted decisions for policymakers, to plan and act projects and decisions that may improve education’ accessibility, quality and performance. Hence, doing comparisons within the same region, between provinces and local spaces, is a pertinent tool to contextualize the needs and permit targeted actions that serve the quality of education as defined by the United Nation’s SDG 04.

4. CONCLUSION

In regard to the results of this study, the provincial scale is significant to prepare a contextualized diagnose, planning and evaluation of the education systems in Morocco. The DEA and the comparative spatial approaches adopted in this study are useful and complementary approaches to identify and understand the spatial differences in the education system’s efficiency. The obtained results in diagnosis show contrasting cases at the provincial scale and may be pertinent for future planning of education systems improvement. The coupled analysis of DEA with plots of key variables of education is useful to assess the education system’s efficiency. We found evidence of weak education impacts among rural populations in the recently created provinces such as Tineghir, Midelt, and Zagora. They are still suffering from illiteracy and their education systems fail to improve the education level of the population. Based on this criterion, Tineghir is ranked in the last position. Considering the importance of public investments in the recently created provinces, it is obvious that this factor is not sufficient to explain observed realities. The provinces with major urban centers such as Errachidia benefit from high school infrastructures but it is not so efficient in terms of baccalaureate success compared with other provinces such as Ouarzazate or even Zagora.

Other factors intervene as the socioeconomic status of households, the population income, and public equipment for example. Finally, the profiles of education systems identified in the studied provinces differ. They confirm the importance of the local and provincial impacting factors. Better attention to these factors is needed in planning and doing, to achieve an improved education system efficiently. Unfortunately, the priorities presently given to increase enrolment of local and provincial factors are not sufficient because most plans were defined at national scales. The quality of service and the impacts of the contextual factors on education should be considered. The provincial scale, compared to larger scales, is the most adapted because it shows the impacts of local factors as they are operational in their own specific contexts. It is therefore pertinent to study and plan the education’s policy and activities in the provincial scale, and focus on the local specificities and contexts in terms of investments and quality decisions, to improve their performances. However, the transposability of these results to other countries needs certainly to define scales that fit to ensure proximity action and local specificities apprehension to develop the education system’s efficiency and sustainability.

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