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An Empirical Study of Education Divide Diminishment through Online Learning Courses

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ABSTRACT
According to the swift development of education system, Taiwanese government is always devoting diminishing the educational divide between rural and urban regions. This research focuses on this educational divide by cross-employing the Grey Relational Analysis (GRA) of quantitative analysis and the Fuzzy Set Qualitative Comparative Analysis (fsQCA) of qualitative analysis in order to reinforce research reliability, validity and representativeness. These analysis method are used to assess the results of questionnaires given to professors', senior industrialists' and senior professionals' experts. Two valuable conclusions are comprehensively induced from the evaluated results: (1) the autocorrelationships between the digital characteristics of Online Learning Courses (OLCs) and the level of rural-urban Education Divide (ED) are completely testified through the correlationships evaluations of the educational features Mediators that directly and powerfully resupply the educational research myth and gap and (2) Connectionization of Course Operation (C-CO) of the digital characteristics of Online Learning Courses (OLCs) is positive to effectively enhance the educational features of the students' basic learning abilities (SBLA) and the education-institution learning capabilities (EILC) that empirically provide the most beneficial niche strategy to minimize the rural-urban Education Divide (ED).
Keywords: educational divide (ED), online learning course (OLC), grey relational analysis (GRA), fuzzy set qualitative comparative analysis (fsQCA)

INTRODUCTION

For a long time, the national resources in Taiwan were primarily invested in the most critical-economic regions and cities in the country such as Taipei (it's capital city), Taichung and Kaohsiung in order to pursuit maximum economic development. According to the 2015 educational records of the Taiwanese Education Department of Executive Yuan (see **Table 1**), the total number of non-collegiate educational institutions (kindergartens, elementary, junior high, senior high schools) are up to 5,310 (51.89%) and further, the total number of Higher Education ("HE") institutions was up to 89 (61.81%) in the most important economic development cities in Taiwan (New Taipei, Kaohsiung, Taichung, Taipei and Tainan Cities).

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State of the literature

- The autocorrelationships between the digital characteristics of online learning courses (OLC)s and the level of rural-urban Educational Divide (ED) are able to directly be broad-range analyzed as well as high-profundity proved in order to resupply academic gap in relative Educational Divide (ED) literatures.
- The Grey Relational Analysis (GRA) of quantitative analysis and the Fuzzy Set Qualitative Comparative Analysis (fsQCA) of qualitative analysis re cross-utilized in this research in order to reinforce research reliability, validity and representativeness. These analysis method are used to assess the results of questionnaires given to professors', senior industrialists' and senior professionals' experts.

Contribution of this paper to the literature

- The autocorrelationships between the digital characteristics of Online Learning Courses (OLCs) and the level of rural-urban Education Divide (ED) are completely testified through the correlationships evaluations of the educational features Mediators that directly and powerfully resupply the educational research myth and gap.
- The Connectionization of Course Operation (C-CO) of the digital characteristics of Online Learning Courses (OLCs) is positive to effectively enhance the educational features of the students' basic learning abilities (SBLA) and the education-institution learning capabilities (EILC) that empirically provide the most beneficial niche strategy to minimize the rural-urban Education Divide (ED).

Table 1. The number of educational institutions in Taiwan in 2015

	Kinder-gartens	Elementary Schools	Junior High Schools	Senior High Schools	Total	Percentage	HE		Total	Percentage
							College	Universities		
Total	6,362	2,633	733	506	10,234	100%	19	126	145	100%
Taiwan Island	6,332	2,606	723	503	10,164	99.32%	19	125	144	99.31%
New Taipei City	1,096	213	62	61	1,432	13.99%	6	13	19	13.10%
Kaohsiung City	677	242	79	53	1,051	10.27%	2	14	16	11.03%
Taichung City	659	235	72	48	1,014	9.91%	-	17	17	11.72%
Taipei City	687	150	61	69	967	9.45%	1	23	24	16.55%
Tainan City	528	211	60	47	846	8.27%	1	12	13	8.97%
Taoyuan City	528	190	58	33	809	7.91%	1	10	11	7.59%
Changhua County	320	175	36	24	555	5.42%	-	5	5	3.45%
Pingtung County	274	167	35	19	495	4.84%	-	4	4	2.76%
Nantou County	177	140	32	15	364	3.56%	-	2	2	1.38%
Yunlin County	140	155	33	21	349	3.41%	-	3	3	2.07%
Miaoli County	174	117	30	19	340	3.32%	1	2	3	2.07%
Hsinchu City	216	85	28	10	339	3.31%	-	2	2	1.38%
Chiayi County	142	124	23	10	299	2.92%	1	3	4	2.76%
Hualien County	131	103	23	13	270	2.64%	2	3	5	3.45%
Taitung County	117	88	21	10	236	2.31%	-	1	1	0.69%
Yilan County	109	76	24	12	221	2.16%	1	2	3	2.07%
Hsinchu City	161	32	13	12	218	2.13%	-	6	6	4.14%
Chiayi City	102	43	11	12	168	1.64%	2	1	3	2.07%
Chiayi County	71	20	8	13	112	1.09%	1	1	2	1.38%
Penghu County	23	40	14	2	79	0.77%	-	1	1	0.69%
Kinmen and Matsu Islands	*30*	*27*	*10*	*3*	*70*	*0.68%*	*-*	*1*	*1*	*0.69%*
Kinmen County	24	19	5	2	50	0.49%	-	1	1	0.69%
Lianjiang County	6	8	5	1	20	0.20%	-	-	-	0%

Table 2. The total number of Teachers in Taiwan in 2015

Taiwanese Regions	Kindergartens	Elementary Schools	Junior High Schools	Senior High Schools	Total	Percentage
Total	46,169	97,374	50,394	55,340	299,889	100%
Taiwan Island	*45,954*	*96,877*	*50,137*	*55,144*	*298,584*	*99.56%*
New Taipei City	7,514	14,519	6,531	7,440	41,243	13.75%
Taipei City	4,908	9,886	5,345	8,222	39,583	13.20%
Taichung City	6,173	11,795	6,131	6,861	37,556	12.52%
Kaohsiung City	5,044	10,266	5,913	6,198	33,079	11.03%
Taoyuan City	4,332	9,078	5,516	4,310	27,401	9.14%
Tainan City	3,865	7,236	3,742	4,538	24,367	8.13%
Changhua County	2,412	5,386	2,757	2,960	14,993	5.00%
Pingtung County	1,491	3,668	1,720	1,736	10,111	3.37%
Yunlin County	1,172	3,415	1,582	1,691	8,799	2.93%
Hsinchu City	1,217	2,092	1,046	1,466	8,047	2.68%
Miaoli County	1,071	2,762	1,292	1,501	7,377	2.46%
Hsinchu County	1,463	2,831	1,395	938	7,202	2.40%
Nantou County	950	2,705	1,386	1,295	6,828	2.28%
Chiayi County	832	2,476	1,102	754	6,187	2.06%
Yilan County	972	2,142	1,251	1,087	6,126	2.04%
Taitung County	485	1,520	692	592	3,565	1.19%
Hualien County	678	1,886	950	962	5,571	1.86%
Penghu County	160	585	312	218	1,394	0.46%
Keelung City	609	1,469	713	1,122	4,594	1.53%
Chiayi City	606	1,160	761	1,253	4,560	1.52%
Kinmen and Matsu Islands	*215*	*497*	*257*	*196*	*1,305*	*0.44%*
Kinmen County	190	398	200	162	1,090	0.36%
Lianjiang County	25	99	57	34	215	0.07%

The total number of educational teachers in these institutions in the major cities totaled 203,230 or 67.77% of the total number of teachers in Taiwan (as shown in **Table 2**).

Because the majority of educational institutions and teachers resided in the six largest cities in Taiwan, the country's educational resources are significantly also directed to these cities. Further, students of elite colleges and universities are heavily-represented from these large cities. In order to effectively minimize the educational disparity of urban-rural and the unbalance allocation of educational resources in Taiwan, the Taiwanese Education Department of Executive Yuan has instituted and implemented the Multiple Entrance Program ("MEP") of HE's recruiting examination because the recruiting examination of HE is the most evaluated factor to be able to realize the level of rural-urban disparity and unbalance of educational resources. MEP also includes the administration of the Star Plan which is a system designed to assist students with lower studying abilities and capabilities in Taiwan's college admissions process. The overall objective of the Star Plan is to reduce the considerable disparity and unbalance of educational resources between urban and rural regions in the country by creating fair entrance opportunity of elite HE institutions. However, Star Plan in Taiwan's College Entrance System has carried on over implementing eight years and it has

never reduced the educational disparity of urban-rural and the unbalance allocation of educational resources in Taiwan. The most empirical reasons for this disparity are:

(1) HE institution elitism: The Star Plan implemented at these elite HE institutions have still settled the higher academic-subject score-thresholds for applicants which means that a majority of student applicants have to be, at least, top 5% of their class in order to enrolled in a qualified elite HE institutions because each elite HE institution only want to recruit the top students from rural and urban senior high schools; for example: National Taiwan University (NTU,), ranking first place in Taiwan, set up the top 1% of entire class to be a applied academic-subject score-threshold.
(2) Studying abilities and capabilities: some management, administrators, professors of these elite HE institutions claim that some students recruited from the Star Plan as unable to keep up with their classmates and it is an official and powerful excuse to support them to set up more serious academic-subject score-thresholds of applied requirements.
(3) Students' elitism: a majority of students in these elite HE institutions have resentment towards students recruited from the Star Plan because these Star Plan students were not required to pass the difficult entrance exam as the regular students did in order to demonstrate their learning abilities and capabilities.

For these reason, Star Plan in Taiwan's College Entrance System has already been another convenient entrance door for original elite students from rural senior high schools; not for urban students with lower academic-subject performances. Specifically, the serious urban-rural disparity and unbalance of educational resources has become an Educational Divide ("ED") issue because elite student from senior high schools in city areas has been only one recruited source of higher elite HE institutions in Taiwan. This Taiwanese education-system development has resulted in if you want to study in elite senior high school, a prospect student must be enrolled in an elite junior high school. The process repeats itself all the way through kindergarten. Consequently, a family's economic power and residential location have spontaneously become one of the most critical factors in the students' basic learning abilities ("SBLA") and the education-institution learning capabilities ("EILC") (Biggs, 1999). Nevertheless, in view of the swift development and speedy popularization of information and telecommunication technologies, a majority of Taiwanese students obtain the knowledge and information through Ho surfing the internet and downloading public up-to-date knowledge as well as two-way sharing and uploading information from various websites in anytime and anywhere through (Keskin & Metcalf, 2011) diversified Computer, Communication and Consumer Electronics ("3C") devices with online and Wireless Fidelity ("Wi-Fi") functional services, such as notebooks, smart phones and etc. This drives the bulk of current students break through two learning restrictions (Bower & Christensen, 1995), time and space limitations, of traditional education because current students are able to easily study from each internet website in anytime and anywhere mode. In this hyper-competitive online technology epoch, each student can be not only a traditional learner to singly acquire knowledge from lecturers but also an educator to provide their own personal experience and professional

comments to each other through two-way learning platform in online learning course ("OLC") (Fini, 2009; Hill, 2012) without the geographic and time limitation of traditional face-to-face educational circumstance (Norris, Sullivan, Poirot, & Soloway, 2003). Subsequently, making a comprehensive survey on the relative ED researches fields (Damarin, 2000; Dickard & Schneider, 2002; Saheb, 2005; Çilan, Bolat, & Coşkun, 2008; Singh, 2010), in consideration of digital characteristics of OLCs, the digital characteristics of OLCs are positive to impact the popularized level of OLCs (Song, Singleton, Hill, & Koh, 2004) ; the popularized level of OLCs is able efficiently to enhance SBLA and EILC (Kizilceca, Sanagustínb, & Maldonadob, 2016) and consequently, the intensification of SBLA and EILC is obviously able to an interfered impact on the digital characteristics of OLCs and level of rural-urban ED (as referred **Figure 1**).

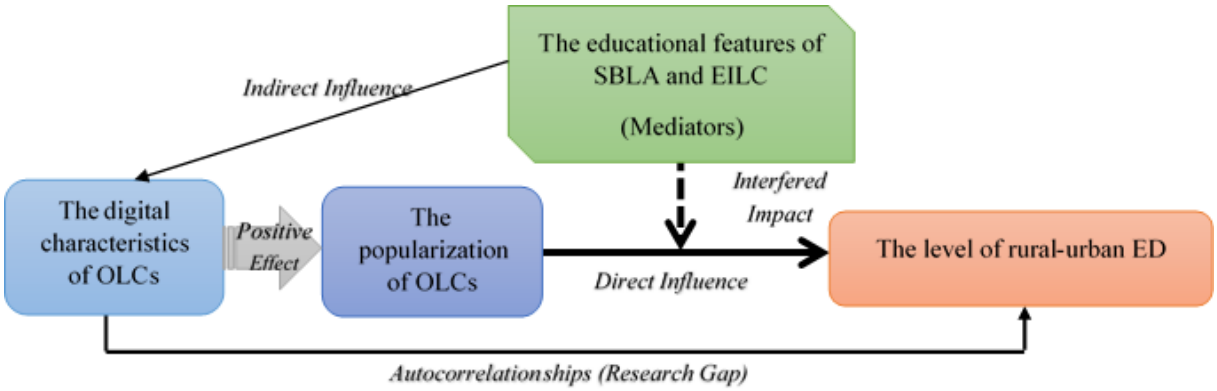


Figure 1. Research conceptual induction

However, no research can broad-range analyze as well as high-profundity prove the autocorrelationships between the digital characteristics of OLCs and the level of rural-urban ED and hence, this research, in order to re-supply this research gap, not only employs Grey Relational Analysis ("GRA") of qualitative analysis to complexly explore the weight-questionnaires of ED and OLC experts for enhancing research reliability but also applies Fuzzy Set Qualitative Comparative Analysis ("fsQCA") method (Ragin, 1987; Huang & Hsieh, 2015) of qualitative analysis (Basurto, 2013) to evaluate the measured GRA consequences for strengthening research reliability to corroborate the autocorrelationships between the digital characteristics of OLCs and the level of rural-urban ED in order to discover the best solution for research topic.

LITERATURES REVIEWING

In sight of unbalance economically and politically regional developments between rural cities and urban counties, a majority of national governments have always unfairly and unequally distributed the educational sources have been into the higher economic development areas with higher populations in order to not only reinforce the national economic competitions but also obtain more political supporting from the increased number of people votes. Eventually, this unbalance-and-unfair-distribution educational development

in each phase of educational students and institutions has directly resulted in solemn ED that more rural-city students snatch the bulk of educational opportunities from urban-counties students (Tiene, 2002); for example: a mass of elite institutions only wants to recruit the elite students from rural cities; not from urban counties (Fu & Ren, 2010). Especially, in the diversified recruited application era, the fair recruiting examination system obviously has been replaced the various student's applications system which means the multiple subjects' performances, such as art and music competition awards, and applied prepared documents, such as recommendation from famous person, have superseded the traditional academic recruiting examinations. For the reason, slight ED in elementary school phase must lead to immense ED in higher education phase. Significantly, OLCs has approved to be a direct and effective manner to conquer various Knowledge Divides ("KDs") (Selwyn, Gorard, & Williams, 2001; Hsieh, 2014, Milligan & Littlejohn, 2016) through the swift development in internet, online and telecommunication technologies (Kerka, 1997). Significantly, this research explores the exploration of cause-and-effect relations among the digital characteristics of OLCs, the popularization of OLCs and the level of rural-urban ED through the educational features of (Hattie, Biggs, & Purdie, 1996; Ravenscroft, 2011) and EILC (Burbules, Nicholas, & Callister, 2000) to assay the most discussed research mainstream issue – "is OLCs also the best solution for the rural-urban ED?". For the reason, taking the educational features of SBLA into consideration, the critical twelve assessed elements of SBLA have been distinctively integrated and then defined as Academic Lecturing ("AL"), Question Stimulation ("QS")(Pool, Koolstra, & van der Voort, 2003), Concept Mapping ("CM") (Kop, Fournier, & Mak, 2011), Tutorial Teaching ("TT"), Excursion Demonstration ("EDN") (Eklo¨f, 2010), Seminar Exemplify ("SF"), Learning Elaboration ("LE") (Hsieh & Chan, 2016), Peer Lecturing ("PL") (Gamoran, 1987), Spontaneous Collaboration ("SC"), Generic Study Techniques ("GST"), Content Study Techniques ("CST") (Fairlie & London, 2011) and Metacognitive Learning Techniques ("MLT") (Grimes & Warschauer, 2008). Moreover, in view of the educational features of EILC, the most crucial seven assessed factors of EILC have been apparently refined as Flexible standardization ("FS") (Gamoran, 1987), Creative literacy and Numeracy ("CLN") (Rowan, Brian, & Jr. 1983), Consequential Accountability ("CA") (Biggs, 1999), Intelligent Accountability with trust-based professionalism ("IATP") (Lee, Valerie, & Smith, 1993), Comprehensive Laboratory ("CL"), Advance Organizer ("AO") (Simpson 1981) and Various Learning Groups ("VLG") (Warschauer, Knobel, & Leeann, 2004). In order to testify the most discussed research mainstream issue, the critical twelve assessed elements of SBLA and the most crucial seven assessed factors of EILC have been applied in evaluated statistics in this research in order to explore the most beneficial determinants of OLCs to overcome the rural-urban ED. In diminishment with avoidance and diminishment of uncertainty and indecision in assessed measurements of surveyed questionnaires, Deng (1982) employed the fuzzified concept of the fuzzy theory in MCDM methodology to induce GRA approach of quantitative analysis to dwell on the entire dependences and independences among each analytical variables or assessed criteria in order to identify and conclude the most appropriate solutions for diversified decision-making issues in social science research fields (Hsieh, Yan, Hung, &

Jane, 2014; Hsieh, 2016a; Hung et al., 2016); for example: macroeconomic circumstances (Hsieh, 2012), advantage-analyses of regional economy, industrial structure analysis (Hsieh, 2016c), industrial finance analysis, and etc. In accordance with essential concept and assumption of GRA, the number of entire interviewee's choices of weight-questionnaire are greified into the grey section between the white-color point (best solution) and block-color (worst solution) and therefore, the appropriate solutions are able to not only identify but also further refine through a series of complicated greified measurements of Grey Correlation Coefficient ("GCC", x_i^*) and Grey Correlation Grade ("GCG", r_i^*) of each evaluate criterion (Hsieh, Hsu, & Lin, 2016). Extraordinarily, in accordance with higher research representativeness and reliability, the Delphi method has always been applied into the statistic assessments of GRA approach because the interviewed questionnaire of Delphi method is briefly collected from experts, specialists or professionals. Subsequently, in consideration with a range of greified equations (Deng, 1989), the five fundamental greified measure-steps are described as:

(1) First greified measure-step: confirming the correspondances among each assessed criteria in accordance with research topic, the independent variable is defined as $X_i = \{X_i(k)|k = 1, 2, \dots, n\}, i = 1, 2, \dots, m$ and then, dependent variable is further defined as $Y = \{Y(k)|k = 1, 2, \dots, n\}$.

(2) Second greified measured step – nondimensionalizing each surveyed data: in order to identify the influence of each independent variable on each dependent variable, the evaluated criteria of the number of columns has been nondimensionalized as $X_i(k) = \frac{X_i(k)}{X_i(T)}, k = 1, 2, \dots, n; i = 1, 2, \dots, m$ in order to calculate the analytical comparison measurements.

(3) Third greified measured step – computing Grey Correlation Coefficient ("GCC", x_i^*) of GRA approach: GCC of each assessed criterion nondimensionalizing each surveyed data are further measured in the calculated equations (1), (2) and (3) in accordance with the three kinds of maximized, minimized and specific characteristics of assessed criteria (considered elements) as follows:

The nondimensionalizing surveyed data belongs efficient goal (maximum is positive) and GCC of each assessed criterion are

$$GCCx_i^* = \frac{x_i^{(0)}(k) - \min x_i^{(0)}(k)}{\max x_i^{(0)}(k) - \min x_i^{(0)}(k)} \quad (1)$$

The nondimensionalizing surveyed data belongs inefficient goal (minimum is positive) and GCC of each assessed criterion are

$$GCCx_i^* = \frac{\min x_i^{(0)}(k) - x_i^{(0)}(k)}{\max x_i^{(0)}(k) - \min x_i^{(0)}(k)} \quad (2)$$

The nondimensionalizing surveyed data belongs specific assessed gold and GCC of each assessed criterion are

$$GCCx_i^* = 1 - \frac{\left|x_i^{(0)}(k) - OB\right|}{\max\left\{\max\left[x_i^{(0)}(k)\right] - OB, OB - \min[x_i^{(0)}(k)]\right\}} \quad (3)$$

In GCC computing equations, $x_i^{(0)}(k)$ presents original data; x_i^* expresses greified date; $\min x_i^{(0)}(k)$ describes the minimum of original data and $\max x_i^{(0)}(k)$ presents the maximum of original data.

(4) Fourth greified measured step – measuring Grey Correlation Grade ("GCG", r_i^*) of GRA approach: after computing GCCs of each assessed criterion, GCGs of each assessed criterion are further calculated in the measured equations (4) for identifying the influence of each independent variable on each dependent variable and measured GCG equation are

$$GCGx_i^* = \frac{\left|minx_i^{(0)}(k) + \delta^* \max x_i^{(0)}(k)\right|}{\left|1 - x_i^{(0)}(k) + \delta^* \max x_i^{(0)}(k)\right|} \quad (4)$$

(5) Fifth greified measured step – calculating Grey Correlation Ranking ("GCK", r_i^*) of GRA approach: after measuing GCGs of each assessed criterion, GCK of each assessed criterion is finally induced for discovering the potential and concrete influences of each independent variable on each dependent variable and GCK greified equation (5) is

$$GCR\, r_i^* = \frac{1}{n}\sum_{k=1}^{n} \varepsilon_i(k), \qquad k = 1, 2, \ldots, n$$

However, in order to enhance the research reliability, the calculated concept of geometric mean $\left(\sqrt[n]{\prod_{i=1}^{n} X_i} = \sqrt[n]{X_1 X_2 \ldots X_n}\right)$ was further considered into the original GCK greified equation as

$$GCRr_i^* = \sqrt[n]{\sum_{k=1}^{n} \varepsilon(k)}, \qquad k = 1, 2, \ldots, n \quad (5)$$

Exceptionally, fsQCA approach of qualitative analysis is further utilized to testify each GCG of GRA approach in consideration with the increment of research reliability. fsQCA approach qualitative analysis (Ragin, 2000) is soured from the initial Qualitative Comparative Analysis ("QCA") method of the Boolean Algebra Theory ("BAT") and QCA method is directly able to evaluate the linear correspondences between each analytical criterion (independent variable) and each induced solution (dependent variable). In analytical measurements of QCA method, the Crisp Set Qualitative Comparative Analysis ("csQCA") has firstly been created to explore the dependences (crisp set, "cs") between two valuable groups (Ragin, 2008): "in" variables ($X_1, X_2, \ldots, X_n$) and "out" variables ($Y_1, Y_2, \ldots, Y_n$). Basically, according to the essential concept of QCA method, the two relation-circumstance between "in" and "out" variables to be in analytical processes: (1) "sufficient analysis": any "in" variable can be "possibly" and not be "necessarily" bring about "out" variable and (2) "necessarity

analysis": any "in" condition is necessary to affect "out" condition. Subsequently, in these analytical relation-circumstances, "consistency" is the extent to which a causal combination generates an outcome and "coverage" is how many surveyed samples with the outcome are represented by a causal condition (Ragin et al., 2006). Furthermore, if the "in" class (X_i) value is less than or equal to the "out" class (Y_i) values, the analyses of fsQCA approach belong "sufficient analysis" and the consistency and coverage are computed as (Schneider & Grofman, 2006).

$$\text{consistency}(X_i \leq Y_i) = \frac{\sum \min(X_i, Y_i)}{\sum(X_i)} \tag{6}$$

$$\text{coverage}(X_i \leq Y_i) = \frac{\sum \min(X_i, Y_i)}{\sum Y_i} \tag{7}$$

Continuously, if "in" class(X_i) value is bigger than the "out" class class(Y_i) values, the analyses of fsQCA approach belong "necessity analysis" and the consistency and coverage are computed as (Mendel & Korjani, 2012).

$$\text{consistency}(X_i \succ Y_i) = \frac{\sum \min(X_i, Y_i)}{\sum(X_i)} \tag{8}$$

$$\text{coverage}(X_i \succ Y_i) = \frac{\sum \min(X_i, Y_i)}{\sum Y_i} \tag{9}$$

RESEARCH DESIGN

Taking interviewed experts into account for going through research analyses and research evaluation, there are fifteen experts were interviewed in person for collection of expert's weight-questionnaires to inductively detect interplays among the digital characteristics of OLCs (independent variables), SBLA and EILC (evaluated mediators) and the level of rural-urban ED (Dependent Variables) because the surveyed research of Dalkey and Helmer (1963) concluded that the collected questionnaires are, at least, over 10 professional interviewees of the total surveyed data in the Delphi method and expertise brainstorm approach for higher research reliability and representativeness. For the reason, the interviewees of collected expert's questionnaire are 15 experts including five professors who have, a long time, at least over 15 years, in relative ED, SBLA and EILC educational research fields; five senior industrialists who have over 10-year working experiences in the related OLC industries and final five senior professionals who have over 10-year analyzing experience in the interrelated ED, SBLA and EILC of empirical or government research institutions. The interviewed questionnaire data were surveyed, in person, for the pairwise comparisons at each level are evaluated with respect to the related interdependence and importance from equal important (1) to extreme important (5) of Likert's scales. Contiguously, in connection with evaluated criteria and in stretch with author's prior researches in relative OLCs fields, the most the key-critical determinants of OLCs (Hsieh, 2016) are re-employed to explore the dependences between digital characteristics of OLCs (independent variables), SBLA and EILC (evaluated mediators) in order to detect the autocorrelationships between the digital

characterisitics of OLCs and the level of rural-urban ED. Subsequently, the ten potential assessed determinants were integrated from the authors' prior related researches and these determinants are Aggregation Technology Function of Basic Function ("ATF-BC") (Fournier, Kop, & Sitlia, 2011; Lawless & Richardson, 2002), Course Evaluation Technology Function of Course Function ("CETF-CF") (Han, Yalvac, Capraro, & Capraro, 2015), Course Professionalization Technology Function of Course Function ("CPTF-CF") (Kop & Carroll, 2012), Feedback Technology Function of Basic Function ("FTF-BF") (Kop & Hill, 2008), Re-purposing Technology Function of Basic Function ("RTF-BF") (Kop, Fournier, & Mak, 2011), Connectionization of Course Operation ("C-CO") (Hazel, Conrad, & Martin, 1997), Openness of Course Content ("O-CC") (Yuan, MacNeill, & Kraan, 2008), Convenience of Course Operation ("C-CP") (Hu & Kuh, 2002), Course Complete Rate of Course Assessment ("CCR-CA") (Kelland, 2006) and User Completely Unrestricted Operation of Course Operation ("UCUO-CO") (Kember, 1995). In succession, making allowance for the essential research methodology, the evaluated measurements are completely referred as a range of greified (1), (2), (3), (4) and (5) equations of five fundamental greified measure-steps and (6), (7), (8) and (9) of one brief fsQCA verify-step in next empirical measurements session.

EVALUATED MEASUREMENTS

Therefore, in order to make probe into the autocorrelationships between the digital characteristics of OLCs and the level of rural-urban ED in high-technology era, the 15 expert's weight-questionnaires has systematically collected by Delphi method and further, GRA and fsQCA approaches have been employed to comprehensively evaluated these surveyed experts' weight-questionnaires. Moreover, there are five main measured-steps to be implemented and these steps are:

First greified measure-step: confirming the correspondences among each assessed criteria in accordance with research topic: in consideration with research conceptual induction as **Figure 1**, the digital characteristics of OLCs were considered as assessed independent variables $X_i = \{X_i(k)|k = 1, 2, \dots, n\}, i = 1, 2, \dots, 10$ and the educational features of SBLA and EILC (Mediators) were recognized as appraised dependent variables ($Y = \{Y_{SBLA}(k)|k = 1, 2, \dots, 12; Y_{EILC}(L)|L = 1, 2, \dots, 7\}$) to verify the correlationships between the digital characteristics of OLCs and the educational features of SBLA and EILC (Mediators) in order to eventually realize the autocorrelationships between the digital characteristics of OLCs and the level of rural-urban ED.

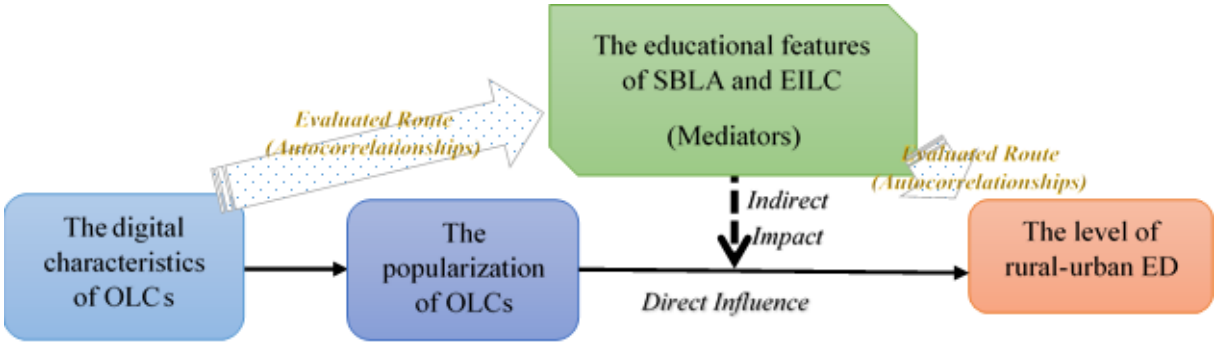


Figure 2. Research evaluated route

Second greified measured step – nondimensionalizing each surveyed data: the 15 experts' weight-questionnaires were gathered in person and specifically, in consideration with the increment of research reliability and representativeness, these surveyed data has further re-computed by geometric mean ($\sqrt[n]{\prod_{i=1}^{n} X_i} = \sqrt[n]{X_1 X_2 \ldots X_n}$) and computations are demonstrated in **Table 3**.

Table 3. The geometric mean of 15 experts' weigh-questionnaires data

Independent Variables	Mediators																		
	The educational features of SBLA												The educational features of EILC						
The digital characteristics of OLCs	AL	QS	CM	TT	EDN	SE	LE	PL	SC	GST	CST	MLT	FS	CLN	CA	IATP	CL	AO	VLG
ATF-BC	3.5847	3.7088	3.5566	3.4646	3.5596	3.5166	3.7248	3.0161	3.7807	3.0904	3.507	3.3082	3.9487	3.0292	3.3988	3.3988	3.8737	3.4552	3.4552
CETF-CF	3.5166	3.0292	3.6129	3.4646	3.4498	3.3722	3.6829	3.3722	3.6829	3.3722	3.4042	3.4135	3.8737	3.6571	3.6384	3.294	3.3134	3.1638	3.1037
CPTF-CF	3.5166	3.6929	3.1811	3.7088	3.5166	3.7838	3.4228	3.3988	3.3486	3.0447	3.8105	3.053	3.7704	3.2823	3.4014	3.4135	3.5749	3.4796	3.2112
FTF-BF	3.8105	3.6541	3.5166	3.5166	3.8571	3.3486	3.1588	3.6829	3.5847	3.4375	3.6384	3.3315	3.547	3.901	3.8105	3.9317	3.4135	3.2505	3.4042
RTF-BF	3.5847	3.4891	3.8842	3.3722	3.492	3.9425	3.8539	3.4986	3.4375	3.22	3.6829	3.2992	3.3722	3.7807	3.2734	3.0662	3.0662	3.3486	3.1887
C-CO	3.8842	3.6541	3.7542	3.6129	3.5596	3.8105	3.1588	3.7381	3.2112	3.7381	3.5596	3.7838	3.8842	3.6829	3.4135	3.4404	3.1638	3.3722	3.4646
O-CC	4.0679	3.6541	3.8269	3.2593	3.6384	3.7704	3.0746	3.6384	3.3486	3.4552	3.6541	3.4228	3.3082	3.5596	3.6285	3.396	3.6441	3.0662	3.3631
C-CP	3.8676	3.8842	3.7248	3.5596	3.5166	3.6988	3.3842	3.5596	3.7381	3.7542	3.6285	3.5566	3.6285	3.3224	3.3722	3.0422	3.5317	3.4552	3.2992
CCR-CA	3.3578	3.4498	3.7279	3.7941	3.3988	3.8571	3.3315	3.4404	3.492	3.6829	3.3486	3.2992	3.8737	3.5847	3.4228	3.2112	3.3224	3.6988	3.3395
UCUO-CO	3.8105	3.6988	3.6988	3.5596	3.507	3.7542	3.3343	3.6829	3.1974	3.7279	3.3343	3.2593	3.0878	3.4135	3.8269	3.3486	3.5749	3.2823	3.3459

Third greified measured step – computing $GCC(X_i^*)$ of GRA approach: the geometric mean of 15 experts' weight-questionnaires are nondimensionalized by the greified (1) equation as expressed in **Table 4**, because of these nondimensionalizing surveyed data belongs efficient goal (maximum is positive), to concretely testify the correlationships between the digital characteristics of OLCs and the educational features of SBLA and EILC (Mediators).

Table 4. GCCs of 15 experts' weigh-questionnaires

Independent Variables	Mediators																		
	The educational features of SBLA												The educational features of EILC						
The digital characteristics of OLCs	AL	QS	CM	TT	EDN	SE	LE	PL	SC	GST	CST	MLT	FS	CLN	CA	IATP	CL	AO	VLG
ATF-BC	0.3195	0.7949	0.5341	0.3839	0.3508	0.2828	0.8344	0	1	0.0643	0.3628	0.3492	1	0	0.2266	0.4009	1	0.615	0.9739
CETF-CF	0.2236	0	0.6141	0.3839	0.1112	0.0397	0.7806	0.4933	0.8324	0.4616	0.1469	0.4933	0.9129	0.7203	0.6594	0.283	0.3062	0.1543	0
CPTF-CF	0.2236	0.7762	0	0.8406	0.2569	0.7328	0.4468	0.5301	0.2593	0	1	0	0.7929	0.2904	0.2313	0.4174	0.63	0.6535	0.2979
FTF-BF	0.6374	0.7308	0.4771	0.481	1	0	0.1081	0.9235	0.664	0.5537	0.6387	0.3811	0.5333	1	0.9703	1	0.4301	0.2913	0.8326
RTF-BF	0.3195	0.5378	1	0.2111	0.2032	1	1	0.6682	0.4117	0.247	0.7321	0.3369	0.3304	0.862	0	0.0270	0	0.4465	0.2356
C-CO	0.7413	0.7308	0.8151	0.6612	0.3508	0.7777	0.1081	1	0.0236	0.9773	0.4731	1	0.9251	0.7498	0.2531	0.4476	0.1209	0.4838	1
O-CC	1	0.7308	0.9184	0	0.5228	0.7102	0	0.8619	0.2593	0.5786	0.6716	0.506	0.256	0.6084	0.6416	0.3977	0.7157	0	0.7186
C-CP	0.7178	1	0.7733	0.5614	0.2569	0.5896	0.3974	0.7527	0.927	1	0.6179	0.6891	0.6281	0.3364	0.1786	0	0.5765	0.615	0.5416
CCR-CA	0	0.4919	0.7777	1	0	0.8562	0.3297	0.5877	0.505	0.8995	0.0302	0.3369	0.9129	0.6372	0.2699	0.19	0.3173	1	0.6534
UCUO-CO	0.6374	0.7831	0.7362	0.5614	0.2361	0.683	0.3333	0.9235	0	0.963	0	0.2823	0	0.4408	1	0.3445	0.63	0.3416	0.6709

Fourth greified measured step – measuring $GCC(r_i^*)$ of GRA approach: after measuring GCCs of 15 experts' weight-questionnaires, GCGs of these survey data are further measured by greified (4) equation as presented in **Table 5**.

Table 5. GCGs of 15 experts' weigh-questionnaires

Independent Variables	Mediators																		
	The educational features of SBLA												The educational features of EILC						
The digital characteristics of OLCs	AL	QS	CM	TT	EDN	SE	LE	PL	SC	GST	CST	MLT	FS	CLN	CA	IATP	CL	AO	VLG
ATF-BC	0.4235	0.7091	0.5176	0.448	0.4351	0.4108	0.7512	0.3333	1	0.3483	0.4397	0.4345	1	0.3333	0.3927	0.4549	1	0.565	0.9504
CETF-CF	0.3917	0.3333	0.5644	0.448	0.36	0.3424	0.695	0.4967	0.7489	0.4815	0.3695	0.4967	0.8516	0.6412	0.5948	0.4109	0.4188	0.3715	0.3333
CPTF-CF	0.3917	0.6908	0.3333	0.7582	0.4022	0.6517	0.4748	0.5155	0.403	0.3333	1	0.3333	0.7071	0.4133	0.3941	0.4618	0.5747	0.5907	0.4159
FTF-BF	0.5797	0.65	0.4888	0.4907	1	0.3333	0.3592	0.8674	0.5981	0.5284	0.5805	0.4469	0.5172	1	0.944	1	0.4673	0.4137	0.7491
RTF-BF	0.4235	0.5197	1	0.3879	0.3856	1	1	0.6011	0.4594	0.399	0.6511	0.4299	0.4275	0.7837	0.3333	0.3394	0.3333	0.4746	0.3954
C-CO	0.659	0.65	0.73	0.5961	0.4351	0.6922	0.3592	1	0.3387	0.9565	0.4869	1	0.8698	0.6665	0.401	0.4751	0.3625	0.492	1
O-CC	1	0.65	0.8597	0.3333	0.5117	0.6331	0.3333	0.7836	0.403	0.5427	0.6036	0.503	0.4019	0.5608	0.5825	0.4536	0.6375	0.3333	0.6399
C-CP	0.6393	1	0.688	0.5327	0.4022	0.5492	0.4535	0.6691	0.8726	1	0.5668	0.6166	0.5734	0.4297	0.3784	0.3333	0.5414	0.565	0.5217
CCR-CA	0.3333	0.496	0.6922	1	0.3333	0.7766	0.4272	0.5480	0.5025	0.8326	0.3402	0.4299	0.8516	0.5795	0.4065	0.3817	0.4228	1	0.5906
UCUO-CO	0.5797	0.6974	0.6546	0.5327	0.3956	0.612	0.4285	0.8674	0.3333	0.931	0.3333	0.4106	0.3333	0.4721	1	0.4327	0.5747	0.4316	0.6031

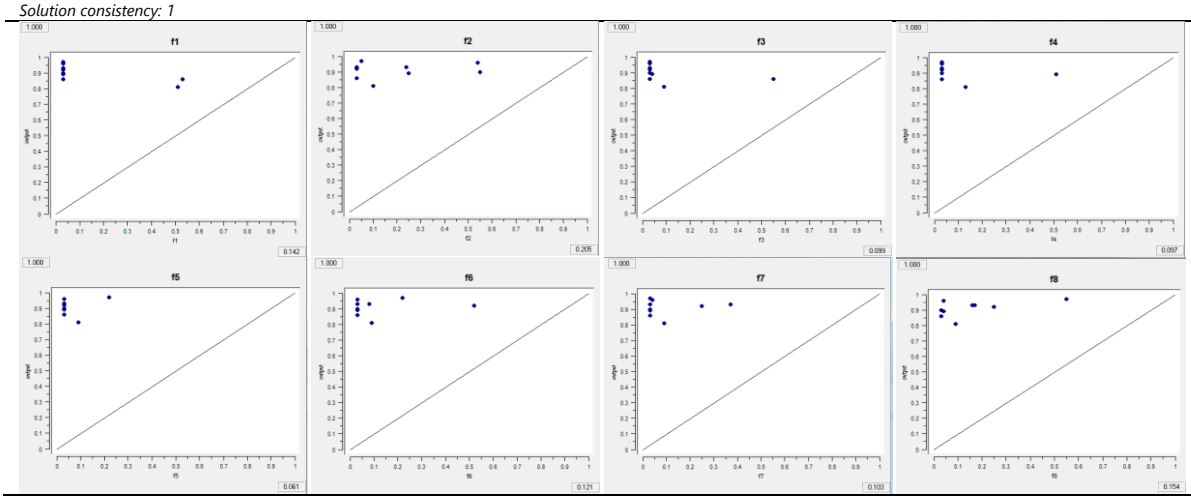
Table 6. GCK of 15 experts' weigh-questionnaires

Independent Variables	Mediators	
	The educational features of SBLA	The educational features of EILC
The digital characteristics of OLCs		
ATF-BC	0.4932	0.6115
CETF-CF	0.4614	0.4914
CPTF-CF	0.491	0.4972
FTF-BF	0.5502	0.6849
RTF-BF	0.5631	0.4217
C-CO	0.6193	0.5706
O-CC	0.5645	0.5026
C-CP	0.6408	0.4686
CCR-CA	0.5236	0.5682
UCUO-CO	0.5341	0.5193

Table 7. The consistency and coverage of the educational features of SBLA

Model: output = f(gcg1, gcg2, gcg3, gcg4, gcg5, gcg6, lpgcc, ptgcc, scgcc, gssgcc, cssgcc, mlsgcc) Results		Raw coverage	Unique coverage	Consistency
F1	~gcg1*gcg3*~gcg4*~gcg5*~gcg6*lpgcc*~ptgcc*scgcc*~gssgcc*~cssgcc*~mlsgcc	0.14175	0.097453	1
F2	gcg1*gcg2*gcg3*gcg4*~gcg5*gcg6*~lpgcc*ptgcc*~scgcc*gssgcc*~cssgcc	0.204873	0.078627	1
F3	~gcg1*gcg2*~gcg3*gcg4*~gcg5*gcg6*~lpgcc*ptgcc*~scgcc*~gssgcc*cssgcc*~mlsgcc	0.09856	0.044297	1
F4	~gcg1*~gcg2*gcg3*gcg4*~gcg5*gcg6*~lpgcc*ptgcc*scgcc*gssgcc*~cssgcc*~mlsgcc	0.097453	0.028793	1
F5	~gcg1*gcg2*gcg3*~gcg4*~gcg5*gcg6*lpgcc*ptgcc*~scgcc*~gssgcc*cssgcc*~mlsgcc	0.108527	0.055371	1
F6	gcg1*gcg2*~gcg3*~gcg4*gcg5*~gcg6*~lpgcc*ptgcc*scgcc*gssgcc*cssgcc*~mlsgcc	0.120709	0.0299	1
F7	gcg1*gcg2*gcg3*~gcg4*gcg5*gcg6*~lpgcc*ptgcc*~scgcc*gssgcc*cssgcc*mlsgcc	0.155039	0.0299	1
F8	gcg1*gcg2*gcg3*gcg4*~gcg5*gcg6*~lpgcc*ptgcc*scgcc*gssgcc*cssgcc*mlsgcc	0.115172	0.036545	1

Solution coverage: 0.586932
Solution consistency: 1



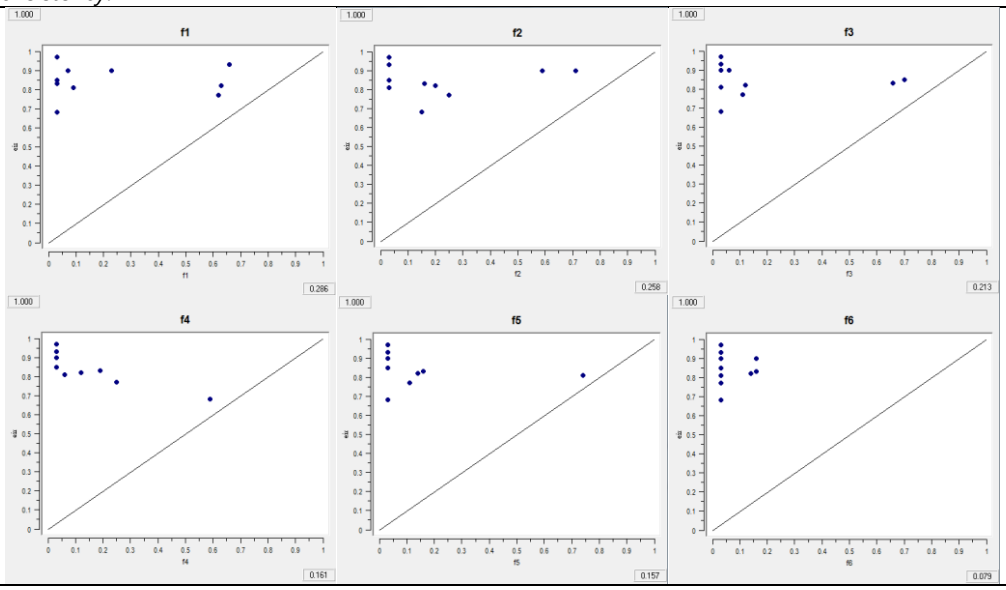
Fifth greified measured step – calculating $GCK(r_i^*)$of GRA approach: after calculating GCCs of 15 experts' weight-questionnaires, GCK of these survey data is consequently induced by the greified (5) equation as illustrated in **Table 6** for detecting the correlationships between the digital characteristics of OLCs and the educational features of SBLA and EILC (Mediators) in order to eventually realize the autocorrelationships between the digital characterisitics of OLCs and the level of rural-urban ED.

Sixth fsQCA measured step –gauging consistency and coverage of fsQCA method: behind a rang of evaluated measurements of GRA approach, the measured consequences of GRA approach are further re-measured the consistency and coverage between the digital characteristics of OLCs and the educational features of SBLA and EILC (Mediators) because the "consistency" is the extent to which a causal combination generates an outcome and "coverage" is how many surveyed samples with the outcome are represented by a causal condition. As a result, the consistency and coverage of the educational features of SBLA and EILC are computed through equations (6), (7), (8) and (9) as described in **Table 7** and **8**.

Table 8. The consistency and coverage of the educational features of EILC

Results		Raw coverage	Unique coverage	Consistency
F1	sfgcc*~clgcc*~cagcc*~iatpgcc*lgcc*aogcc	0.286052	0.169031	1
F2	sfgcc*clgcc*~cagcc*~iatpgcc*~lgcc*vggcc	0.257683	0.107565	1
F3	~sfgcc*cagcc*~iatpgcc*lgcc*~aogcc*vggcc	0.212766	0.134752	1
F4	~sfgcc*clgcc*~cagcc*~iatpgcc*~lgcc*~aogcc*~vggcc	0.160756	0.052009	1
F5	sfgcc*clgcc*cagcc*~iatpgcc*~lgcc*~aogcc*~vggcc	0.157210	0.076832	1
F6	sfgcc*clgcc*cagcc*iatpgcc*~lgcc*~aogcc*vggcc	0.141844	0.062648	1

Solution coverage: 0.763593
Solution consistency: 1



Extraordinarily, in connection with **Table 5** and **6**, the coverage of the educational features of SBLA and EILC are bigger than 0.5, the consistency of the educational features of SBLA and EILC are both 1 and the number of fsQCA equations of the educational features of SBLA and EILC are located at the up side of fsQCA standardized linear. This results obviously indicates evaluated consequences of GCGs and GCR both belong "necessity" circumstance and consequently, all the digital characteristics of OLCs are positive correlationships between the digital characteristics of OLCs and the educational features of SBLA and EILC.

CONCLUSION AND RECOMMENDATION

Taking a series of assessed measurements and consequences of GRA and fsQCA approaches, the three highest GCR scores of the digital characteristics of Online Learning Courses (OLCs) for the educational features of the students' basic learning abilities (SBLA) are Convenience of Course Operation (C-CP)(0.6408), Connectionization of Course Operation (C-CO) (0.6193) and Openness of Course Content (O-CC) (0.5645) as well as on the contrary, the three lowest GCR scores of the digital characteristics of OLCs for the educational features of SBLA are Course Evaluation Technology Function of Course Function (CETF-CF) (0.4614), Aggregation

Technology Function of Basic Function (ATF-BC) (0.4932) and Course Evaluation Technology Function of Course Function (CETF-CF) (0.4614). Continuously, the three highest GCR scores of the digital characteristics of OLCs for the educational features of the education-institution learning capabilities (EILC) are Feedback Technology Function of Basic Function (FTF-BF) (0.6849), Aggregation Technology Function of Basic Function (ATF-BC) (0.6115) and Connectionization of Course Operation (C-CO) (0.5706) as well as in the opposite, the three lowest GCR scores of the digital characteristics of OLCs for the educational features of EILC are Re-purposing Technology Function of Basic Function (RTF-BF) (0.4217), Convenience of Course Operation (C-CP)(0.4686) and Course Evaluation Technology Function of Course Function (CETF-CF) (0.4914). In succession, taking a cross-analyses of these measured consequences, Connectionization of Course Operation (C-CO) of the digital characteristics of OLCs is postive to effectively enhance the educational features of SBLA and EILC because the educational students and institutions do both focus on the course's operating connectionization in OLCs. In reverse, Course Evaluation Technology Function of Course Function (CETF-CF) is neagive to distinctively avianize the the educational features of SBLA and EILC because the educational students and institutions do both not like course evaluations, such as student's learning performance evaluation, institutional teacher's evaluation, institutional course's evaluation in OLCs and etc. Momentously, there are two very valuable discovery: (1) Convenience of Course Operation (C-CP) in OLCs is able to strengthen the educational features of SBLA because a majority of students desire to get education from OLCs without time and location restrictions of traditional face-to-face courses; reversely, it is able to reduce the educational features of EILC because the students' tuition and miscellaneous fee debts of OLCs are always lower than traditional face-to-face courses; (2) Aggregation Technology Function of Basic Function (ATF-BC) in OLCs is able to raise the educational features of EILC but lessen the educational features of SBLA because a plurality of educational institutions definitely provide the academic courses with professional knowledge of specialists in OLCs; however, a mass of students desire the vivid and vigorous courses for attaining not only professional knowledge but also various information, empirical studying cases and life-experience of each individual in OLCs that directly and powerfully resupply the educational research myth and gap. Particularly, beyond completing this research, the inductive contributions of this research are:

- ✧ GRA of quantitative analysis and fsQCA of qualitative analysis are innovatively consolidated into the assessed measurements of experts' weight-questionnaires for the reinforcement of research reliability, validity and representativeness.
- ✧ The cross-analyses results are to definitely testify the autocorrelationships between the digital characterisitics of OLCs and the level of rural-urban ED through assessments of the correlationships between the digital characteristics of OLCs and the educational features of SBLA and EILC (Mediators) that directly resupply the research myth and gap in the relative OLCs research fields.

- ✧ Connectionization of Course Operation (C-CO) of the digital characteristics of OLCs is most critical determinant to empirically provide the most beneficial niche strategy to the Taiwanese educational government departments and institutions to establish the most effective and efficient OLCs in order to overcome the serious rural-urban education divide.

Eventually, in terms of the swift development of diversified educational technologies, some digital characteristics of OLCs are still continuously creating and discovering and therefore, these developing digital characteristics of OLCs may become the research limitation in this study. However, the evaluated model of this research is able to provide the effective and efficient methodology for future research direction to identify and assess these innovative digital characteristics of OLCs in order to find out the most critical solutions for the decrement of ED in this dynamic education era.

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