International Journal of Educational Researchers
14(1): 18-30
ISSN: 1308-9501, Copyright © 2023
DOI: 10.29329/ijer.2023.522.2

Educational Research Association Turkiye • 2008
www.eab.org.tr
IJERs

ORIGINAL ARTICLE

Territorial Profiling of the Education System's Performance and Development's Sustainability in Draa Tafilalet Region (Morocco)

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Ethical Statement
No ethical considerations were needed.

Funding Information
No funding was received for the study.

Conflict of Interest
No conflict of interest is present in the conduction or the reporting of this study.

ABSTRACT

Despite the plethoric literature on the education systems' efficiency and its impact on sustainable development, issues of performance under specific conditions such as in the Moroccan rural contexts are still less studied. The questions of adapted scales to apprehend the education system's efficiency are raised. Instead of apprehending indicators at a national or regional scale, it is suggested to analyze causality and key parameters at a more detailed scale (provincial or even local). The aims of this study are to apprehend the spatial and territorial differences of the education system's efficiency using inputs, outputs, and causality in the provincial scale at Draa – Tafilalet region (Morocco). They are pertinent either to diagnose or to plan future education development and sustainability of local development. Official data collected from the General Census of Population and Habitat, the High Commissariat of Plan and the Regional academy of Education and Formation (Errachidia) are analyzed using the Data Envelopment Analysis (DEA) coupled with the profiling approach based on plots of key parameter. Useful indicators to compare the spatial variability of education system's efficiency in the studied provinces were produced and discussed. The five provinces of the region are considered as adapted Decision-Making Unit (DMU) in the study due to their power and competencies in the decision-making. The Data Envelopment Analysis approach coupled with key variables' plots is significant to study the spatial differences of education efficiency and development sustainability. It shows evidence of weak education impacts among rural population in the recently created provinces such as Tineghir, Midelt and Zagora. Based on this criterion, Tineghir is ranked in the last position and needs special attention. Considering the importance of public investments in the recently created provinces, it is obvious that this factor is not sufficient to explain observed realities. Other factors such as the socioeconomic status of households, the population income and public equipment intervene. To obtain a better education efficiency and reinforce the development sustainability, the priorities presently given to increase enrolment should change. The content and quality of service and the impacts of the contextual factors on education should be considered.

Keywords: Education, efficiency, DEA, provincial scale, Draa-Tafilalet Region, Morocco.

Received: 18/03/2022 **Accepted**: 23/12/2022

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INTRODUCTION

Quality of education, its efficiency and territorial equity are acute questions mainly in developing countries (Hill and Cole, 1999; BAD, 2013; UNDP, 2016; Delprato and Antequera, 2021). They are commonly considered among fundamental factors of sustainable development due to their evident impacts in societies and economies. The World Bank Group (2021) for example, noted that hourly earnings for one extra year of schooling increase by 9% in developing countries. Education drives long term economic growth and social cohesion. Its role as a driver of wellbeing, sustainable development, and social integration is confirmed (Wiborg, 2009). However, education's quality and efficiency are still facing major challenges in the middle-income countries and in 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 (Cuervo, 2016). A plethoric literature was produced on the schooling characteristics and impacts, mainly in the secondary level, to argue the needs of reforming the education policy. Silvia et al. (2020) investigated the important role of the performance of secondary school to ensure the success of students in their first year at the university and confirm the main impact in preparing students for future challenges. The questions of expanding enrollment and education efficiency are often privileged as research themes (Hughes, 2006; Gropello, 2006; Delprato and Antequera, 2021). The quality issues of education were discussed among other priorities (OECD, 2011). Nevertheless, issues of performance of the education policy under specific conditions as in the Moroccan rural contexts are still less studied.

In Morocco, inequalities in education may cause structural deficits in economic and social development. El Aoufi and Hanchane (2016) used the term "objective inequalities" to describe how the territorial vulnerability is important to consider in developing capabilities and their achievements, including the population's access to education and basic health in addition to the households' income. In terms of human wellbeing, they emphasize the beneficial effects of strengthening the conversion of resources to capabilities and projects' performance.

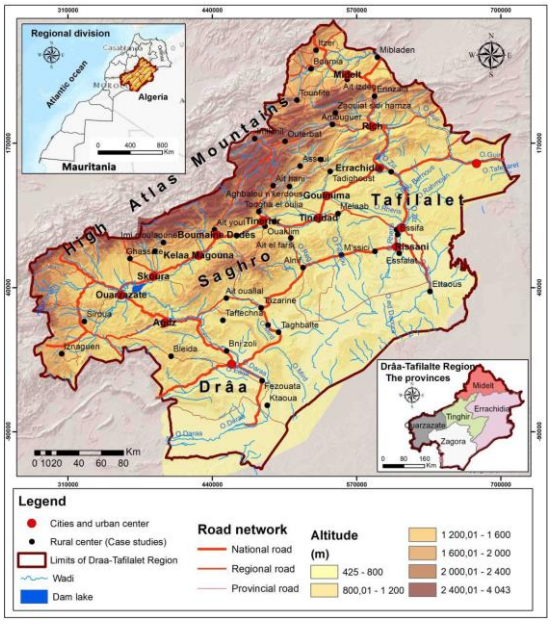
The Moroccan National Human Development Initiative (INDH), which focuses on social development, employment and reducing poverty, launched programs that aim to reduce the observed territorial and socioeconomic inequalities (INDH, 2005). It is supported by other programs of public sector where education is a national priority to attain a balanced and sustainable development. Although investments were huge in education, 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 (HCP, 2014).

Several indicators including the performance in education are contrasted in regional and provincial scales. They underline the crucial problem of how adequation between resources (inputs) and results (outputs) may be spatially achieved in terms of educational efficiency, how they are measured, and how this adequation may be used to improve territorial equity in the education strategies and policies. Considering the provincial authorities' institutional competencies in territorial management and public services, the province framework is commonly considered as a main "decision making unit" (DMU). The benchmarking of secondary schooling in different provinces is based on their specific data, and allow a territorial profiling that facilitates the apprehension of equipment inequalities and how local factors are influencing the education policy in the region. Therefore, the alternative strategies may be implemented in the provincial scale.

Information About the Region

The Draa - Tafilalet region is marginal in position and located in the southeastern Morocco (Figure 1). The geographic position and environmental context vulnerability are among the Draa - Tafilalet region's characteristics. They do not facilitate the public equipment's proximity for population and the quality of education services offered to communities. Rurality is dominant in the uplands, hills and mountain areas and in the 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.

Figure 1. The studied area (The five provinces of Draa Tafilalet region)



Created in 2015, the region is still suffering from equipment and development deficits in its rural areas. The most equipped province in public administrations is Errachidia (Table 1).

Table 1. Table heading. Table headings should use 7-point size.

Provinces (DMU Decision- Making Unit)	Area in Km^2	Population (2014)	Number of communes	Number of public institutions (2021)
Tineghir	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

Source: Monography of Draa -Tafilalet region (2016), HCP, 2014, Draa -Tafilalet Regional Academy for education and training, 2021.

The global poverty ratio ranks the region among the three poorest regions in Morocco (HCP, 2014). 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' buildings and human resources allocation, but deficits are still huge, and the stressing socioeconomic factors

favor national and international emigration from the region (Essayouti, 2012; HCP and WB., 2017). 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 (Zhang, 2014; Oum, 2019; Brown and James, 2020; Queiroz et al., 2020; Hofmarcher, 2021 ; Asongu et al., 2021). 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.

Table 2. Poverty and related indicators (in %)

Provinces (DMU Decision-Making Unit)	Global poverty ratio	Monetary poverty indicator	Households' equipment in drinking water, electricity and sanitations	Households' satisfaction of 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

Source: HCP. (National Population and Habitat Census, 2014) and Monography of Draa Tafilalt region (2016).

The Education system in the Draa -Tafilalet region is a part of the national system with a regional governance under the responsibility of the AREF (Regional Academy of Education and Formation), and locally represented by the Provincial Directions of Education. Each province has a provincial direction which supervise education sector in its primary and secondary levels.

Table 3. Secondary education public institutions and professors' numbers in the provinces of Draa – Tafilalet region

Provinces (DMU Decision-Making Unit)	Number of secondary education public institutions	Number of Secondary teachers in public institutions
Tineghir	30	687
Midelt	17	525
Errachidia	38	942
Oarzazate	21	551
Zagora	27	662

Source: Draa – Tafilalet Regional Academy for education and training, 2021.

Research Questions

Several research questions were underlined since our preliminary investigation on the local education system in the Draa - Tafilalet region. The differences between education system's inputs and outputs are different comparing the five provinces of the region and must be understood and explained. They engender spatial changing in the education efficiency; their indicators, causality and factor's apprehension in terms of system's constraints and advantages to produce useful elements in terms of planning prospective education prioritized in this context. Questions of how adequate resources allocated to education are 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.

METHOD

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.

Context and Sampling

The parametric links were measured within the five provinces forming the Region Draa - Tafilalet (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 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.

Procedure & Data Analysis

A system's performance is generally evaluated comparing the results (outputs) to input parameters (investments). Approaches adopted to study and measure this performance are multiple all over the world. The Data Envelopment Approach (DEA) is often preferred to compare performance in several sectors such as agriculture, energy, banking, and education (Charnes et al., 1978; Liu et al., 2013). These authors document its widely use both for purely methodological and real world questions. The software tools development supports this evolution. The Data Envelopment Approach (DEA) is a non-parametric modelling 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 (Charnes et al., 1978). The ratio (Theta) 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 for 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 (Thanassoulis, 200; Ramanathan, 2003; Aparicio et al., 2019; Delprato and German, 2021). 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 Decision-Making Unit (DMU) in in the study. At the provinces scale, the education system's performance is apprehended considering the system's outputs and its selected inputs. The outputs are expressed by the success 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 have impact on each other (HCETSR, 2018) and their role for the transition to adulthood was confirmed (Tsipianitis et al., 2019). In this study, the population number, the households' income and other sociocultural factors are considered as influent variables on education. The importance of active population, the importance of analphabet populations, the basic equipment of households (drinking water and electricity) is among influent factors that explain the results.

RESULTS

The comparison of provincial socioeconomic 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 Data Envelopment Analysis (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 Data envelopment analysis of secondary institutions in the five studied provinces of the region.

Table 4. CRS-INPUT Oriented Data Envelopment Analysis Efficiency Results, in the provinces of Draa Tafilalet Region (2020).

Province (DMU Decision-Making Unit)	Rank	Thêta
Tineghir	4	.81
Midelt	1	1.0
Errachidia	5	.56
Ouarzazate	1	1.0
Zagora	3	.84

Note. Options were: RT(CRS), ORT(IN), STAGE(2).

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 at 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 educated population, these outputs were also considered as efficiency indicators and useful basis to rank the different decision-making units. 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 5. CRS-INPUT Oriented DEA Efficiency Results: analphabets and population with high school level education (2020).

Province (DMU Decision-Making Unit)	Rank	Thêta
Tineghir	5	.86
Midelt	4	.93
Errachidia	1	
Ouarzazate	1	
Zagora	3	.97

To integrate the demographic differences and their potential impacts on the results, Figure 2 illustrates the provincial weight of population in the region. The province of Errachidia is rapidly growing and actually has more than 418.500 habitants. 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 meet the needs of the population, improves the educational rate of the population but can be conditioned in terms of performance and efficiency by other factors. Figure 3 shows a comparison of the provinces based on the distribution of high schools built. We understand the priority given to the province of Errachidia, which is home to the largest demographic mass in the region, and we can see the significant investment effort in the newly created provinces such as in Zagora.

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

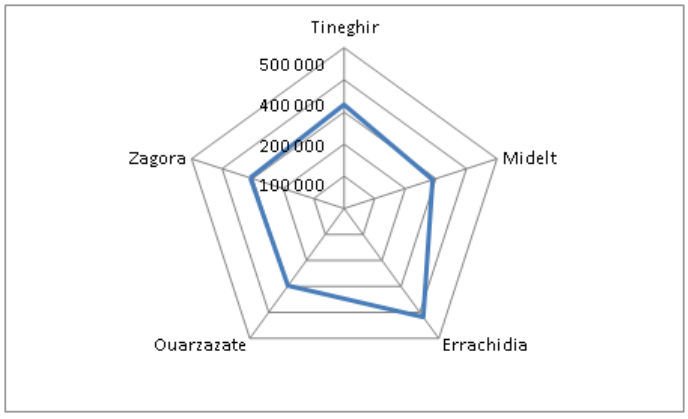


Figure 3. Distribution of the high schools in the Draa-Tafilalet Region

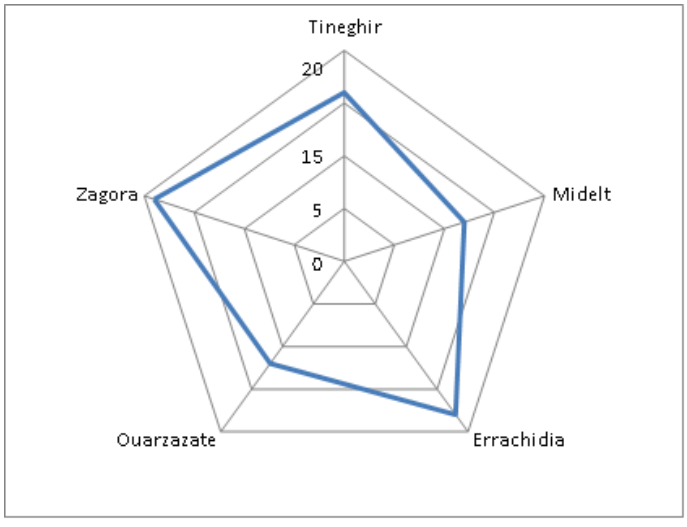


Figure 4. Active population the provinces of Draa-Tafilalet Region (in %)

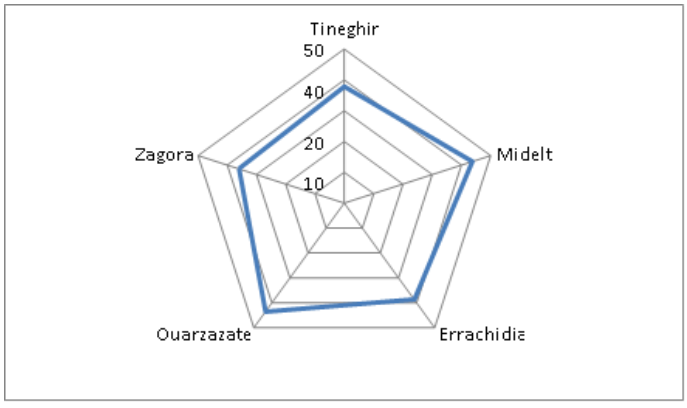
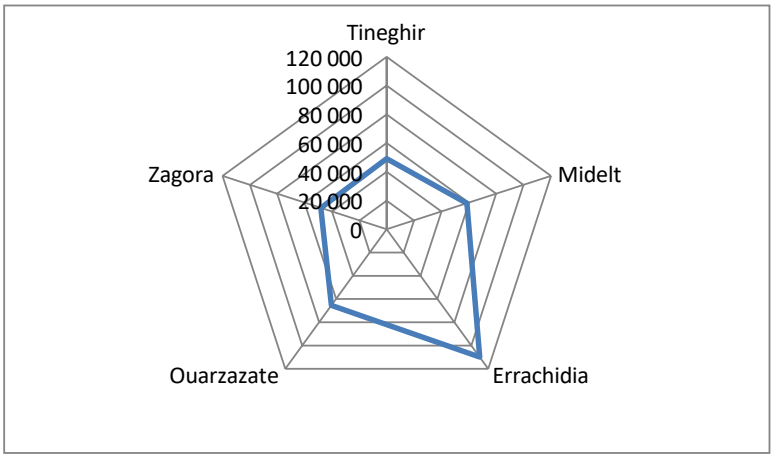


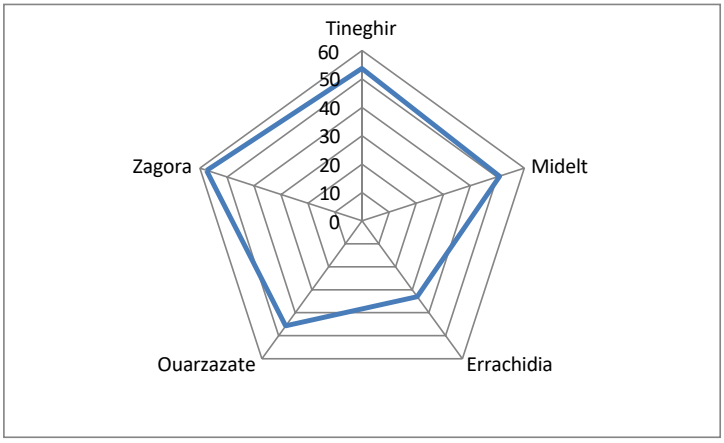
Figure 5. Number of houses connected to electricity network in the provinces of Draa – Tafilalet Region



The importance of the active population in the area is among the impacting factors on education results. Figure 4 shows a comparison between the provinces of Draa - Tafilalet region. The provinces of Ouarzazate, Midelt and Errachidia are in better position, but knowing local economy of these provinces, we may question the position of Midelt where rural economy (agriculture and forestry) is dominant. The problem of the lacking equity 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) are also important for education. The access of households to this equipment improves the home education and facilitate modern services for well-being and prosperity. Figure 5 compares the five provinces of the region in terms houses' electricity equipment.

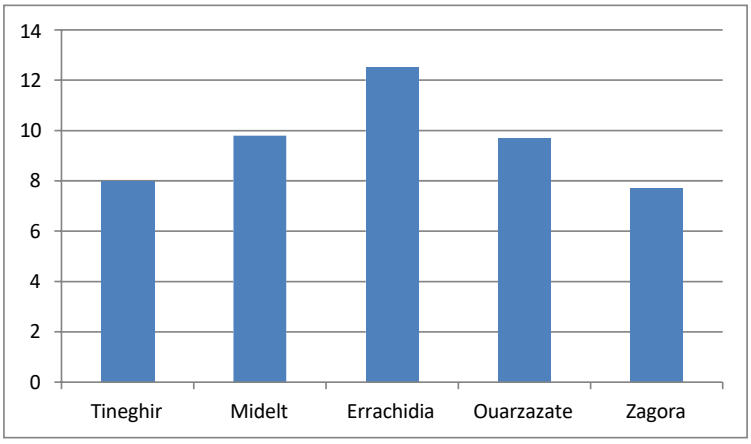
The most equipped households in electricity among the five provinces is in Errachidia. Serious needs were noted mainly in Zagora and Tineghir. The importance of analphabets among the population aged 35 to 39 years in each province is another indicator of the human development. It shows the school's impact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

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



The analphabetism is problematic as it limits the ability of individuals to understand and use 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 with high school level is significant here. We compare the five provinces using this criterion (Figure 7).

Figure 7. Population with High School education level (in %) at Draa - Tafilalet Provinces



A major difference appears mainly between Errachidia and Zagora. Zagora and Tineghir have weak percentages of population with a high school level. The various comparisons initiated above 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 students' success at the baccalaureate exam in 2020 (Table 6).

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

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

DISCUSSION

As demonstrated by Green and Letts (2007) the spatial study of education may help in diagnosing and for identifying prospective needs and planning actions. We adopt it in 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 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 to affect the outputs of the

provincial education systems and their efficiency differently. 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 the 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 DEA results in table 5 present evidence of education impacts among 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. A further analysis of the comparative plots 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 (UNDP, 2016, p. 68) 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. (2020) carried out an empirical analysis of inputs and outputs to estimate educational efficiency and concluded that unprepared local systems deprived of national and regional financial supports 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 social and economic development of the local context and vice versa. Education plays a major role in social integration (Wiborg, 2009).

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 percent of the inequality in school attendance and almost 50 percent of the inequality in access to sanitation" (UNDP, 2016, p. 76). The 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 do not favor performance in the education system. The observed high ratio of analphabets and poor households in Tineghir confirm the fact that, for lack of resources, important populations could not invest in the development of their capacities and weakly focus on 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, Creating and Communicating (UNDP, 2016, p. 115). The future of education, mainly in the secondary level, will focus on skills, quality and its indicators and measurement (Michael and Modell, 2003; Charu and Narayan, 2018).

In its benchmarking study of the educational systems in countries of similar development level, the African Bank of Development (BAD, 2013) argued that the performance of a country in terms of school coverage is due to the public resources invested for its education sector, but demographic constraint and educational policies implemented, and costs should be considered. 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 the 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 education's support and priorities targeting. In the African context, disparities in the education systems mainly in the secondary level, have extremely low internal

efficiency due to the bad use of the existing scarce resources (Lauglo and Maclean, 2005). As confirmed in the case of Draa-Tafilalet region in this study, the same region shows major differences between its provinces. The education systems' management should change 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.

CONCLUSION AND RECOMMENDATIONS

The Data Envelopment Analysis approach and the comparative spatial approach adopted in this study are significant to identify and understand the spatial differences of education 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 population in the recently created provinces such as Tineghir, Midelt and Zagora. They are still suffering of analphabetism 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 efficient in terms of baccalaureate success compared with other provinces such as Ouarzazate or even Zagora. Other factors such as the socioeconomic status of households, the population income, and public equipment intervene. Finally, the profiles of education systems identified in the studied provinces differ. They confirm the importance of the local impacting factors. A better attention to these factors is needed to achieve an improved education system. Unfortunately, the priorities presently given to increasing enrolment of local factors are not sufficient. The quality of service and the impacts of the contextual factors on education should be considered.

Acknowledgments

Thanks to Prof. Sabiri Aboubakr for the location map design and to Prof Hamid Akdim for the DEA calculating data. The logistic support of the University Sidi Mohamed Ben Abdellah, Fez is appreciated.

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