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Mitigation of Regional Disparities in Quality Education for Maintaining Sustainable Development at Local Study Centres: Diagnosis and Remedies for Open Universities in China

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Abstract: Regional disparities in quality education remain a sensitive issue in developing and developed countries and also in basic and higher education. The issue for the moment is especially crucial for open educational institutions regarding the stability of the open education ecosystem and the capacity for sustainable development. Our research focuses on the aspect of the quality of teaching and learning and its enhancement. In the study, we systematically explored the regional disparities of teaching and learning quality in local study centres with samples of 72 from Jiangsu Open University (JOU), China. With statistical toolkits and a typological research paradigm, we have identified the ranking of the local study centres according to holistic performance. By the clustering methods, we categorised the local study centres as belonging to four types: potentially contradictory, urgently to be reformed, less cost-effective, and normatively autonomous in terms of their basic attributes, learners' support services, and teaching commitment. The research findings proved that the region where the study centres are located did have impacts on the quality of teaching and learning, and the scalability of student enrolment. The authors conclude and suggest that mitigation of the regional disparities in quality education will facilitate the optimisation of the local study centres in the regional education ecosystem and maintain sustainable development.

Keywords: regional disparities; local study centre; quality education; evaluation; open, flexible and distance learning; statistical analysis; education ecosystems; sustainable development

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1. Introduction

1.1. Background for the Research

Regional disparities in quality education present a sensitive issue not only in developing countries but the issue has often arisen and been discussed in wealthier countries even back to the 1960s [1–6]. Globalisation, worldwide migrations due to wars or natural disasters, for example, the pandemic of COVID-19, make the situation worse [7].

Through the lens of regional disparities of quality in education, some factors will be dependent upon social background, economic status, government policies, parental/peer influences, and perception of schooling, etc. Sumioka [8] lists six aspects of the regional disparities in education, the most impressive factors are the visible and invisible disparities in the regions. Other commonly-mentioned disparities lie between urban and rural regions, which link with social and economic development in terms of GDP per capita, decentralised educational funding allocation, the population density of well-educated people and a friendly ecosystem for talented people [9–15].

The regional disparities of quality education in terms of teaching and learning are present not only in the field of K 12 education but also exist in higher education [16–18]. However, with the booming of a brand new generation of scientific and technological revolution represented by clouds, big data, the internet of things, mobility and smartness [19],

higher education is no longer limited to campus, offline teaching. On the contrary, it has taken the online mode for assurance of educational equity. Lifelong learning is embedded in the conception of a learning society, a knowledge society.

To mitigate the gap of regional disparities in education, adopting the mode of open education (OE) seems to be the best roadmap for quality education [20], especially in higher education. The governments of most countries invest in building up mass higher education systems and developing infrastructures for equitable and available access to educational resources in public educational institutions. In doing so, the inclusion and equality of educational missions will be achieved and secured [21].

The concept of OE is an umbrella term covering a wide range of issues such as open educational resources, open science, open pedagogy, open data, and open scholarship, etc. [22]. At the same time, it has undertaken the important task of building an open, flexible and distance learning (OFDL) system. An open university is an important form of OE in the field of higher education. In terms of its attributes and mission, it is much more expressive than ordinary universities in terms of classical concepts and open attributes [23].

Quality in higher education is another concern for equality and equity of education [24,25]. In addition, in open universities, the governance, management, assessment, and control of quality, in terms of holistic performance, human resources, organisation, teaching and research, are undergoing continuous evaluation to achieve the institutional goals and objectives.

1.2. Theoretical Underpinning Theories

1.2.1. Bronfenbrenner's Ecological System Theory

Urie Bronfenbrenner believed that the development of humanity is always in the process of interaction between an individual and the environment to which they connect. In his ecological model, he lists four systems: the microsystem, the mesosystem, the exosystem, and the macrosystem. Later in his career, he added the chronosystem into his theory. All these five systems are interrelated and interact with each other surrounding the individual with direct or indirect impacts [26]. Bronfenbrenner originally aimed at studying child development; however, the model offers a holistic approach to understanding development shaped by the environment, that is, the ecosystem. In practice, the ecological system theory suggests that an individual/institution will surely change with the surrounding environment in the ecosystem. In other words, the OU system is an individual in the educational mesosystem in the holistic social and economic system in China.

1.2.2. The PEAR Model of Sustainable Development

The concept of Sustainable Development (SD) first appeared in the Brundtland report in 1987. She created the concept of sustainable development with its new guiding principle for United Nations [27] and was accepted five years later, in 1992, at the Rio Earth Summit. The definition reads: "Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

UNESCO issued the Sustainable Development Goals (SDGs) in 2015 to ensure people, especially children and younger adults, have equitable access to quality education, aiming to reduce poverty and promote inclusive societies in its member countries [28].

Sustainability is a holistic design or framework linking three dimensions: ecosystem, economies, and social justice. It is not a state. It can be considered a process, a continuing process, or a model. It is not an ultimate goal for realisation in one stage, but a guiding principle, a theory for directing people's action in the slow evolution process.

Based on the context, Bilgin proposed his PEARL model attempting to integrate multidisciplinary issues into one intertwining framework:

1. Perception
2. Environment
3. Action
4. Relationship

5. Locality

This model has theoretical, pedagogical, and practical significance in that it calls for institutional integrity for SD, institutional responsibility for social justice and regional responsiveness with a qualitative understanding of various objective, subjective and measurable indicators [29].

1.2.3. Iron Triangles Theory

The triangle theory (often called the Iron Triangle) refers to in higher education the three major challenges: cost, access, and quality; latterly accessibility, quality and efficiency.

The triangle theory has been applied extensively in management with an adaptation of diverse naming of each side. In his 'triangle of assurance' theory of higher education quality assurance, Barnett suggests that academic power, state power, and market influence affect the higher education system in each country to varying degrees, and in the case of quality assurance, government, academia, and the market are the three main interest groups facing universities [30]. Daniel's 'iron triangle' theory of traditional higher education suggests that quality, cost, and effectiveness are the three main factors in the development of quality in traditional higher education mutually constraining and influencing each other. He and his colleagues advocated an alternative route to access higher education via open and distance learning for the fulfilment of "wide access, high quality and lost cost" in his paper "Breaking Higher Education's Iron Triangle: Access, Cost and Quality" [31].

1.3. Related Research

After more than 40 years of reform and progress, Open Universities (formally Radio and Television Universities, OU) in China have helped popularise higher education and build a lifelong education system. However, with the bourgeoning expansion of digital transformation with online learning in higher education for the last two decades, conventional universities, particularly elite ones, have commenced taking the steering wheel in the traditional fields of open universities with the introduction of MOOCs [32–34]. OUs, the main task force for open, flexible, and distance learning (OFDL), have been experiencing a critical risk of survival in terms of the scalability of student populations. Worst of all, the uneven development within the OU system, namely the regional disparities in local study centres, severely hinders sustainable growth. Local study centres, though the end of the chains of provision of OFDL facing the end users, should be studied. Their problems in the OU system in the digital transformation process should be perused and solved to maintain sustainable development [35–38].

Having searched the China National Knowledge Infrastructure (CNKI), a total number of 129 papers with the keywords study centres has been found. With the keyword *Jicheng Dianda Fenxiao*, the Chinese equivalent of Study Centre, 59 papers were listed. Among the 59 papers, the majority of them were position papers, focusing on the proposals for enhancing and improving the OU system; only around twenty fewer papers addressed the local study centres in terms of teaching support services, management, or policies. Some scholars expressed concerns about the regional disparities from the perspective of economic development [39,40], and some addressed the decline in the enrolment of students [41–43]. In his article, Ding analysed four types of local learning centres: single, two-functional, three-functional and hybrid, from the case of N. Open University in ZJ Province. Based on SWOT analysis, he made a credible analysis from two internal and two external dimensions: strengths, weaknesses, opportunities, and threats [44]. In 2005, Zhou conducted a questionnaire survey on learning support services for distance education at Jiangsu Open University (JOU), trying to understand the current status of learning support services at JOU, and conducted a regional comparison study on learning support services through data analysis [45].

As we reviewed above, the majority of publications in China are concept or position papers. Rarely could we find empirical studies with statistical data which made the analysis of the status quo in the local study centres comprehensive. As such, we intend to scan the

local study centres in JOU from a different perspective, conducting a holistic evaluation of quality education with statistical models in terms of engagement by faculty and students, online teaching, and basic information on scalability. With the backdrop of the decreasing access and increasing cost, and realisation of sustainable development at the local study centres, we propose the following hypothesis:

1. There exist regional disparities in the urban and rural study centres in terms of teaching and learning.
2. The rural study centres have a better geographical advantage in terms of the scalability of student enrolment.

2. Materials: Model and Data Analysis

2.1. An Overview of the Structure of Open Universities in China

Open Universities in China have constructed a dramatic network in the traditional headquarters–periphery model offering OFDL in higher education with branch campuses and local study centres scattered all over both urban and rural areas of the provinces and autonomous regions in the country. To date, there exist six open universities, that is, Jiangsu Open University (JOU), Yunnan Open University, Beijing Open University, Guangdong Open University, Open University of Shanghai, and the Open University of China; the last of which is the largest with more than 30 branch campus in the country. All the open universities have been accredited by the State Ministry of Education and are eligible to offer baccalaureate degrees to a large population of adults, old and young and lifelong learners regionally and nationwide. Consequently, there is a concern over the quality of teaching and learning in such a hierarchical educational network. Daniel [46] believes that the triangular relationship between Cost, Access and Quality should be balanced in terms of quality assurance. As a ladder for the educational equality and mobilities of the ordinary people, the provision of OE by the open universities faces challenges from the diversities and differences in regional quality of teaching and learning [47,48].

In the headquarter-peripheral structure of the Open Universities in China, such as headquarters—provincial branches—city-level colleges—county-level study centres, it is the "study centre" that provides various kinds of educational services (see Figure 1). The local study centres not only need to handle routine management in alignment with the regulations and directives from the higher level of administration but also provide a full range of learning support services to the learners registered at their centres, including the allocation of tutors, student registration and examination, communications, and daily management of the centre and affective support if learners are in need. As the last ring in the OE chain of course delivery, their diverse nature and operation mode indirectly lead to their different roles, while their differentiated teaching and learning quality directly determines the provision of quality of educational services, affects their social reputation, and induces them to form different types of institutions. Therefore, the local study centre is considered the cornerstone of the quality in the entire OE system and plays a crucial role in guaranteeing the quality of teaching and learning and the well-being and happiness of the learners [49].

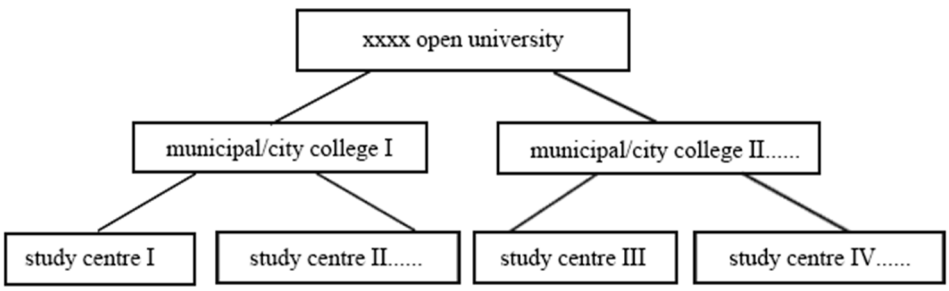


Figure 1. The hierarchical structure of open universities in China.

The division of study centres falls into diverse types in the perspective of modes of educational practice according to different scholars. In the mode of construction, they can be divided into independent, jointly constructed and shared, and social and public services; according to the learning mode, study centres can be divided into serving individual learning and serving group learning [50]; to the mechanism of operation, they are divided into traditional study centres, course-based study centres, and recognised deemed study centres [51]; and from the perspective of institutional organisation and management, they can be divided into minimalist, community-based, partner-based, exclusive, corporate and regional centre models. However, divisions based on the quality of teaching and learning have been discussed less in the myriad of literature on OFDL [52].

2.2. Selection of Samples and Index System

In this study, the school of open learning of JOU was selected as the research object. JOU, the member university of Mega Open University Alliance recognised by UNESCO and a flagship higher educational institution in terms of teaching and learning quality, enrolment scale, and total qualities of management in China, performs a good sample for the research of sustainable development in OE. JOU runs independently with its courses for the province, while the school of open learning is responsible for relaying the courses by the headquarters of the National Open University of China. The school of open learning in JOU currently has more than 60,000 registered students scattered across the province; of course, the number of student enrolments has been decreasing in recent years because of the active participation from the conventional universities with the provision of MOOCs (see Figure 2).

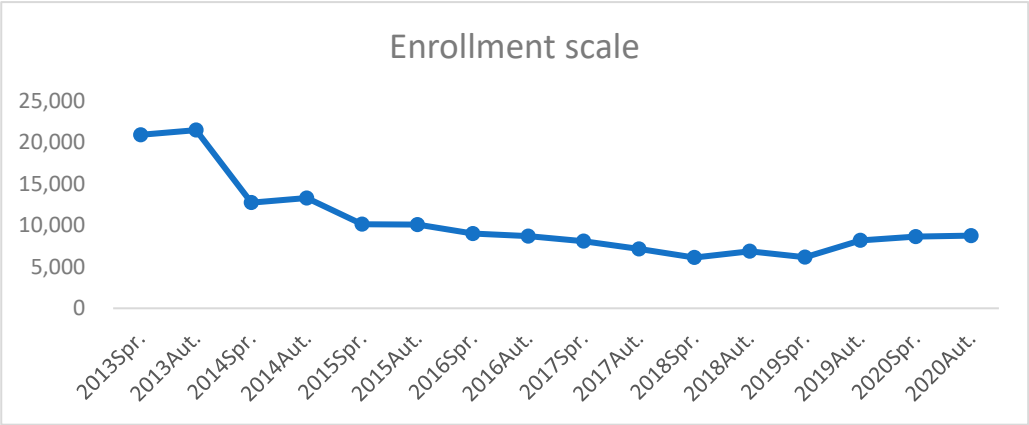


Figure 2. The tendency for the enrolment scale in the school of open learning, JOU.

The study centres under the jurisdiction of 13 cities in the province were scanned by systematic research radar, and finally, 72 study centres were selected to be the objects of the study. In terms of regional distribution, these study centres spanned 13 cities in the northern, central, and southern parts of the province; in terms of the level of operation, there are 12 city-level colleges and 60 county-level study centres.

The data for this study were sampled from log files of the learning platform in which 15 indicators for observation on demographics and online learning behaviours: the number of students who were enrolled at the study centres; the number of active registered students; the number of academics; the number of physical classes organised for tutorials; the number of students registering at learning system; the number of online classes with assigned tutors; the proportion of students accessed the system to learn; the proportion of teachers accessed system to teach; the allocation rate of teachers for online courses; the number of times students logged into the system per capita; the number of days students accessed system per capita; the number of posts shared in the course forum per student; the number of

times teachers logged into the system per capita; the number of days teachers accessed system per capita; and the proportion of effective behaviour per capita.

2.3. Models Constructed for Generic Assessment of the Quality of Teaching and Learning

The model for scoring and the model for comprehensive score (F) of the relevant factors can be obtained through the table of factor loading values and total variance interpretation. Having determined the evaluation significance of the main factors, the linear expression of each factor on the original index variables was obtained in line with the factor loading matrix. Finally, the comprehensive score of the four main factors was generated by calculation F = W1xF1 + W2xF2 + W3xF3 + W4xF4, in which the four main factors F1, F2, F3, and F4 replaced the original 15 basic observation indicators from the comprehensive assessment model for educational quality in local study centres (see Figure 3), F was the comprehensive evaluation index, W represented the weight, which was composed of the variance contribution rate corresponding to the eigenvalues of the main factors. The model for the score of the factors and the comprehensive score F can be seen in Figure 4:

2.4. Data Analysis

The data extraction for the abovementioned observation indicators was collected from the log files in the learning platform of JOU before the end of the autumn semester of 2020.

The Statistical Package for Social Science Data Analysis (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY, USA: IBM Corp) was utilised to analyse quantitatively the research data for this study.

After the data were standardised, the test of fitness was performed, and the Bartlett spherical test was used to check whether the relevant array was a unit array and whether it was suitable for extracting the common factors for the next step of factor analysis. After the cumulative variance contribution was counted by principal component analysis, the factors were then rotated, and the common factors were extracted by Caesar's normalised maximum variance method, and the number of factors to be extracted was subsequently cross-validated by scree plot to guarantee the appropriateness of factor extraction.

To construct a comprehensive score model for the teaching and learning quality at the local study centres, a comprehensive evaluation model was derived based on the factor loading values to the score model of the relevant factors after statistical weighting analysis of each evaluation index. To determine the teaching quality traits and degree of the study centres participating in the study, the 72 study centres were evaluated for quality by the constructed comprehensive score model.

In the process of typological review, the study centres were classified by K-means cluster analysis, and the main characteristics of each type were analysed. Fisher Discriminative Analysis (FDA) was used to conduct the discriminant test, and Cross-Validation was performed to ensure the validity of the classification of study centres and to identify the potential traits of the categories of study centres.

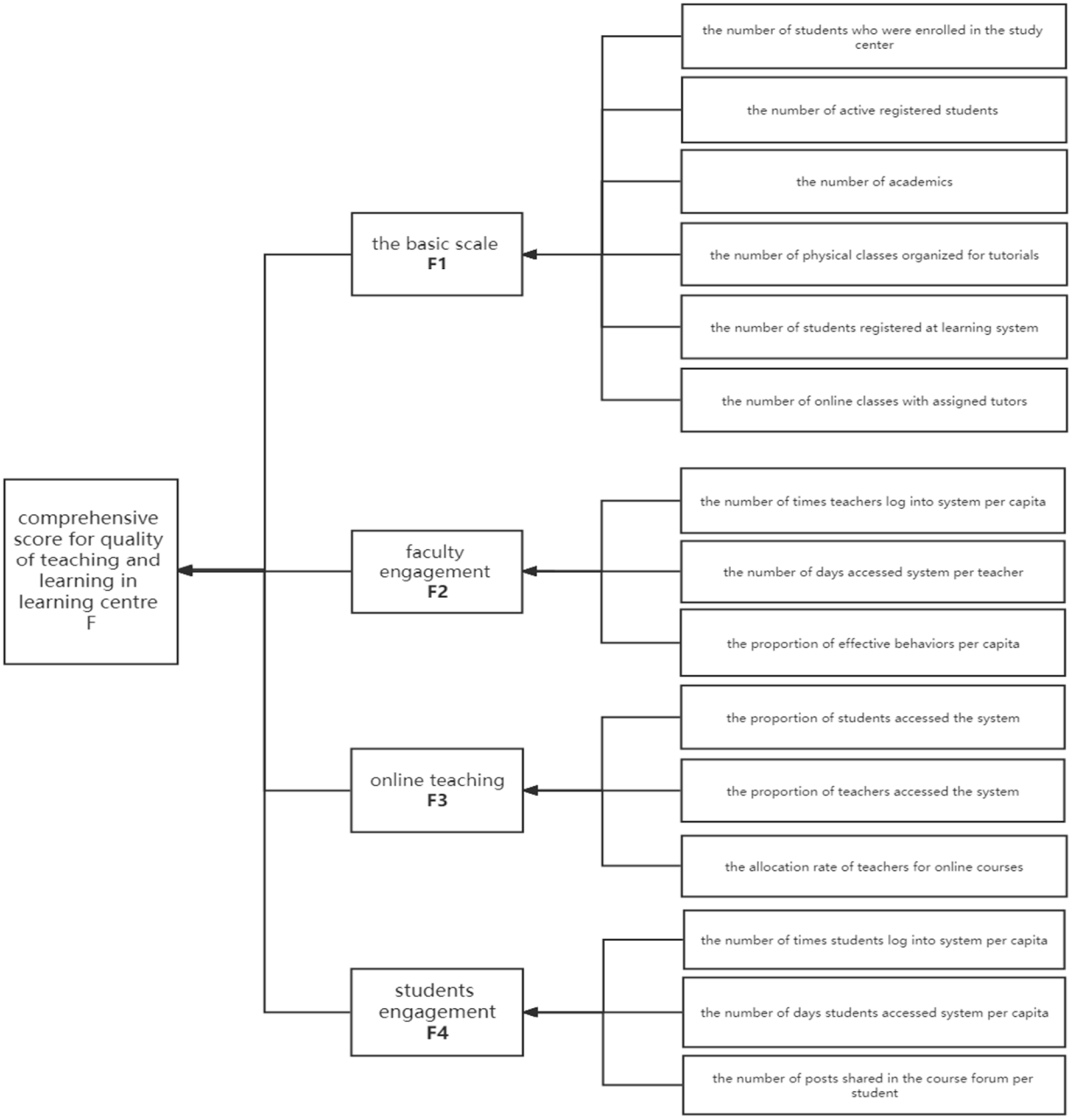


Figure 3. Assessment model for educational quality in local study centres.

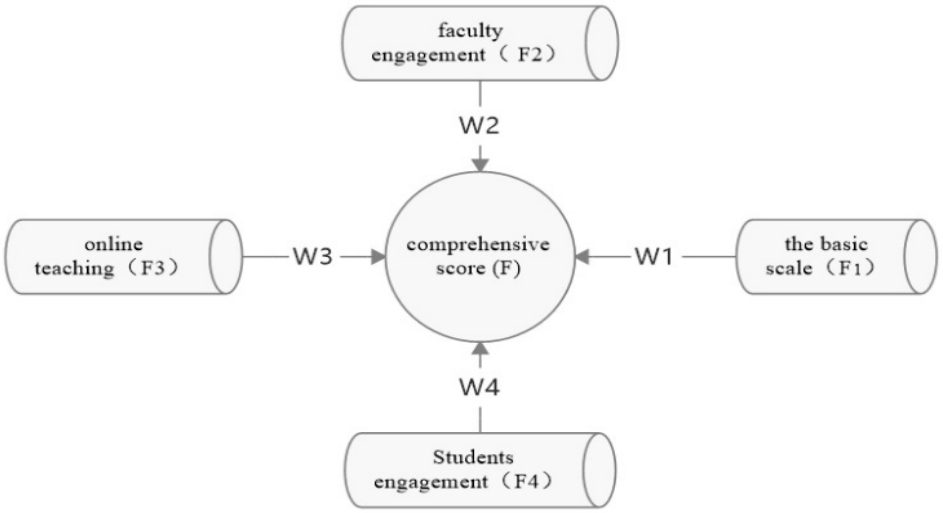


Figure 4. The scoring model of the factors and the comprehensive score F.

3. Results and Analysis

3.1. Statistical Analysis

3.1.1. Data Standardization and Aptness Test

Considering the problem of non-uniformity in the magnitude of indicators, to eliminate the errors between different variables due to the magnitude of the outline and the size of the values, it was necessary to standardise the original data first. The processing formula for data standardisation was $x^* = (x - \mu)/\sigma$, where μ was the mean and σ was the standard deviation of the data for that variable, and the standardised value was positive for raw scores greater than the mean and negative for those less than the mean.

Factor analysis uses fewer common factors to explain the complex relationships in more variables to be observed, aggregating variables with high relevance using dimensionality reduction and calculating the scores of the newly generated factor variables to reduce the complexity of the problem [53]. To ensure the accuracy and rigour of the study, the total data composition was first tested for fitness, and the results of Bartlett's spherical test were used to determine whether the correlation array was a unit array. The results showed that Bartlett's sphericity test KMO = 0.668 > 0.6; approximate chi-square2 = 3072.907; degrees of freedom df = 105; significance sig < 0.001, indicated that the correlation matrix was not a unit array and the variables were correlated with each other, which was suitable for extracting common factors and conducting factor analysis.

3.1.2. Factor Extraction and Explanatory Analysis

In addition to constructing factor variables and conducting explanatory analysis on them, the factor analysis method can calculate factor loadings using the extracted common factors for comprehensive evaluation [54]. In this study, the extraction of common factors was used to characterise the main features of the original indicators and to make a comprehensive evaluation of the teaching and learning quality of the local study centres. Based on the results demonstrated by the number of factors, the total explanatory strength was 80.440% > 80%, indicating that the extraction results were reasonable, and most of the features in the original variables were explained by the four principal factors, with more complete information and better supported the model. The factors were subsequently rotated using the maximum difference method to obtain the rotated component matrix.

3.1.3. Extracted Factor Analysis

To guarantee the accuracy of factor extraction, the cross-validation of the number of factors was adopted, and the weight of the information of the variables covered by the factors was presented visually by scree plot (see Figure 5). As shown in the figure, the

horizontal coordinates represent the number of factors extracted, the vertical coordinates represent the characteristic roots of the factors, and the scree plot of the variation of the characteristic roots with the number of factors is formed in alignment with the order of the factors extracted. Accordingly, it can be seen that the eigenvalues of the first four factors were larger, and the total contribution can explain the original variables more completely, while the eigenroot value after the fourth factor was smaller and the contribution to the explanation of the original variables is negligible, according to which it can be verified that it is sound and reasonable to extract the first four main factors for analysis in this study.

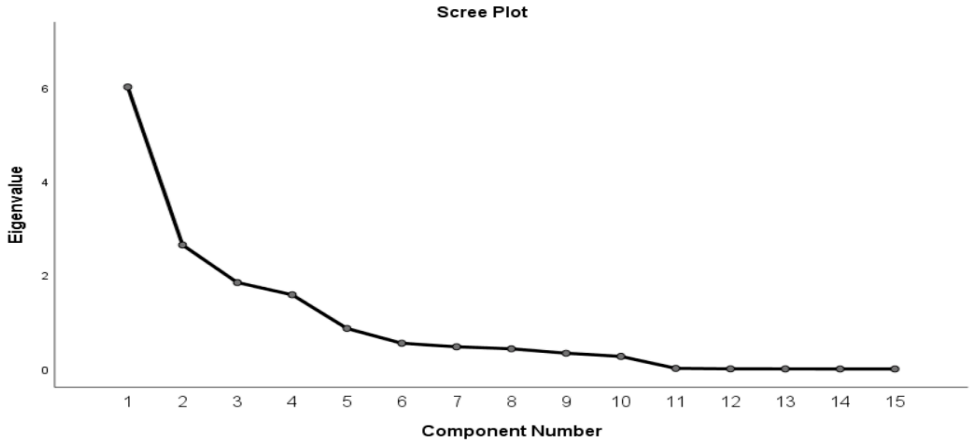


Figure 5. Extracted factor analysis scree plot.

3.2. Results Interpretation

3.2.1. Ranking Based on the Comprehensive Scores

With the comprehensive evaluation model of teaching and learning quality being constructed (see Figures 3 and 4), we evaluated the total data of teaching and learning quality in different regions of the province and then substituted the scores of each study centre on the four factors in turn. The comprehensive scores and rankings of 72 study centres in the school of open learning in JOU were calculated and graded into three quality ranking scales, namely, high, moderate, and low (see Figure 6). Through the comprehensive evaluation of the factor analysis, there was no direct subjective weighting of the indicators, and the obtained weights were statistically significant [55,56], so accordingly, the correlation interference between the evaluation indicators was eliminated, and the degree of discrimination between the factors manifested high.

The evaluation score for teaching and learning quality takes F = 0 as the reference standard. The overall evaluation of the study centres with a comprehensive score greater than 0 meant a better one, and it stood at the moderate level or above. The larger the value is, the higher the comprehensive teaching and learning quality and the higher the ranking stand. When the score was greater than 0 and the mean of the highest score (0.267), the teaching and learning quality is considered to be at a high level. On the contrary, the study centres with a comprehensive score of less than 0 were relatively poor in teaching and learning quality. Moreover, the higher the negative absolute value, the worse the overall performance of the study centres. The overall teaching and learning quality of study centres with a comprehensive score close to zero is at a moderate level. The comprehensive teaching and learning quality score (F) showed that 33 study centres in the province with positive teaching and learning quality evaluation scores (i.e., F > 0) graded a good teaching and learning quality, accounting for 45.83% of the total sample. Teaching and learning quality in the 39 study centres was below the moderate value.

The top-ranked study centres, Y4, J0, L2, L0, T2, X0, X3, and Y7, achieve comprehensive scores of 0.534, 0.432, 0.364, 0.353, 0.353, 0.325, 0.311, and 0.273, respectively, indicating that the overall teaching and learning quality of these eight study centres demonstrate better performance. In terms of teaching and learning quality, all study centres have reached

certain basic criteria. There exists an obvious polarisation between regions, and the regional unevenness of teaching and learning quality was more prominent (see Figure 6).

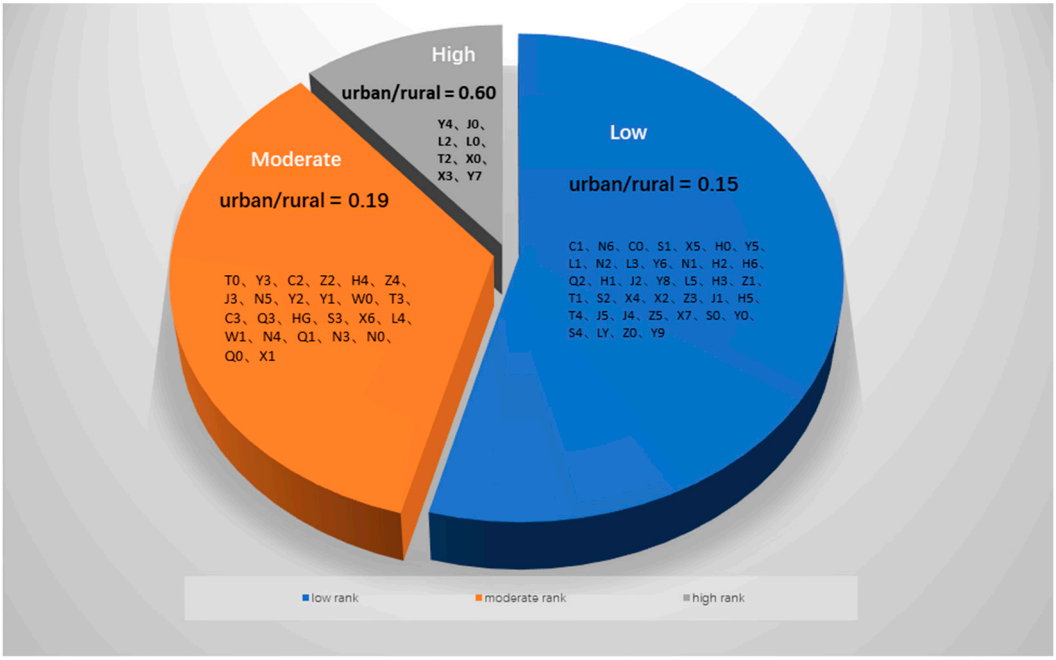


Figure 6. The ranking of the study centres based on the total scores and the ratio of urban and rural study centres. Note: In the pie chart, the letter stands for the initial of a region, and the number represents a study centre. 0 means an urban centre, while 1 − n stands for a rural centre.

From the perspective of local performance, the study centre Y4 scored higher on both the indicators of faculty engagement and student engagement, especially the top-rank indicator of faculty engagement, which indicates that the study centre attaches a higher value to teaching, effective strategies for promoting and assisting students have been adopted. Consequently, the total quality of online teaching and learning is relatively high. However, for study centre Y4, the scores of the other two indicators, scales of school operation and online teaching, are below the average grade. The ranking falls into the lower 20%, indicating that there are certain problems in its scale of online teaching, which is, of course, often influenced by objective factors such as external policies from the local government and basic school conditions. The last three study centres, LY, Z0, and Y9, scored −0.665, −0.709, and −1.426, respectively, in terms of total teaching and learning quality, which indicate that the poorer total quality level, especially in terms of the scale of online teaching, faculty engagement and students' engagement. This indicates that there are problems in the mechanisms of teaching and day-to-day management in these study centres. These centres need to find the right panacea, coordinate internal and external relationships, endeavour to meet the adult learning needs, and try the hybrid teaching approach to achieve a dynamic balance between cost, access and quality to continuously improve teaching and learning quality and enhance students' learning effectiveness.

In terms of the performance of individual indicators, the scores of the four main factors show a positive trend. In terms of the school scale, seven study centres scored positive values, accounting for only 10% of the total samples, indicating that the overall education scale of OE, including the number of registered students and the number of trained teachers, has shrunk to varying degrees. In terms of faculty engagement in online teaching, 64.38% of the study centres gain positive scores, with Y4, L2, and X1 ranking among the top three, showing good teaching effectiveness, but lagging slightly behind in terms of the scale of online teaching. Attention should be paid to balancing the relationship between scale and

effectiveness, committing to more engagement in online teaching and maintaining their advantages in high-quality teaching engagement.

From the perspective of the scale of online teaching, Y2, S2, J0, and C1 perform better, holding a higher proportion of teachers and students who access the system in teaching and learning. However, there is still more room for upward mobility in the dimension of students' engagement. The lower-ranked study centres with lower scores in overall evaluation need to identify the key factors that affect the teaching and learning quality and explore strategies to improve and enhance quality.

In terms of students' engagement in learning, 45.83% of study centres show positive scores, indicating that study centres attach more importance to students' engagement in learning, introduce certain measures in providing learning support services, and have a clear understanding of learners' needs. Of course, they still need to do more to innovate strategies to help promote learning and seek to improve the total quality.

3.2.2. Four Categories of Local Study Centres

However, there is still no consensus on classification based on quality. Therefore, the judgment of multiple indicators in the comprehensive evaluation model of teaching and learning quality in the study centres helps effectively make up for the weak subjective judgment.

Clustering is a multivariate statistical method for the classification of samples or variables by calculating the distance between samples or indicators to obtain similarity coefficients. The classification standard is the degree of intimacy between samples or variables to be analysed. Commonly used clustering methods include K-means clustering, stepwise clustering, and systematic clustering. K-means cluster analysis proposed by Mac Queen [57] was used. Based on the researcher's prediction of the number of types, the distance was used as the similarity evaluation index. Class analysis was used for hierarchical comparison, and the rationality of clustering was judged by the distance between cluster centres and the performance characteristics of clusters, and finally, the most appropriate type of division method was selected.

To achieve a reasonable clustering result, that is, to maximise the distance between groups and minimise the distance within the group, based on standardised data processing, relevant theoretical assumptions were combined to explore with 3–6 as the number of classifications separately. After comparing the centres' distance and performance characteristics after clustering, four major modes of classification have been selected after 29 iterations. Concerning the factor performance characteristics of each type, the four types of study centres were classified as follows:

Potentially contradictory type: The scale of the school is often considered a key factor affecting the operation of quality in the local study centre and expanding the scale within a certain range can reduce the average cost per student and bring more economic benefits to the study centre. However, this type of study centre has embarrassed several enrolled students but demonstrates excellent performance in teaching and learning quality. This may involve a game between scale–efficiency–quality, and therefore this type is termed a "potentially contradictory type".

Urgently to be reformed type: This type of study centre is weak in all four factors and possesses individualised characteristics. In terms of organisational operation, this type of study centre acts as an agency for several higher educational institutions, not the sole study centre for JOU. In the case of study centre Y9, for example, it merged under the auspices of the local educational authority with a vocational school, the scale of open university admission has declined sharply, and currently, less than 100 students are registered at the centre, and in turn, specialised and competent faculty lack, in consequence, the administrative staff were assigned with multiple and overlapping jobs, which seriously deteriorated the quality of teaching and learning. Therefore, there is an urgent need to intensify the operation mode of these study centres, sort out their problems, and find realistic solutions for improvement.

Less cost-effective type: These study centres have obvious advantages in school scale and usually have good faculty members, but they do not show high performance in terms of faculty engagement and students' engagement in teaching and learning and do not form an effective ecological cycle for teaching input-scientific management-quality output. Teaching effectiveness might be the crucial target for them to reach with stimulation of enthusiasm of more engagement from academics and students.

Normatively autonomous type: This type of centre means that the study centre possesses a mature school operation mechanism, operates systematically under the established administrative system, consciously regulates its teaching and management behaviour with a satisfying instant response mechanism when facing unexpected problems, and conscientiously and continuously improves teaching and learning quality. This type of study centre usually regards OE as the main body of the school, pays a high degree of attention to it, and is good at exploiting various strategies to improve teaching and learning quality. Regulation and Quality Benchmarks guide teachers and students to actively participate in interactive teaching and learning activities and ensure online teaching moves smoothly and orderly. These study centres also actively explore the team-teaching mechanism in the hybrid teaching mode to help the in-depth development and application of course resources; and actively creates "micro-classroom" and "micro-teaching" with regional traits to emphasise the shaping of a quality atmosphere.

3.2.3. Discriminant Analysis Based on Four Types of Study Centres

To further demonstrate the rationality of the construction of the four classification types of the study centres, Fisher's discriminant analysis method was used to test the four quality-based classifications reflecting the main characteristics of study centres for bridging the disequilibrium of teaching and learning quality in regions.

First, the original classification information was used to create a type variable, and some study centres were randomly selected to define according to the established classification cases (1 = potentially contradictory, 2 = urgently to be reformed, 3 = less cost-effective, 4 = normatively autonomous) so that it became the training set, and the remaining part was defined as the cases of unknown classification, that is, the validation set. With the Fisher function coefficients, three orthogonal typical discriminant functions were finally generated to distinguish the main features of different types of study centres. The proportions of the samples are 50.1%, 31.8% and 18.1%, respectively; the typical correlations are 0.858, 0.800 and 0.709, respectively. Functions 1 and 2 can explain 81.9% of the samples and make the judgment of most cases. If combined with function 3, complete judgment can be realised.

4. Discussion

4.1. Hypothesis

The holistic statistical evaluation of the local study centres in the school of open learning has proved our previous hypothesis for the research.

4.1.1. Hypothesis 1

The results of the study show that judging from the three levels of zones in the educational quality of study centres, i.e., high, moderate, and low, the absolute ratio of each interval is less than 1, which is clearly due to the geo-location of the study centres. The majority of study centres are located in counties or rural areas. However, in terms of relative ratios, the highest urban/rural ratio of study centres in the high score zone is urban/rural = 0.60, indicating that the relative ratios of urban study centres at the high score zone are higher in number than those in the low score zone, which to some extent confirms that the hypothesis 1 that the quality of education in urban study centres is relatively higher than that in rural study centres, and that regional differences are significant. Moreover, the urban-rural ratio of the distribution of study centres in the moderate and low score zones shows that the difference between the high score zone and the high status of rural study centres is even greater and that the quality is more clearly polarised. This

situation is not conducive to the sustainable development of the OU system. The statistical data conformed with the results found in other relative research in less economically developed regions [58].

4.1.2. Hypothesis 2

The results show that on the scale of enrolment in the study centres, no more than seven study centres scored positive values, less than 10% in the total samples of the 72 study centres in the school of open learning. That indicates that the overall scale of study centres in recent years has shrunk tremendously at an appalling speed. Other studies also gave evidence for the virus phenomenon [59].

However, compared to urban areas, rural regions often face a shortage of resources, especially in terms of quality educational resources. The distributed study centres of the OU system, which are located in both urban and rural areas and offer a digital learning environment for the general public, are a great opportunity for this cohort of lifelong learners to participate. Accordingly, though urban areas have a greater concentration of high-quality educational resources, giving learners more choice of access, rural regions are relatively short of resources, so rural study centres have a better geographical advantage in terms of enrolment and have a larger base of provision than urban study centres.

4.2. Quality, Access, Cost and Sustainability in the Ecological System

In the field of OFDL, the issue closely related to the quality of education is the scalability (access) or the number of students. John Daniel analysed the core competitive advantage of the OU system with modified iron triangle theory and pointed out that the OU system boom is because of the rapid growth in the number of groups served (the number of students) and the resulting economies of scale, which is different from the general development of traditional universities [60]. Now, with the shrinking size of JOU enrolments, this competitive advantage is slowly being lost, causing a certain impact on its sustainability.

The problem of quality and scale has always been a challenge for the OU systems, and large-scale online teaching can dilute existing educational resources. How to keep the balance of the iron triangle with its appropriate shape of the side still remains a challenge to educators, administrators, and relevant stakeholders in the OFDL community. However, Bronfenbrenner's ecological system theory and Bilgin's PEARL Model of Sustainable Development provide the theoretical guiding principles for the future orientation of OFDL improvement. The advantages of high technology seem to offer new opportunities for solving this problem. Distributed teaching, mobile learning, and video conferencing thanks to broadband internet enhance the quality of learning support services—making use of the Open Educational Resources to promote personalised learning and AI technologies for the diagnosis of learning to enhance the attainment of learning goals. Modern high technology, in fact, moves away the barriers that separate distance learners geographically, psychologically, and physically in the past with its educational ecosystem as a learning community. Thus, by open education, equality and equity of education can be realised for anyone who desires to participate in learning anytime, anywhere. Regional disparities in quality education are to be mitigated, and a steady improvement in holistic quality will be obtained, which then leads to a higher social reputation by the quality of excellence and again adversely expands the scale of operation to make OU system great again. In this way, the OU system will step into a virtuous cycle of sustainable development.

4.3. Diagnosis and Reflection on the Regional Disparity of Teaching and Learning Quality

Tracing back at the trajectories of the development, as early as the period of radio and television university operation, open universities have formed an inherent policy-dependent path, but on the other hand, there is a lack of supporting policy guarantee system. Although open universities have fulfilled the mission of academic degree compensation for working people in the 80s and 90s, today, with the popularisation of higher education,

the governments demand that open universities take the leading role for lifelong learning and technology and career training. Twenty-six conventional universities, including some elite ones, joined the pilot projects offering online learning opportunities for young adults in 1999 [61]. As a result, the landscape of OFDL has been dramatically changed; the open universities lost their monopoly status, in turn, went from being a major player to one of the players in the game. The number of students enrolled in the school of open learning of JOU has dropped from more than 100,000 at its peak to about 67,000 today, and the mismatch between its scale of operation and financial support has become a new normal in the local study centres. The lack of necessary financial support and institutional cost for management not only directly affects the motivation and consciences of faculty members and staff but also indirectly restricts the sustainable development of the study centres. In such a situation, the quality of teaching has been positioned next after the pursuit of cost-efficiency. In the absence of protection from government policies and the reality of multiple competitions, the study centres have been grilled in an "embarrassed" dilemma, which even leads to an existential crisis. Once external competition intensifies or policy reliance weakens, the attributes of local study centres as learning entities are bound to diminish, directly affecting the quality of their teaching services thus influencing the stability of the whole OE ecosystem.

The term "involution", a buzzword in China, originated from the field of agriculture referring to a phenomenon that has reached a certain level of development and cannot upgrade or overpass to a higher level due to the constraints of external expansion, so it begins to involute [62]. In the case of education, "involution" is "over-density", i.e., the development seems to be an "exponential increase", but in essence, it is "qualitative stagnation" [63]. The interaction of internal and external factors has led to an inevitable inefficient repetition of school development, which is accompanied by an increase in internal consumption while barely being maintained in the state of reservation. That is a typical characteristic of "involution", and the most prominent one is the misalignment caused by the deviation of school development values [64], thus bogged down in motivational stagnation. The occurrence of involution in the study centres originates in the school development philosophy. The local study centres experience complicated feelings on OE with the learning system, and most of them are still stuck in the inertia of the days of traditional distance learning, repelling the introduction of digital technologies into their comfort zone. In terms of professional settings, the homogeneous courses pose a risk for the study centres. Different study centres locate in different regions with diverse local characteristics, and their industrial structure and economic scale demonstrate different traits. Chasing blindly after "going viral" programmes but ignoring the ones associated with the local needs of regional economic development, as a consequence, make the study centres difficult to obtain special funding and personnel support from the local government. Orthodoxy is the funding and personnel support that sustain the stability of the education ecosystem and maintain the powerhouse for sustainable development [65–67].

Quality Assurance is a basic concept from the field of management, which is an operational technique or related activity to make people ensure the quality of a product, process or service, including internal quality assurance and external quality assurance. In contrast, education, as an extremely complex type of systemic engineering, should be more diversified in terms of quality assurance, and it is difficult to have sustainability of any purely technical actions that are taken for granted, idealised, or simplistic [68]. The weak awareness of quality assurance is one of the contributing factors to the uneven teaching and learning quality of the study centres in JOU and the lack of credibility from society about the quality of talent training. As far as the whole open university system is concerned, the headquarter-peripheral school structure has gradually evolved from a tightly-knit one to a loosely-knit one. The strict management system formed under the "five unified" principles in terms of a unified teaching plan, syllabus, teaching materials, examinations and grading standards have been given ways to different criteria set by other higher educational institutions that are more prestigious than the open universities.

However, to a certain degree, it is also objectively caused by the rigidity of the management system, which in turn affects the total quality of operation of the institutions [69–71]. Apart from that, due to the evolution of the policy environment and the survival environment, the original benefit distribution is no longer applicable to the existing development needs, and the systematic and balanced resource allocation is unable to mobilise the enthusiasm of all study centres in the system. In this pattern, study centres are more concerned with maximising their benefits and ignoring the standardisation and unity of quality assurance, and even "downgrading" the quality of teaching in the delusion of special and differentiated schooling traits, which in essence lies in the lack of quality assurance awareness.

4.4. Remedies for Improvement of Teaching and Learning Quality

Repositioning strategic development depends on the rational judgment of each institution's advantages. Through differentiated strategic repositioning, advantages and characteristics are transformed into pursuits of value. Consequently, the construction of diversified study centres is a natural and pertinent choice for OFDL development. This not only ensures the construction process of the study centre but also satisfies the needs of the local economy and the talent market, forming a new pattern of differentiated development of OE through diversified internal development for rational distribution of niches in the education ecosystem [72–74].

Select statistical toolkits to explore the potential of improving teaching and learning quality in OFDL. Develop and innovate the learning system to increase resilience and enhance perception of usefulness and ease of use from lifelong learners sustaining their motivation and dynamics in online learning. Ironically, it is the COVID-19 pandemic that helps accelerate this experience [75–78].

For the governance of the local study centres, the awareness of the quality of the teaching and learning in open universities should be aroused, and the administrative and academic support services to students should be advanced to increase the perception of the quality of the study centres in terms of the panoramic entity.

Adopting open educational resources is necessary to offer affordable access for all people willing to learn in terms of diversity, equality, equity, transparency, justice, and well-being.

Different types of study centres seek different value positions, and the repositioning of study centres depends heavily on their vision and mission for future development. Therefore, its core competitiveness lies in the characteristics of regional schooling, professional training, and integration of local resources. Specifically, it can facilitate the promotion of local industrial development and economic structure optimisation with its mode of open, flexible and distance mode of workforce training. Being local as its own responsibility, the study centres endeavour to actively obtain support from local governments and create specific and quality courses to serve the vicinity with the existing resources in the OU system, as well as integrating social and economic resources from industries, enterprises, and higher educational institutions in the region to create a promising and vibrant educational ecosystem for the sustainability of OFDL.

5. Conclusions and Suggestions

5.1. Summary of the Research

Regional disparities in quality education have manifested themselves as an education divide that needs to be mitigated in developing and developed countries or in different regions in one country and basic and higher education. The issue is especially crucial to OE in terms of stability and capacity for the OE ecosystem and sustainable development. Many scholars and experts have published extensively focusing on educational equality and equity, proposing the means of OFDL to lessen the contradictory situation concerning access, cost, and quality. Our research spotlight, tinted with relevant theories on iron triangles and sustainability, has scanned the core of quality education, that is, quality of teaching and learning and its enhancement systematically explored the regional disparities of teaching and learning quality in local study centres with the samples of 72 from JOU.

Adopting statistical toolkits and the typological research paradigm, we have identified the ranking of local study centres in terms of their basic attributes, learners' support services, and teaching commitment during the evaluation of—the school of open learning in JOU. Our findings proved the two hypotheses on regional disparities and scalability of enrolment: the region where the study centre locates does exert certain impacts on the quality of education and also the scale of enrolment of student cohorts more or less. We worked out the categories of study centres with the help of the clustering method in the hope that the local study centres could make the right choice for quality and sustainability in OFDL. In the paper, we have provided diagnoses and remedies with some specific suggestions to the learners and stakeholders for reference in their further actions. In a word, keeping balance in the perspectives of access, quality and cost in the educational ecosystem seems a good roadmap for the local study centres to achieve sustainable development.

5.2. Limitations

Our study offers profound insights into the regional disparities of education in terms of teaching and learning to the countries or educational institutions facing similar situations. However, we know that this study is just a quantitative one without further structured in-depth interviews, and another weakness lies in the short timeline for the research data. Further research is to be encouraged on longitude study shortly.

5.3. Suggestions

The vitality of open educational institutions lies in hierarchical organisational structure, organic internal linkage, and a contractual spirit of common compliance. Therefore, the development mode of the OU system should be reformed from the roughly and fast-overgrowing scale mode to quality first mode, thus initiating strategic planning for sustainable development with keeping a balance between quality and scalability in the–learning society [79–82].

In the following, we make further specific suggestions to the administration in OFDL:

First, the policy. The organisations in OFDL should seek support policies from local governments or educational authorities to mitigate the regional disparities caused by the local economical level of development. The so-called one policy for the whole country does not promote educational equality or mitigate the gaps between different regions and tiers of universities.

Second, benefit differentiation. To attain general equality, both "take" and "give" need to be differentiated. In economically backward, isolated, ethnic minority, or other specific places, "less should be taken and more given"; in economically developed areas with high basic circumstances and strong schooling, "more should be taken and less given" to "support the weak with the strong and progress together" "Supporting the weak and developing together" The central university and certain provincial universities are trying to foster the system's balanced development, which will be beneficial.

Third, work promotion differentiation. Separate goals should have different objectives, requirements, and assessments. The weak, the strong, the small, the large, and the large should be promoted so universities at different development levels can be fully developed, forming a good trend of common development with their characteristics and enhancing the overall strength of the radio and television university system.

To the local study centres:

Quality assurance systems should be effectively applied to increase quality and build a good reputation. The most important task of the transformation and upgrading of the study centre is to improve teaching and learning quality and develop a quality assurance system. If possible, establish an internal-external feedback mechanism on education quality functioning as gatekeepers for the quality standards.

More specific professional courses related to work should be created or introduced to respond to the local expansion of economic development. The realistic and intrinsic goal

for the local centre is to adapt to the societal ecosystem. During digital transformation, the main task for OU is the provision of work-related courses, not academic courses.

The appointment mechanism of adjunct faculties and relevant evaluation should be changed in the local study centre. It is not so easy to invite a university professor to be a tutor in the rural study centres. However, it is not an insurmountable hurdle for tutoring in the digital age. Professionals can also be appointed as professors of practice.

Local study centres should pay particular attention to exploring the construction of a new type of schooling system, building and sharing resources through open cooperation in relevant specialities that are in short supply in the industry and the region, to continuously enhance the characteristics of schooling and form competitive advantages.

OFDL offers multimodality delivery with initiatives to expand open access to formal, informal, and non-formal education and contributes to the establishment of a lifelong learning system and learning society.

For rural study centres, it is suggested to reposition as a one-stop learning hub, that is, offering tertiary education, vocational education, and secondary education for sustainable development in education.

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