ORIGINAL RESEARCH

Factor analysis of teacher professional development and evaluation based on math methods of RaschGSP curve, ISM, GSM and MSM

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ABSTRACT

Professionalism has been estimated as the most important fundamental impetus in progress. Teacher profession as the most important within-school factor has been emerged to explain effective teaching and learning by research. In viewing of teacher in-service training, professional development and innovation is thus highlighted as key prerequisite for high quality teaching. Factor analysis of teacher professional development and evaluation based on math methods was primarily to identify factorial sequences of activity involving two teamwork in the classroom. The purpose of this study is to perform to: 1) Couple quantitative and qualitative accesses to display teaching research, 2) Deliver the differences of pedagogical reasoning between graduate students and undergraduate students, 3) Analyze and visualize the educational practices based on math methods, the former is to embody educational performance in academic features, the latter is to communicate concretely and contextually. Research techniques herewith are Nagai's proposals of Rasch model GSP curve (RaschGSP curve), Grey structural modeling (GSM) and Matrix-based structure modeling (MSM) have been applied to illustrate structural analysis.

Key Words: Pedagogical reasoning, Math methods, RaschGSP curve, GSM, MSM

1. INTRODUCTION

Since 1990, along with innovation and progress of information technology and digit communications, civilization and standard of living have been brought to enter a new way to work, live and recreation. In the future, the interactive communication through the no limited cloud computing and big database through various methods, change and challenge have emerged frequently whereby to prove power of knowledge and to embody human potential to open disruptive innovation as well as to win through innovation.[1] "Investing in education is an investment in the future", so that innovation and educational reform have become a national focus with more attention. Noteworthy, "Teacher quality is the key to student success" matter living and competing, which has

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been lifted up to the most important.

Recalling April 10 of 1994, the naive march for educational reform has causally determined a series of educational reform in Taiwan. As P. F. Drucker (1909-2005) *Innovation and Entrepreneurship* stated lack of creativity is synonymous with death,[2] in- and renovation is greatly. Factors affecting creativity, innovation, even invent is diverse, such as the professionalism, tactic conduct, context knowledge, critical thinking and collaboration etc., which also affect the survival of education, shown in reasoning, actions, and turn round of those working in education. To lecture the necessity and importance of teacher professional development and evaluation, is to converge impact factors, such as school leadership and self-awareness on one hand, and to motivate teamwork conducting this study on the other.

Based on technology trends and challenges for work in the 21st century, teacher professional standard and horizon[3] has been expected to promote. Factor analysis of teacher professional development and evaluation aims to: 1) Outline the key variables for teacher professional development and evaluation retrieved from education-based graduate thesis, 2) Analyze pedagogical reasoning between graduate students and undergraduate students in viewing of variables, 3) Interpret and differentiate contextual structure of the two teamwork. Additionally, math methods as research tools used to: 1) Implement the research process featured with numerical value, 2) Visualize the framework topologically, 3) Bridge qualitative and quantitative analysis shown alternative educational research.[4, 5]

2. METHOD

Science and technology are indispensable to educational profession as well as modernization. In digitized communication and networking in education, educational technology as technological tools and media that facilitate teaching and learning since 1960s, have been becoming more important than before. Math methods based on mathematical logic and language invented, are used extensively in quantitative science, such as natural sciences and engineering disciplines.[6] Herein is to attempt to apply in educational praxis, whereby to visualize a framework of logic context, to generate structural analysis and to add scientific feature in pedagogy.[7]

2.1 Interpretive structural modeling (ISM)

ISM was proposed by J. N. Warfield in 1972, established as methodology for handling discrete data based on binary matrixes in system modeling, with which data has been defined and identified complex issues to form interpretable patterns.[8, 9] Having decided the contextual relation, a kind of complex causal relationship is derived from based on pair-

wise comparison of variables enroute reachability-matrix transitivity.[10]

In terms of Peirce's sign theory, ISM is not only seen as mathematical methodology, but as modeling technique,[11] general speaking, the former logically to lend a comprehensive grasp and imagine of explicit and implicit entity of data, the latter scaffolding-based to structure an meaningful and efficient organization of knowledge, which have been equipped with symbolic logic, academic paradigm and the organization of human knowledge.

Supposed a complex system $S = (s_1, s_2, \cdots, s_n)$ and a binary relation R on S.

The steps of ISM are as follows:

Step 1: Establishing the relationship matrix.

The relationship matrix is established in the following way:
$A = [a_{ij}]_{n \times n}$, where, $\begin{cases} a_{ij} = 1, & if \ (s_i, s_j) \in R \\ a_{ij} = 0, & if \ (s_i, s_j) \notin R \end{cases}$

Step 2: Calculating the reachable matrix

The reachable matrix is defined as follows: Let B = A $\bigoplus$ I, I be the unit matrix of size n. $B \neq B^2 \neq \cdots \neq B^{k-1} = B^k = T$.

Step 3: Determining the levels

(1) The confirmation of the first level: Let $P(s_i)$ be the reachability set and $Q(s_i)$ be the antecedent set of elements s_i.
$P(s_i) = \{s_i \mid (s_i, s_i) \in R, \ j = 1, 2, \cdots, n\}$
$Q(s_i) = \{s_i \mid (s_i, s_i) \in R, \ j = 1, 2, \cdots, n\}$

(2) The confirmation of other levels: If s_i belongs to the first level, the i_{th} row and the i_{th} column are deleted from T. After deletion, the matrix T converted into a new matrix T_1. Then, based on the operation of the confirmation of the first level, the elements belonging to the second level are identified. This process is continued until all the levels are determined.

Step 4: Forming the structural model

The structural model is generated from reachable matrix and the levels achieved in step 3. The formation rules are as follows:

If $(s_i, s_i) \in R$, the relationship between s_i and s_j is presented by an arrow which points from s_i to s_j.

If $(s_i, s_i) \in R$ and $(s_j, s_k) \in R$, the arrow presenting the relationship between s_i and s_k is deleted.

2.2 Grey structural modeling (GSM)

GSM proposed as system modeling method by Nagai M. *et al.*,[12] is merged together of grey system theory and graphic

theory, of which purpose is generated analyzing structure of system, one is to estimate a hierarchy of given elements, and the other to discern the relationship from observed value such as statistical graphical modeling.

GSM constructed on topological-based grey relational analysis was to calculate localized grey relational grade, globalized grey relational grade and grey relational ordinal. Then based on grey relational grade to compare with each other, when one of the parties had a larger value, it was identified as more important item, and became criteria of structural system arrangement.[12, 13]

The formula of localized grey relational grade is:

$$r_{0i} = \frac{\max\limits_{\forall i} \|x_0 - x_i\|_\rho - \|x_0 - x_i\|_\rho}{\max\limits_{\forall i} \|x_0 - x_i\|_\rho - \min\limits_{\forall i} \|x_0 - x_i\|_\rho},$$

where,

$$\|x_0 - x_i\|_\rho = \bar{\Delta}_{0i} = \|x_{0j} - x_{ij}\| = \left(\sum_{j=1}^n \left[\Delta_{0i}(j) \right]^\rho \right)^{\frac{1}{\rho}}$$

And formula of globalized grey relational grade is:

$$r_{ij} = 1 - \frac{\|x_i - x_j\|_\rho}{\max\limits_{\forall i}\max\limits_{\forall j} \|x_i - x_j\|_\rho}$$

GSM draws digraph by using three parameters: distinguish coefficient ρ which decides the basic composition of digraph, class coefficient θ which gives the hierarchy, and path coefficient ψ which gives an ordered pair of element arrows. In this paper, $\rho = 2$ is used that means Euclidean distance is applied.

2.3 Rasch model GSP curve (RaschGSP curve)

RaschGSP Curve was also proposed by Nagai M. *et al.*,[14] which is assigned to analyze the student item responses. This mathematical model is a mixture of GSP Chart and Rasch Model, and constructed with Nagai's formula of localized grey relational grade and Rasch logistic regression. RaschGSP Curve has been shown: 1) To measure examinees' competence and calibrate items response quality effectively; 2) To visualize characteristic curve of sets of students and problems accurately; 3) To fit problem-solving small sample sizes with nonparametric methods mathematically.[15]

The logistic regression model used in Rasch GSP method is the three parameters logistic model. Its mathematical formula is described as follows:

$$y = f(x) = \gamma + \frac{1 - \gamma}{1 + e^{-\alpha(x-\beta)}}$$

where x is the order value of student (or the order of item

difficulty), y is the localized grey relational grade, and α, β and γ featured as parameters, in specific, α means student or item discrimination between group of high gamma and group of low gamma, β means partitioned between high difficulty group and low difficulty group, and γ means guessing distributed between lowest score and highest score.

2.4 Matrix-based structure modeling (MSM)

MSM, an extension of interpretative structural modeling, was also proposed by Nagai M. *et al.*[16, 17] MSM is designed not only to generate multiple associations between matrixes, but also to reconfigure an overall mega matrix, and to illustrate graphically the comprehensive overview of data.

In general, MSM is known as multi-matrix interpretative structural model, which is of value to: 1) Grasp the meaning of respective sets; 2) Convey the logical relationship of local clusters; 3) Visualize parts and whole matrixes of sets. The process of generating MSM is as follows:

Let the combined set $M = \bigcup M_i$, where M_i is the concept set matrix, it can be all set of material objects, it can also be the set of all attributes such as set of students, set of questions, set of learning concept, set of goods, set of merchandise category, set of commodity components, set of commodity production conditions, *etc.*

Establish the structure system theory of MSM as follows: $W = MSM(M, T, f)$, where 1) $M = \bigcup M_i$ is a combined matrix of factor set; 2) $T = \bigcup_{r \in M} T_r$ is structure matrix; 3) f: $M \times M \to T$ is reachable function, $M \times M = \{(m_i, m_j) \mid m_i, m_j \in M\}$, $f(m_i, m_j) = m_{ij} \in T_r$.

Because f is a reachable function, so f satisfies the following:

(1) Reflexive law: $f(m_i, m_i) = 1 \Leftrightarrow m_i \to m_i, \forall i$
(2) Anti-symmetric law:
$f(m_i, m_j) = f(m_j, m_i) = 1 \Leftrightarrow m_i \to m_j, m_j \to m_i \Rightarrow m_i \leftrightarrow m_j, \forall i \neq j \Leftrightarrow m_i = m_j$
(3) Transitive law:
$f(m_i, m_j) = 1, f(m_j, m_k) = 1 \Leftrightarrow f(m_i, m_k) = 1 \leftrightarrow m_i \to m_j, m_j \to m_k, \forall i \neq j \neq k \Rightarrow m_i \to m_k$

In practice, to build up MSM, first to find out matrix of relation and its correlated clusters, second to determine the proposed structure of mega matrix. Note that, to generate the multiple cluster of matrixes is focused on matrix' various elements and attributes, and to establish structural analysis based on multiple association of matrixes.[18, 19]

3. CASE STUDY

Facing the global economic competition and market demand change, basic education and teacher profession have become more important than ever. Teacher professional management and evaluation is a topic course of educational philosophy. In view of professional development and teacher evaluation confused since 2006 (the year of professional development and teacher evaluation officially on trial), case study is to analyze the learning outcomes, featured as follows: 1) Practical operation from data collection to questionnaire designed; 2) Group working divided into graduate students and undergraduate students; 3) Item selection and definition in panel discussion.

Table 1. Data collection

| Master thesis	Keywords	Year
A study of principal role-performance of teacher professional growth at elementary school：Take the four counties and cities of central Taiwan as examples	Elementary school, Teacher professional growth, Principal role-performance	2010
A study of meta-evaluation of teacher professional development evaluation in Taichung city's elementary school	Teacher professional development evaluation, Meta-evaluation	2010
A study on the correlation between principal's knowledge leadership and teachers' attitude toward professional learning community of elementary school in Taichung city	Principal's knowledge leadership, Teacher professional learning community	2010
The current situation of teachers' participating in web-based learning community and the related study of teachers' professional growth on elementary schools in Taichung county	Web-based learning community, Teachers professional growth	2010
A case study on the teachers' professional role perception and role performance elementary school	Teacher professional role perception, Teacher professional role performance, Teacher evaluation for professional development	2010
A study on the relationship between teacher professional role perception and role performance-example of elementary schools implemented the teacher evaluation for professional development in Taichung city	Teacher evaluation for professional development, Teacher professional role perception, Teacher professional role performance	2010
The research of trial teacher evaluation for professional development at elementary school in Taichung county	Teacher evaluation for professional development, Elementary school	2010
A study of the promotion and implementation of the trial on elementary teacher professional development evaluation in Nantou county	Promotion and implementation of teacher professional development evaluation, Trial scheme of teacher professional development evaluation	2010
The study of relationships between elementary school principals' leadership behaviors and teachers' professional growth	Elementary school principals' leadership, Teachers' professional growth	2010
A study on the relationship of the learning community and professional performance of teachers in elementary of Taichung county and city	Learning community, Teacher professional performance	2010
The study of the relationship between Taichung county elementary school teachers' professional growth and professional commitment	Professional growth, Professional commitment	2010
The current status and the needs of investigation in teacher evaluation for profession development support system which the elementary school teachers participate in	Teacher evaluation, Teacher evaluation for professional development, Support system	2010
A study on the relationship of the learning community and professional performance of teachers in elementary of Taichung county and city	Learning community, Teacher professional performance	2010
The study of relationships between principal instructional leadership and the interaction of teachers' professional learning communities in the elementary school	Elementary school, Principal instructional leadership, The interaction of teachers' professional learning communities	2010
Research of elementary school teacher professional learning community forming history-Taichung city Kuo-Kuang elementary school children's musical troupe as example	Teacher profession development, Teacher professional learning community	2011
The development of a teacher professional learning community: A case study of Shu-Guang learning community in Taichung city	Children's musical, Professional learning community, Case study	2012
A study of elementary school teacher leadership, teacher professional learning community and school effectiveness	Teacher leadership, Teacher professional learning community, School effective	2012
A study of the relationship between principal's positive leadership and teacher's professional commitment in the elementary school	Principal's positive leadership, Teacher's professional commitment, Elementary schools	2012

3.1 Research process

Firstly, data of Master theses of Taichung University of Education are taken as a database. Secondly, the keywords searched are teacher career development or teacher professional development, even teacher evaluation, and set the graduation year from near to far, the latest in 2013 until 2009.

There were 340 papers about educational research and curriculum research, in which 34 theses are regarded complied and 18 specifically in the range of elementary school (see Table 1). Thirdly, the classification of keywords had been sorted to 3 tracts and 12 concepts (see Table 2).

Table 2. Data compilation

Keyword sorting
Elementary school
principals' leadership
Principal role-performance
Principal's knowledge leadership
Principal instructional leadership
Principal's positive leadership
School effective
Teacher leadership
Teacher professional role perception
Teacher professional role performance
Teacher professional performance
Teacher professional commitment
Teacher profession development
Teacher professional growth
Support system
Teacher professional learning community
Web-based learning community
Learning community
The interaction of teachers' professional learning communities
Teacher evaluation
Teacher professional development evaluation
Meta-evaluation

Scale	Item
Principal management & leadership	School leadership
	Administration
	Organizational culture
	School effectiveness
Professional development & growth	Professional commitment
	Professional performance
	Professional perception
	Professional ethics
Professional learning community	Online community
	Expertise accreditation
	Peer coaching
	Teacher evaluation
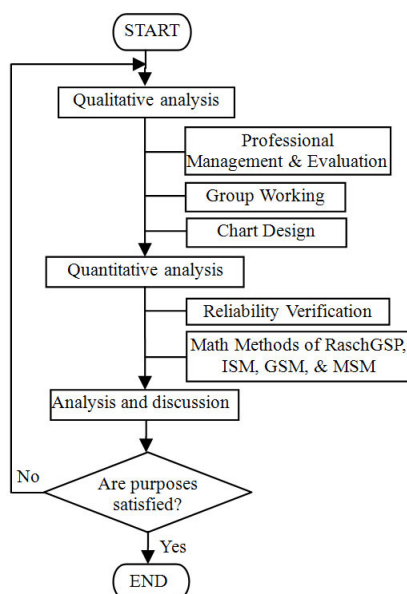
Figure 1. Research process

As designed, the process of qualitative and quantitative researches is divided into stages (see Figure 1), data of 12 graduate students, inclusive 8 full-time teachers and 15 undergraduate students (see Table 3). In SPSS Statistics, the Cronbach's value of graduate students and undergraduate students, graduate students, and undergraduate students are separately 0.826, 0.830, and 0.804 which mean reliable data or so scaled clean data.[20]

3.2 Grey relational analysis

Applying the calculation by formula of Nagai's localized grey relational analysis, γ values of the factors affecting professional management and evaluation shown as follows:

(1) Integrity means here that the data of 12 graduate students and 15 Undergraduate students are processed together (see Table 3).

(2) The data of graduate students, inclusive 8 regular teachers is presented in Table 3.

(3) The data of undergraduate students is shown in Table 3.

Table 3. Graduate students and undergraduate students GSP chart

SP	Max	Principal management & leadership					Professional development & growth			Professional learning community				γ
		school leadership	admin	organizational culture	school effectiveness	professional commitment	professional performance	professional perception	professional ethics	online community	expertise accreditation	peer coaching	teacher evaluation	
Max		9	9	9	8	9	9	9	9	6	4	7	7	
S1	9	9	6	7	3	8	7	5	4	3	2	5	6	0.644
S2	8	6	8	7	4	5	6	4	3	2	2	3	3	0.456
S3	9	9	9	9	8	6	8	7	7	5	3	4	5	0.931
S4	7	7	5	4	3	4	5	4	3	2	1	4	3	0.329
S5	9	8	7	8	7	9	9	9	9	3	3	6	5	1.000
S6	9	8	6	9	2	6	4	7	3	2	2	5	3	0.477
S7	8	8	5	7	2	8	3	6	7	1	3	4	6	0.522
S8	8	8	5	7	1	6	5	8	3	2	2	4	5	0.464
S9	8	8	7	7	2	5	4	6	5	1	3	4	5	0.503
S10	9	8	6	9	3	7	5	4	2	1	3	5	5	0.469
S11	9	7	7	6	5	9	7	5	8	6	3	4	7	0.812
S12	9	7	9	8	1	5	7	4	3	2	4	6	6	0.495
S13	8	6	5	7	2	4	6	8	3	1	3	5	5	0.451
S14	6	6	5	2	2	1	4	2	1	1	1	2	2	0.000
S15	9	7	8	7	5	6	4	5	2	3	2	4	6	0.530
S16	9	8	5	7	3	9	8	5	5	3	2	6	7	0.674
S17	8	6	7	5	1	4	8	6	4	2	3	5	5	0.469
S18	9	6	5	8	1	6	4	5	9	2	3	5	7	0.514
S19	9	7	6	7	5	9	8	5	4	3	4	4	5	0.685
S20	9	5	4	8	2	9	5	5	7	5	2	7	4	0.565
S21	7	6	7	6	3	3	7	4	4	5	3	6	6	0.528
S22	7	5	4	3	1	3	7	5	3	1	2	1	2	0.155
S23	7	7	6	5	1	5	6	7	3	2	2	4	6	0.444
S24	8	4	2	8	1	7	2	3	4	1	1	2	3	0.145
S25	8	6	4	5	3	8	5	7	3	5	2	4	6	0.511
S26	8	6	5	5	1	4	7	8	2	2	3	5	7	0.402
S27	8	5	7	8	2	7	8	7	6	1	3	4	5	0.606
γ		1.000	0.771	0.971	0.042	0.793	0.741	0.694	0.395	0.000	0.030	0.474	0.602	

Graduate

SP	Max	Principal management & leadership					Professional development & growth			Professional learning community				γ
		school leadership	admin	organizational culture	school effectiveness	professional commitment	professional performance	professional perception	professional ethics	online community	expertise accreditation	peer coaching	teacher evaluation	
Max		9	9	9	8	9	9	9	9	6	4	6	7	
S1	9	9	6	7	3	8	7	5	4	3	2	5	6	0.471
S2	8	6	8	7	4	5	6	4	3	2	2	3	3	0.201
S3	9	9	9	9	8	6	8	7	7	5	3	4	5	0.930
S4	7	7	5	4	3	4	5	4	3	2	1	4	3	0.000
S5	9	8	7	8	7	9	9	9	9	3	3	6	5	1.000
S6	9	8	6	9	2	6	4	7	3	2	2	5	3	0.217
S7	8	8	5	7	2	8	3	6	7	1	3	4	6	0.294
S8	8	8	5	7	1	6	5	8	3	2	2	4	5	0.205
S9	8	8	7	7	2	5	4	6	5	1	3	4	5	0.265
S10	9	8	6	9	3	7	5	4	2	1	3	5	5	0.205
S11	9	7	7	6	5	9	7	5	8	6	3	4	7	0.741
S12	9	7	9	8	1	5	7	4	3	2	4	6	6	0.237
γ		1.000	0.785	0.919	0.135	0.742	0.615	0.586	0.358	0.000	0.040	0.415	0.477	

Undergraduate

SP	Max	Principal management & leadership					Professional development & growth			Professional learning community				γ
		school leadership	admin	organizational culture	school effectiveness	professional commitment	professional performance	professional perception	professional ethics	online community	expertise accreditation	peer coaching	teacher evaluation	
Max		8	8	8	5	9	8	8	9	5	4	7	7	
S13	8	6	5	7	2	4	6	8	3	1	3	5	5	0.656
S14	6	6	5	2	2	1	4	2	1	1	1	2	2	0.000
S15	8	7	8	7	5	6	4	5	2	3	2	4	6	0.701
S16	9	8	5	7	3	9	8	5	5	3	2	6	7	1.000
S17	8	6	7	5	1	4	8	6	4	2	3	5	5	0.705
S18	9	6	5	8	1	6	4	5	9	2	3	5	7	0.828
S19	9	7	6	7	5	9	8	5	4	3	4	4	5	0.942
S20	9	5	4	8	2	9	5	5	7	5	2	7	4	0.872
S21	7	6	7	6	3	3	7	4	4	5	3	6	6	0.743
S22	7	5	4	3	1	3	7	5	3	1	2	1	2	0.238
S23	7	7	6	5	1	5	6	7	3	2	2	4	6	0.669
S24	8	4	2	8	1	7	2	3	4	1	1	2	3	0.253
S25	8	6	4	5	3	8	5	7	3	5	2	4	6	0.743
S26	8	6	5	5	1	4	7	8	2	2	3	5	7	0.597
S27	8	5	7	8	2	7	8	7	6	1	3	4	5	0.906
γ		0.996	0.753	1.000	0.000	0.829	0.861	0.801	0.456	0.066	0.081	0.551	0.742	

3.3 RaschGSP curve

Combining Table 3 and Rasch Model,[21, 22] have been plotted GSP Curve and RaschGSP Curve (see Figures 2, 3). As Figures shown: 1) Both given with numerical value as preferable sets; 2) RaschGSP Curve formulated discrete sorting sets of students and items into continuous data sets; 3) γ value 0.5 with students at the point (α, 0.69) and items at the point (β, 1.62), the former β is 42.7%, the

latter β is 41.7%. It manifests the one is students left of S_9 & S_6 more difference than right distributed, the other is items left of P_{12} estimated less important than right.
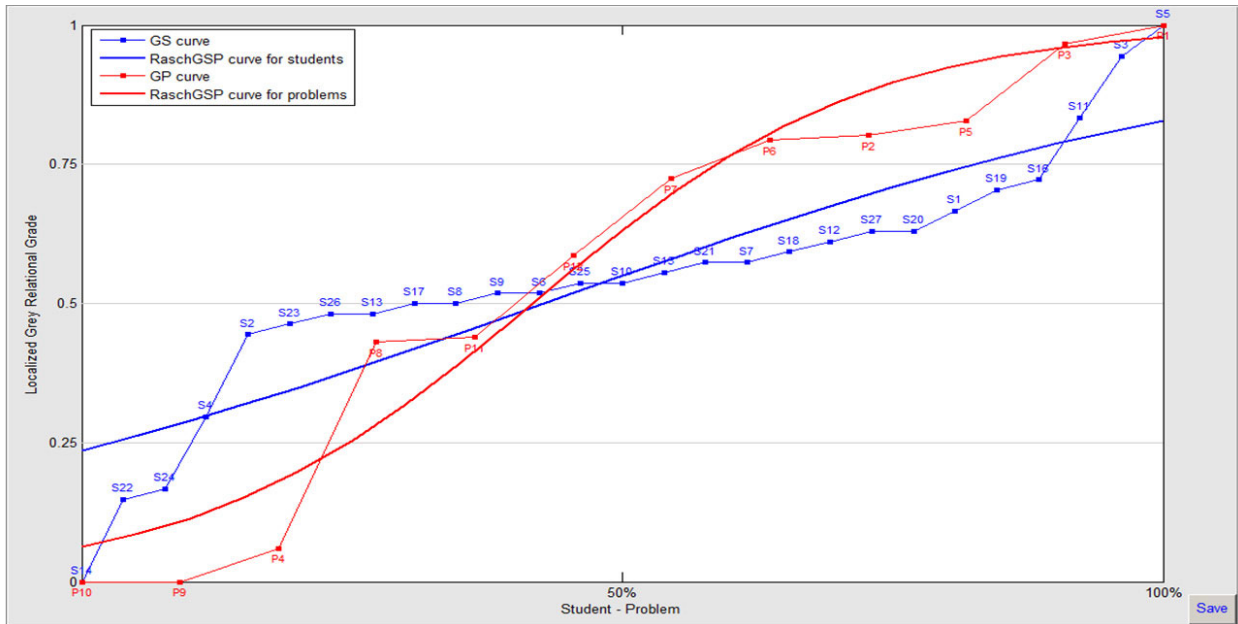

Figure 2. Graduate students and undergraduate students GSP curve
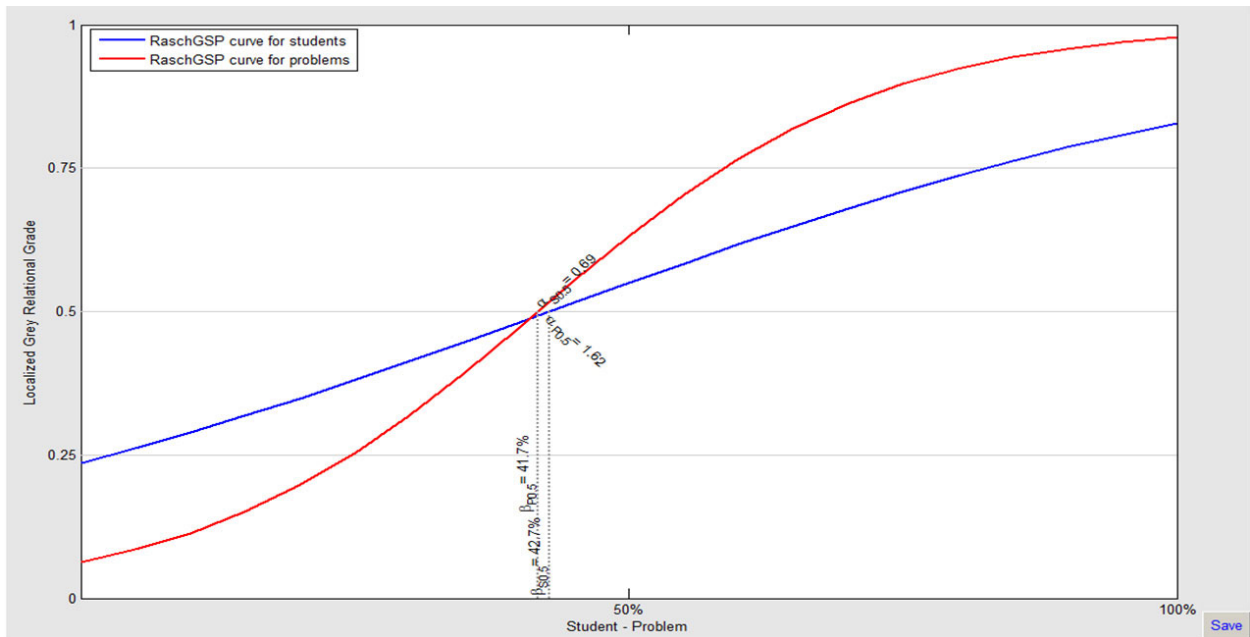

Figure 3. Graduate students and undergraduate students RaschGSP curve

3.4 GSM

According to Table 3, using numerical values of localized and globalized grey relational analysis to construct grey structural model (see Figures 4-9). In the first place, the purpose is to understand the distribution state of items; in the second place, structural analysis is performed. It is noteworthy that numerical value-based structural analysis is different from the style of speech narrative structural analysis, the previous primarily gives feedback of logical relation, the following focuses more on text, semantics, and composition structure, both in common is coherent mining, offline without showing meaning in the structural relationship.
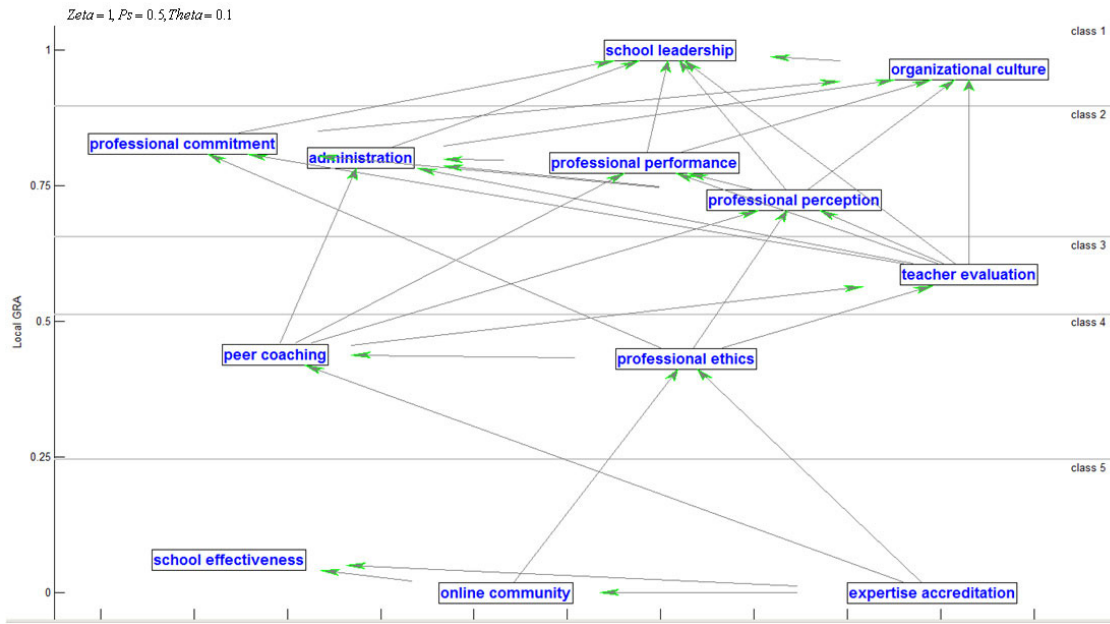
Figure 4. Graduate students and undergraduate students GSM

3.4.1 *Integrity (Graduate students and undergraduate students)*

Based on Figure 4 and Figure 5, pedagogical reasoning regarded as pragmatism, related structural characteristics: 1) School leadership and organizational culture as indicator of organization function; 2) Teacher evaluation linking peer coaching and professional performance; 3) School effectiveness, expertise accreditation and online community relatively less important.
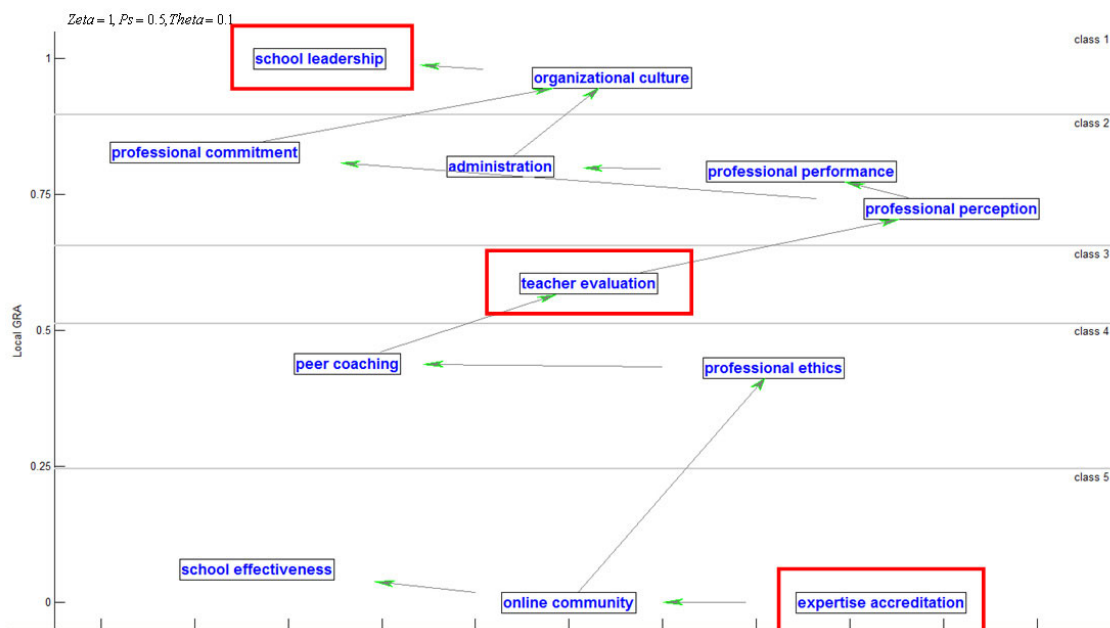
Figure 5. Graduate students and undergraduate students GSM (simplify)

3.4.2 *Graduate students*

In accordance with Figure 6 and Figure 7, pedagogical reasoning regarded as scientific, related structure characteristics: 1) Principal management & leadership as instrumental indi-

cator of organizational operating; 2) Professional learning community as means; 3) Professional development & growth as targets. Note worth, professional ethics has been embodied in teacher evaluation.
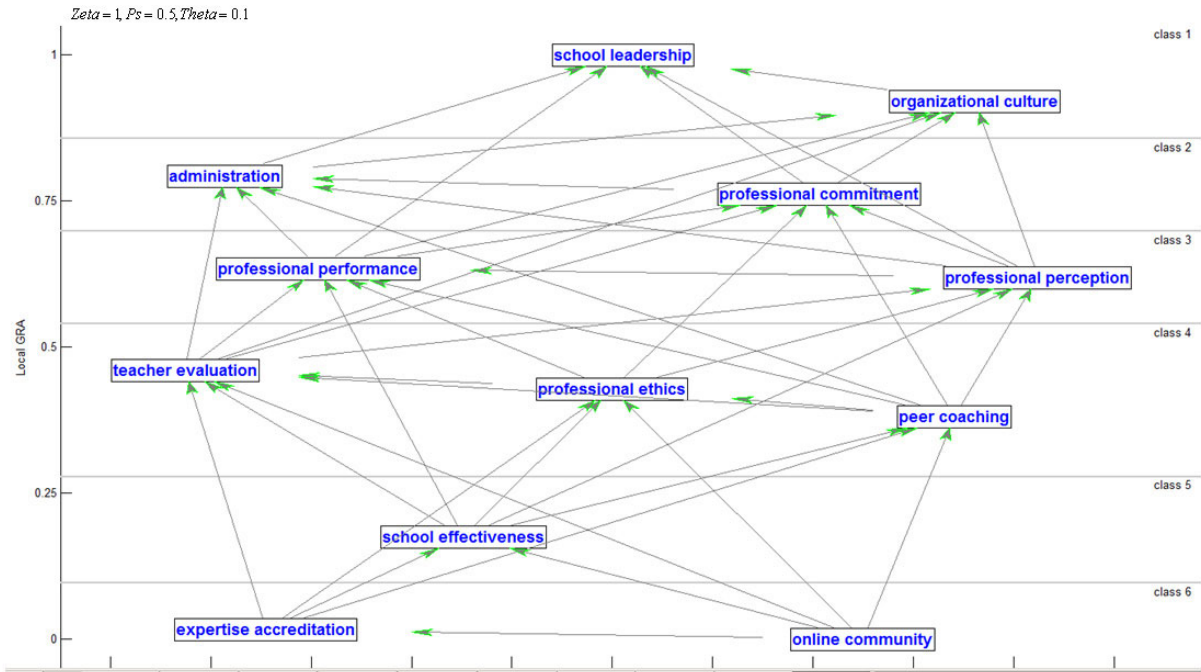
Figure 6. Graduate students GSM
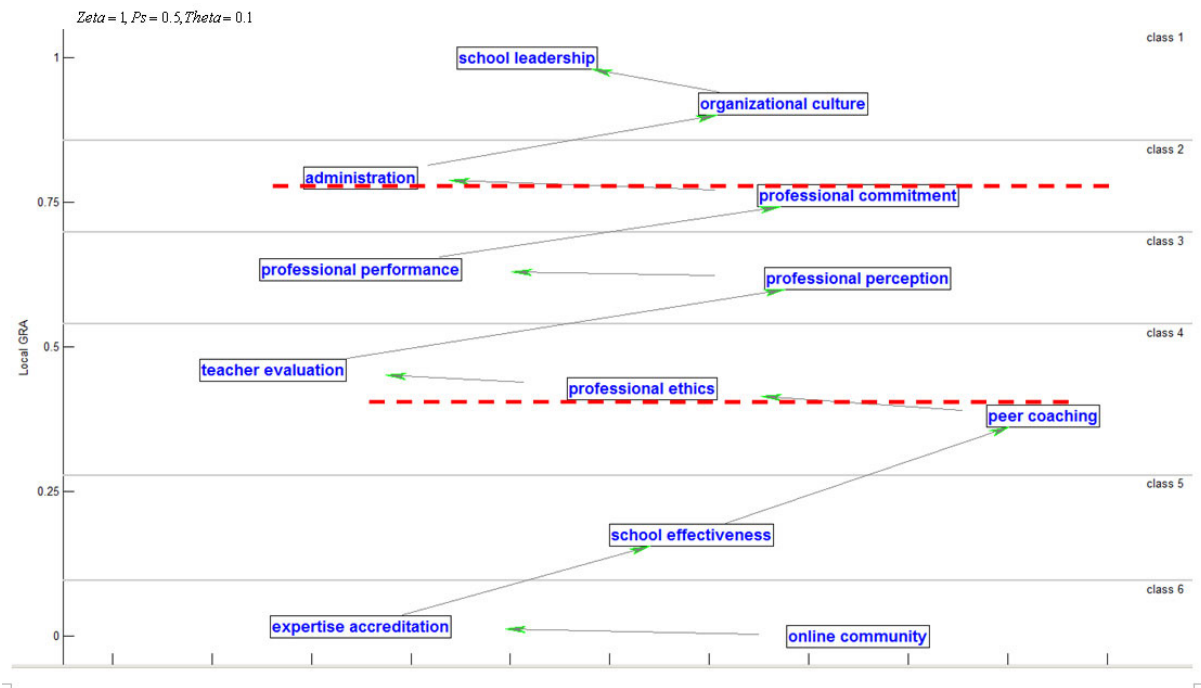
Figure 7. Graduate students GSM(simplify)

3.4.3 *Undergraduate students*

In line with Figure 8 and Figure 9, pedagogical reasoning regarded as rough, related structure characteristics: 1) Organizational culture as most important, contrarily, school effectiveness as lest important; 2) School leadership beneath professional commitment; 3) Peer coaching tying up teacher evaluation, administrative and professional performance.

As above described, Figures 4-9, the former presented plotted with all relationship of items, the latter character the special case, allegedly Reachable GSM, which has been cultivating based on cut array and correlation relationship transitivity.[23]
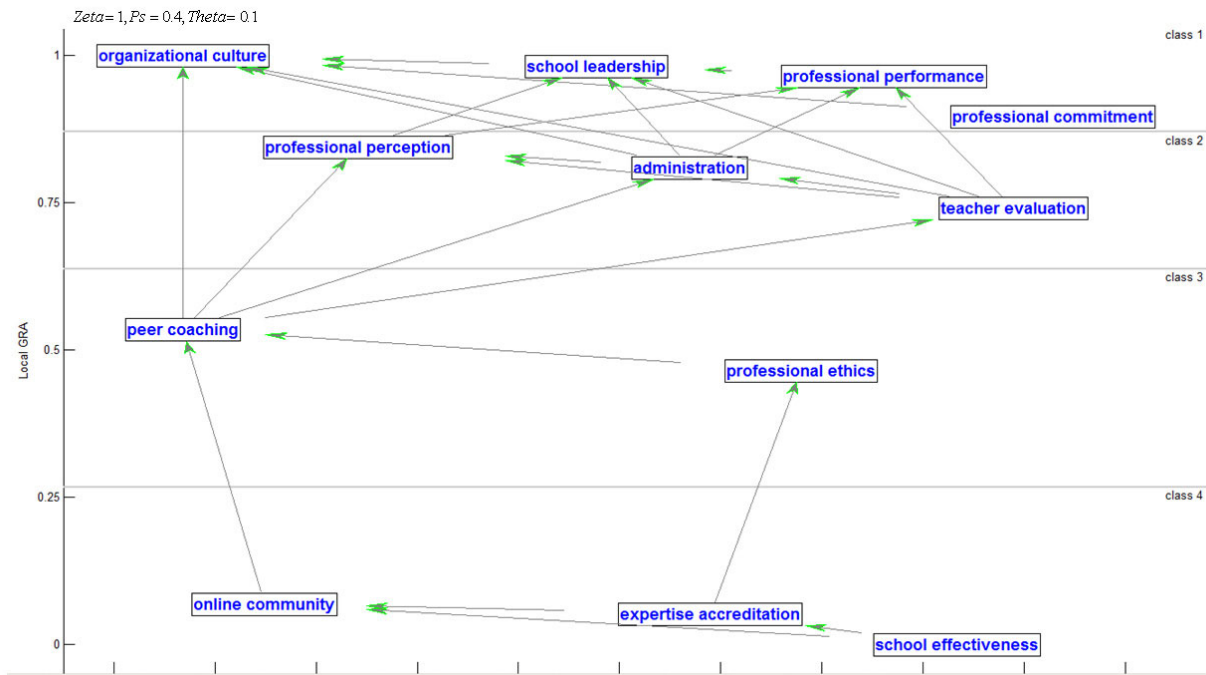
Figure 8. Undergraduate students GSM
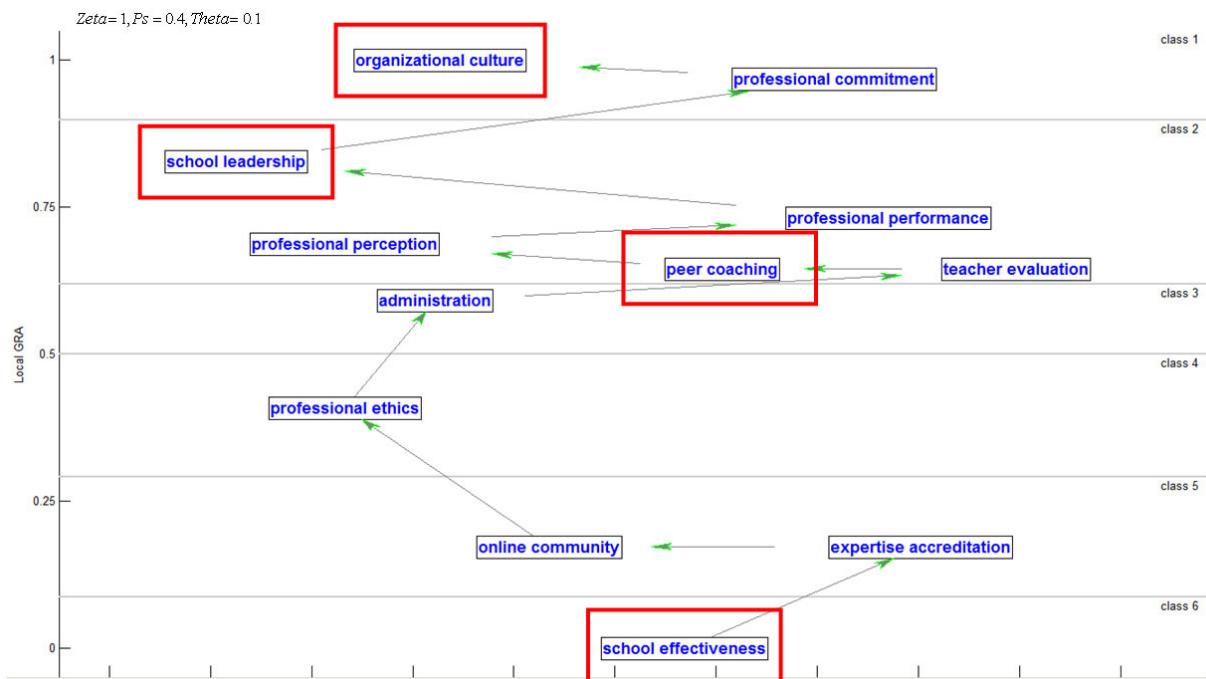
Figure 9. Undergraduate students GSM(simplify)

4. RESULT ANALYSIS

Case study of teacher professional management and evaluation is referred to the digital era and the related items collected in group working. Based on ISM, plotting digraphs as frame-referred analysis: 1) Digital era context (see Figure 10), items content (see Figure 11), and combining context and content (see Figure 12); 2) Constructing interconnection of multilevel subsystems and common, transitive, contextual relation by designing a numerical measurement to designate complexity and usability; 3) Evolving the structural character of the basis by accumulated experience.

Figure 10. Education & Teacher profession ISM
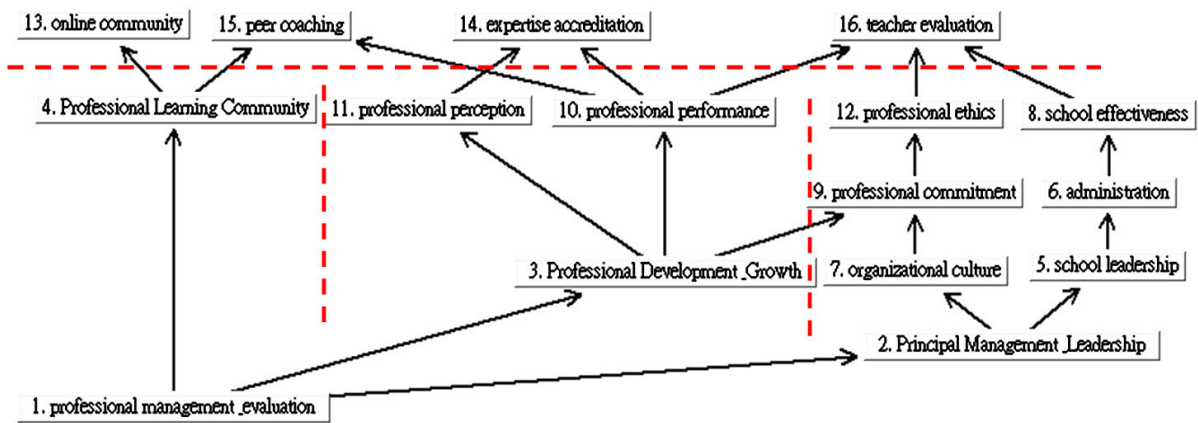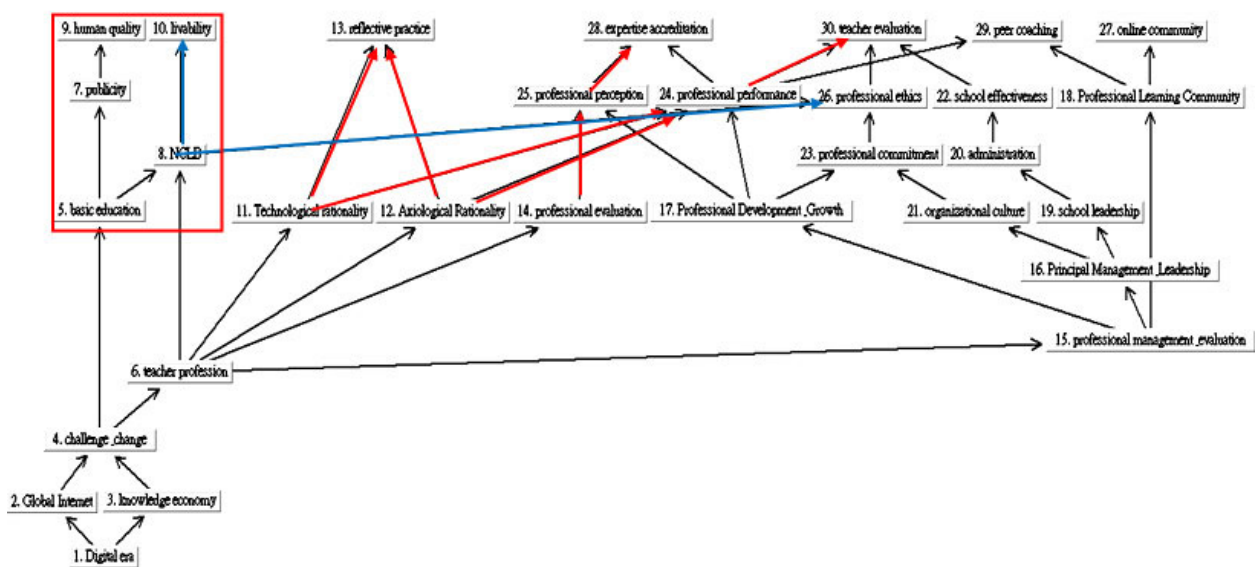

Figure 11. Professional management & Evaluation ISM

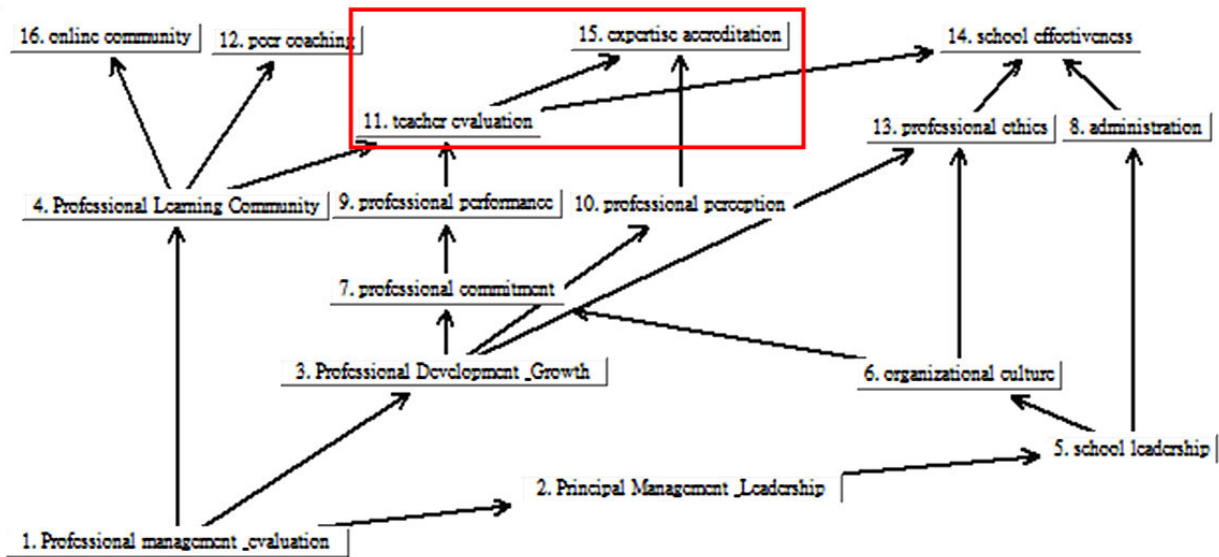**Figure 12.** Professional management & Evaluation in the digital Era ISM

Figure 13. Graduate students and undergraduate students' Items ISM

4.1 Professional management

Facing digital era and global politic-economic competitive nets, to make the best use of knowledge and advance professionalism have been becoming indispensable. Based on school education as "the diffusiveness of excellence", teachers or so-called knowledge workers ought to do their professional management well where intellectual value is added and the prime niche is basic training rooted in academic knowledge and expertise.

On account of elementary education practices, school leadership and school organization have a key role in motivating teachers towards individual and shared professional development. Namely, effective principal leadership characters

foresight, vision, discourse, and action, and school education is neither technological rationality nor axiological rationality, rather more adhering to the principles of creative and economic efficiency of knowledge.[24]

To master pulse of the times, among principal leadership and administrative, teacher quality and professional management, and school effectiveness and achievement outcomes have been recognized a stakeholder-connected network. Upon "Scaling Up Excellence",[25] organization culture is to construct on the one hand, modern education is to deliberate professional and functional significance and purpose on the other hand.
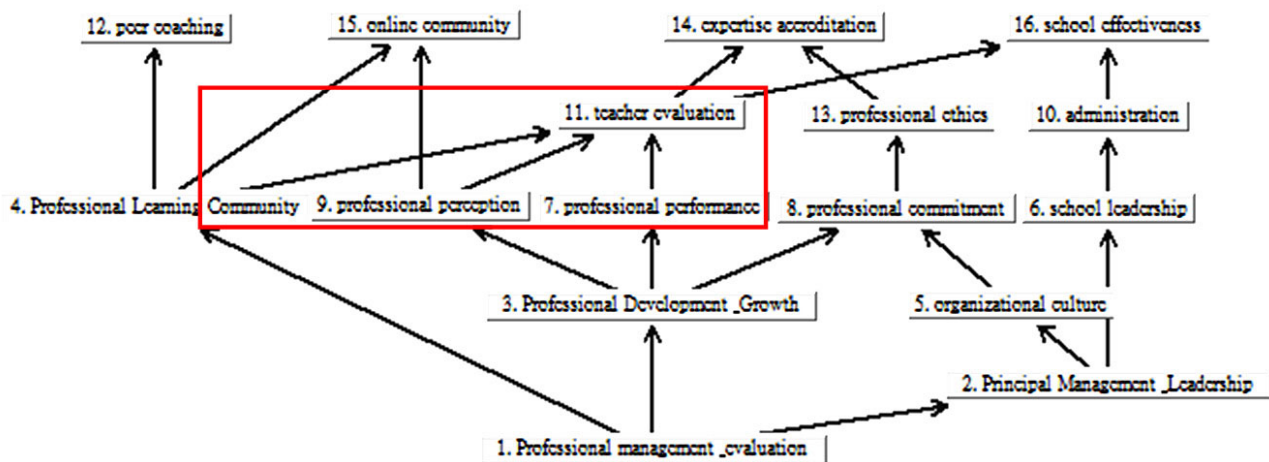
Figure 14. Graduate students' Items ISM

4.2 Structural analysis

Firstly, profile of structural analysis has been plotted based on: 1) Correspondence between Figure 7 and Figure 14, Figure 9 and Figure 15; 2) Figure 12 as contextual structure;

3) Difference between ISM and GSM, the former delivered relational structure of items, the latter featured mutual relative ranking among items. Secondly, as set out above, structural analysis of items comprises as follows.
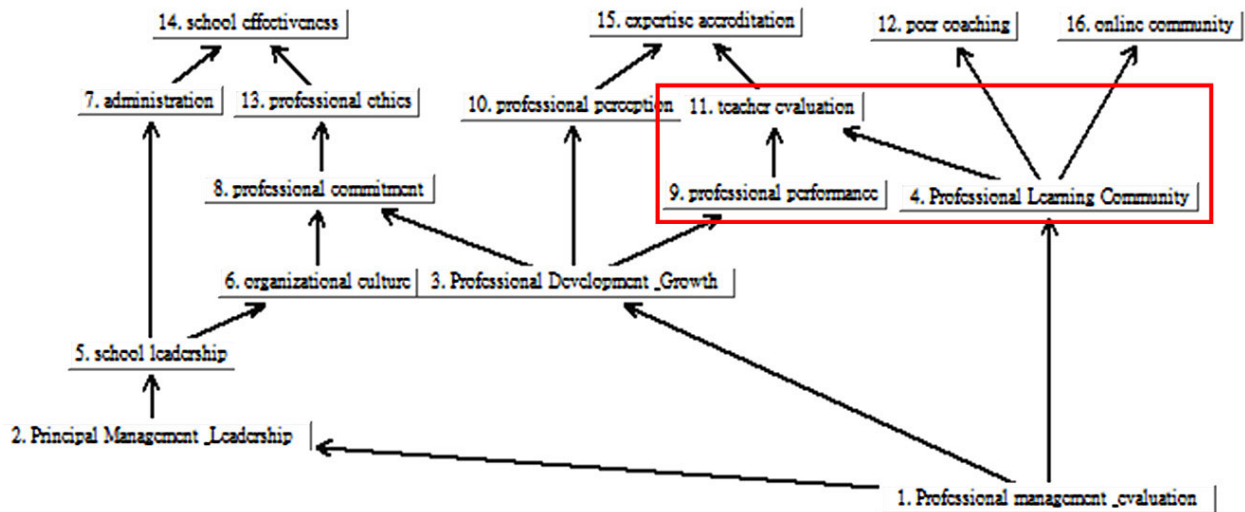

Figure 15. Undergraduate students' Items ISM

4.2.1 *Professional and practices*

Overviewing civilization status and progress tracking of mankind intelligence and competence, from experience accumulated, through reasonable awareness, instrumental reasonable awareness, to mathematical formal logic and artificial intelligence, the importance of school education is increasing and indispensable.

Professional performance: 1) Graduate students: Professional performance is the target of professional development and growth, and evaluated to ensure effectiveness of teaching and learning. 2) Undergraduate students: Substantially the same as above. 3) Ideal structural relation: Firstly, professional performance is advancing with the time. Secondly, it is founded on technological rationality and axiological rationality, which will be evaluated formally and peer coach informally, to make sure educational standard.

4.2.2 *Professional and ethics*

Educational Essence is the science of norm and value, which has become more important in the future. Because the information-oriented society does not fear that the information is not enough but fear that good and bad information, which confuse judgement. Critical discourse about technology are deficient, pluralistic value and hasty decisions are reducing benefits to solve the problem of danger. General speaking, no science is not good, but only scientism is not good, therefore, professional ethics should be reiterated and reinforced.

Professional ethics: 1) Graduate students: Professional commitment is meant commitment to ethical professional conduct. Professional ethics is not really for the sake of expertise accreditation, but a kind of professional virtue. 2) Undergraduate students: As shown in Figure 15, professional ethics backtracking to organizational culture, facilitates to breed school effectiveness, which focuses more on personal integrity and social responsibility. 3) Ideal structural relation: Professional ethics is not external element, nor an emerging one, conversely, which reflects reasoning essence, resolute moral action of self-reflecting.

4.2.3 *Professional and evaluation*

"Knowledge is power", "knowledge is wealth", "knowledge is force", just knowledge is in material life and social activities indeed more responsible. Education disclose intelligence and behaviors, used for living environment. That is why professional, professional quality and professional evaluation have been motivated, advanced and controlled.

Teacher evaluation: 1) Graduate students side: Professional learning community as supportive endeavor, professional performance monitored to ensure standard, professional perception as motivator and facilitator to establish expertise accreditation, and teacher evaluation yielding school effectiveness. 2) Undergraduate students: Substantially above, of which difference in lack of professional perception and school effectiveness. 3) Ideal structural relation: As shown in Figure 12, teacher evaluation backtracking to teacher pro-

fession based on technological rationality and axiological rationality, which have been offered in professional perfor-

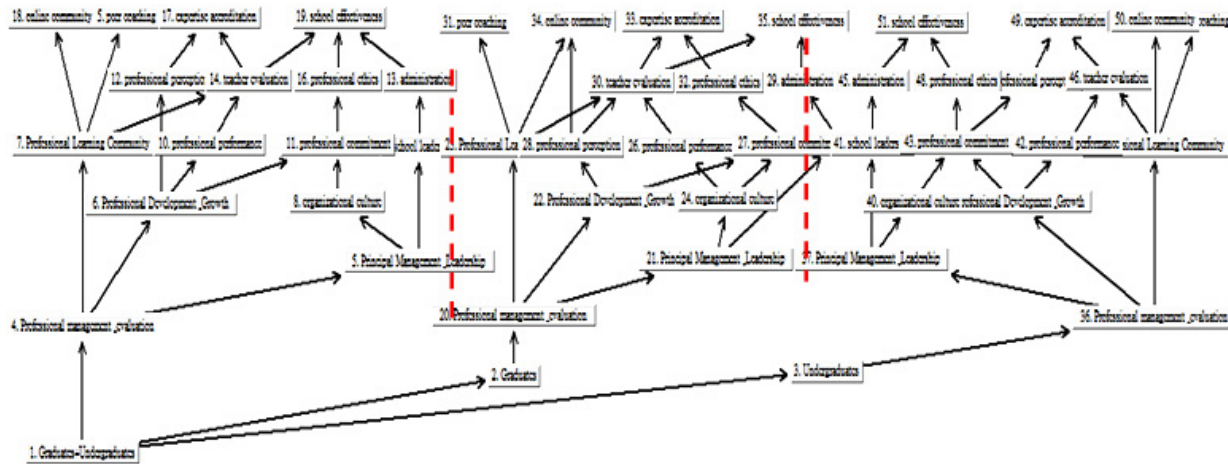mance. School efficiency lying on school leadership and administrative stands in teacher evaluation.

Figure 16. Three classes Items MSM

4.3 Teacher evaluation

About Western and Japanese teacher evaluation, standardization of teacher evaluation has been documented, however, why, how and for what about teacher evaluation has been shown still no consistency in the three groups, this has responded on the one hand because of multiple claims of teacher professional autonomy, on the other hand on accounting of test anxiety, inequity and secondary tag, even discharge from a position.

Note worth, teacher evaluation and evaluation of teacher professional development is mixed up by Taiwan Academic Circle of Education, the aftermath is: 1) Self-appraisal, peer coaching and performance evaluation rubric as core elements

of professional development evaluation; 2) Professional evaluation resulted in tension evaluation among teachers, school leadership and local educational administrative; 3) Educational standardization under constructed.

To meet requirements for formal education and its attempts to diversify, teacher profession is top priority. Teacher evaluation or teacher professional evaluation has been given as follows: 1) Diagnosis and immediate feedback; 2) Ensuring professional qualities; 3) Making a reference base of the advanced professional development.[26] In addition, teacher evaluation is not peer training, rather more professional, objective and follow-up effects.
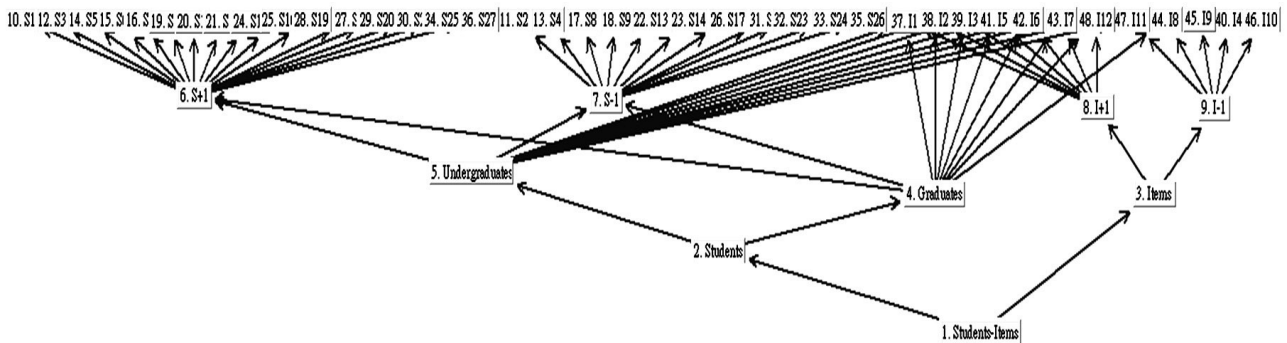

Figure 17. Students - Items MSM (+side)

4.4 MSM

According to raw data files, including numerical data and classroom discourse, the former is Table 3 and Table 4, the latter are Figures 13-15, exerting MSM presents items struc-

tural relation of professional management and evaluation of 3 classes separately and as the whole (see Figure 16), outlined an overall digraph, which facilitates to understand and communicate, even remodeled.

Figure 16 displays as follows: 1) Structural organization divided into and principal management and leadership, professional development and growth, and professional learning community; 2) Differences interpreted based on cause and effect; 3) Education as cross-contextual events, the outcomes of items structural relationship of the whole students and graduate students conveyed more alternative, and the undergraduate students fixed basic.

Table 4. Classes Item rank based on GRA

Students	Graduates	Undergraduates + Graduates	Undergraduates
	school leadership	school leadership	organizational culture
	organizational culture	organizational culture	school leadership
	administration	professional commitment	professional performance
	professional commitment	administration	professional commitment
	professional performance	professional performance	professional perception
Item ranking	professional perception	professional perception	administration
	teacher evaluation	teacher evaluation	teacher evaluation
	peer coaching	peer coaching	peer coaching
	professional ethics	professional ethics	professional ethics
	school effectiveness	school effectiveness	expertise accreditation
	expertise accreditation	expertise accreditation	online community

In contrast to Figure 12, Figure 16 takes into account the context to better grasp teacher professional management and evaluation. Moreover, to get γ value 0.5 with students at the point (α, 0.69) and items at the point (α, 1.62), composed Figure 2 and Figure 3 by MSM, providing students and items distributed +side and –side structure (see Figures 17, 18), which convey who and what to get more remedial or redefinition for the sake of professional development and growth in the era of the internet.
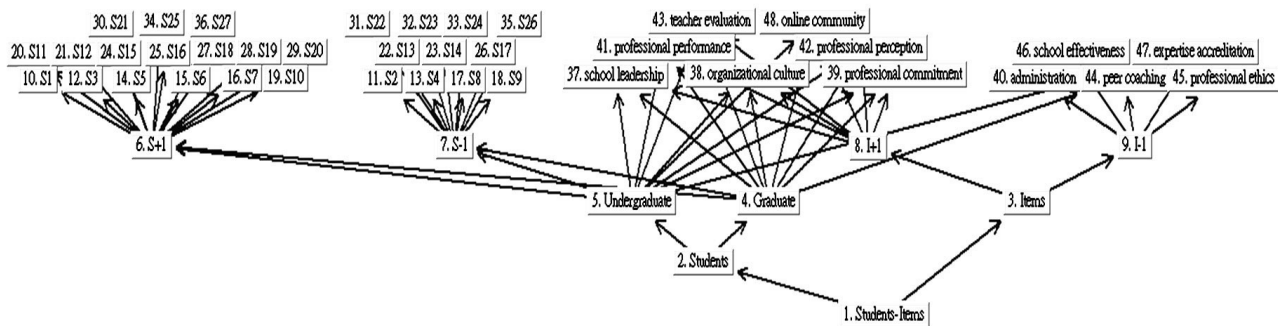
Figure 18. Students - Items MSM (-side)

5. CONCLUSION

In the industrially-advanced country, education has experienced standard-based reform in the last two decades, like teacher profession and evaluation, classroom discussions and reasoning, and curricula and instruction which yield a wide range of shift from routing lecture to self-acting module activity. Namely, education has been not merely transiting knowledge and norms, but also disclosing the intellectual and practical skills, which are required in the digital era. After all, teacher professional development and evaluation has been implemented half in Taiwan, for development except evaluation. Teacher evaluation or professional evaluation has been considered as constraint to professional autonomy.

As the above, factor analysis of teacher professional development and evaluation is motivated to understand graduate students and undergraduate students how to think of professional development and teacher evaluation, even professional evaluation, indeed, the former is to display self-disciplined stature, the latter is to secure educational quality. Regarding to teacher evaluation, the study is shown the difference between 2 teamwork in professional perception, in common is to approve expertise accreditation. Noteworthy, graduate students assert teacher evaluation influences school effectiveness, not reversed, which highlight a mode of professional empowerment. Undergraduate students are appreciated by school provider.

With the trend of interdisciplinary collaboration and educational modernization, educational methodology is to inject common features. Herein mathematical tools are well-established methodology according to research shown, of which like ISM, Nagai's GSM and MSM have been applied in different research branches. Case study of factor analysis based on math tools aimed at: 1) Interdisciplinary integration: Presenting the proceeding and result; 2) Numerical value: Analyzing structural context of students' performance on 12 items by operating arithmetic; 3) Research model: Manifesting and integrate an alternative model between academic and scientific substantive of educational practices.

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