A Proposed Supply Chain Management Model for Teacher Education Institutions: A Structural Equation Modeling

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***Abstract* – The higher education system has been facing major challenges, especially in matching its outcomes to the market (society) needs. These challenges are increasing as the job market becomes more globally competitive. Anchored from the Integrated Tertiary Educational Supply Chain Management (ITESCM) model, this study proposed a Supply Chain Management (SCM) model for Teacher Education Institutions (TEIs) in the Philippines. The study utilized cross-sectional, explanatory research design and was participated in by 863 respondents composed of administrators, faculty, students and graduates selected through purposive sampling using partial least square– structural equation modeling (PLS-SEM). Results from instruction model show that the program establishment is the most significant factor for both instruction development and instruction assessment in producing high level of quality graduates. Results from research model show that the program establishment in research development and TEIs' culture in research assessment are the most significant factor in producing relevant research output. For the extension output, program establishment is the most significant factor in extension development while in extension assessment, faculty capabilities and facilities are the most significant factors in producing service oriented professionals. The model was called Productivity and Advancement of Graduates through a Unified and Innovative Outputs – Instruction, Research and Extension or PAGUIO-INREX Model. This model emphasizes the importance of the trifocal function of higher education to the formation of productive and competent graduates of Teacher Education Institutions, who in turn, can contribute to the progress and development of the country.**

Keywords: *Educational Management, supply chain management model, structural equation modeling, cross-sectional explanatory research design, Olongapo City, Philippines*

1. Introduction

Globalization and technological advancements deliver and increase access to the world and, subsequently, educational trainings should reflect this global outlook. The higher education landscape has changed radically in the light of globalization. The effects of globalization on higher education bring rapid developments, thereby, foreseeing changes within teaching and learning systems and producing an information-based society. The higher education system has been facing major challenges, especially in matching its outcomes to the market (society) needs. These challenges are increasing as the job market becomes more globally competitive. In order to survive in the current business world, companies are competing for highly qualified manpower [1].

A study on the Typology of Higher Education Institutions (HEIs) in the Philippines, however, showed that only fifteen (15) out of two hundred twenty three (223) HEIs in the sample met the requirements for the graduate-capable HEI category, and only two HEIs met the criteria for doctoral and research university categories. This means that the majority of the HEIs in the country are teaching institutions [2].

Republic Act 7784, otherwise known as "An Act To Strengthen Teacher Education In The Philippines By Establishing Centers of Excellence, Creating a Teacher Educational Council For The Purpose, Appropriating Funds Therefor, And For Other Purposes" recognized that the teacher is the key to the effectiveness of the teaching-learning process by drawing out and nurturing the best in the learner as a human being and a worthy member of the society [3]. Thus, this Act aims to provide and ensure quality education by strengthening the education and training of teachers nationwide through a national system of excellence for teacher education.

International Journal of Supply Chain Management
IJSCM, ISSN: 2050-7399 (Online), 2051-3771 (Print)

This study is anchored on the Integrated Tertiary Educational Supply Chain Management (ITESCM) model which furnishes stakeholders of the supply chain with appropriate strategies to review and appraise their performance toward fulfilment of ultimate goals, i.e. producing high caliber graduates and high impact research outcomes, which represent two main contributions, for the betterment of the society [4]. It aims to integrate the basic concepts, principles and processes of Supply Chain Management (SCM) in the current higher education environment, specifically in Teacher Education Institutions (TEIs). The outcome of this study is deemed significant as it may: (1) provide the teacher education institutions' (TEIs') stakeholders a model integrating supply chain management principle in education management which could address the gap between the TEIs' outcomes and the market's (society's) needs ;(2) encourage the TEIs to both administrator and faculty to assess and evaluate the institution's performance toward fulfilling their goals in producing high level of graduates, relevant research outputs and service oriented professionals; (3) help the TEIs' stakeholders to strengthen their active participation in community service and extension.

2. Literature Review

Researchers develop supply chain models mostly for improving business operations. Few, particularly academic researchers, do not realize that the research on academic SCM may also be conducted for their own educational institutions. The performance of the SCM depends on the seamless coordination of all supply chain stakeholders to ensure attainment of desirable outcomes [5].

Ref [6] posed that SCM helps business organization to compete in the dynamic global market. The goal of SCM is to integrate activities across and within organizations in providing the customer value. This should also be applicable to the higher education institutions. The goal is to provide the society value by producing high quality graduates, research outcomes and extension service. Similarly, Ref [1] introduced in a study the concepts of supply chain management as a possible solution for the educational institutions to cope with market needs. Furthermore, said study explored the implications of supply chain management principles on higher education and examined the possibility of utilizing these principles and methods in bringing educational institutions closer to society and market needs and in making educational institutions more flexible and responsive to business needs.

In educational supply chain, a university works in close collaboration with schools, further education colleges, its current students, university staff, and employers of its graduates in designing curricula to ensure that the needs of all stakeholders are satisfied. Educational supply chain has customer driven vision that can produce a number of competitive advantages for the supply chain by helping improve productivity, boosting customer satisfaction, producing quality outcomes. Increasingly, many end-users of products are recognizing the potential benefits of partnering with their suppliers in managing quality in their supply chains [4].

Supply Chain Management has gradually been embraced as a proven managerial approach to achieving sustainable profits and growth. This is accomplished primarily by focusing on the whole SCM process to deliver the right products or services, in the right quantity, to the right place, at the right time and with the maximum benefits [7]. For higher education systems, which are part of the service industry, as providers of knowledge, adopting the concepts and principles is even slower because of the nature of the service provided and the long-lasting culture and values of higher educational institutions [2].

Many universities are currently adopting some practices that bring employers closer to the Higher Education Institutions (HEIs) especially in training and programme development. These practices emerged as the gap between the knowledge, which is offered by higher education institutions, and the required knowledge and skills needed by the job market is widening. Some of these practices are enforced by accreditation bodies as a pre requirement for accreditation. These practices are major steps in strengthening the supply-demand chain [1].

One of the main goals of an educational management is to improve the well-being of the end consumer or the society. Improved well-being of society would be possible with quality graduates and quality research outcomes by implementing proper educational management for the universities from the raw materials, i.e. students and research projects to finished products, i.e. graduates and research outcomes [8]. The Integrated Tertiary Educational Supply Chain Management (ITESCM) Model represents supply chain management for the academia. [9].

The application guidelines of ITESCM model for better Supply Chain Management in Universities encompasses education supply chain, research supply chain and educational management as major constituents. Four main activities, includes education development, education assessment, research development, and research assessment in four aspects, namely Programs Establishment, University Culture, Faculty Capabilities, and Facilities were investigated at three decision levels [10].

For this particular study where supply chain management principles are applied in Teacher Education Institutions, the suppliers, customers and consumers were identified vis-a-vis the three trifocal functions of HEI as enumerated below. Generally, these concepts were adopted from the theoretical framework of ITESCM model and modified in the context of trifocal functions of Higher Education Institutions.

Suppliers. Instruction Suppliers are the stakeholders namely: faculty members, students, parents, regulatory organizations, government and industry. The research suppliers are the internal research projects involving institution self-funding and external research

projects involving external research funds, government funds, private organizations, etc. The extension suppliers are the internal extension or community project involving institution self-funding and external extension or community projects involving external extension funds, government funds, private organizations, etc.

Customers. Instruction Customers are the graduates, family including parents, siblings, relatives, employers of government and industry. The research customers are the research outcomes involving researches and research publications and funding organization of research project. The extension customers are the community and funding organizations of extension or community projects.

*Consumers***.** The study identified institutions offering teacher education program as part of the society as the end customer or end consumer of the proposed model.

SCM is needed for various reasons: improving operations, better outsourcing, increasing profits, enhancing customer satisfaction, generating quality outcomes, tackling competitive pressures, increasing globalization, increasing the importance of Ecommerce, and the growing complexity of supply chains [11].

In the past, the education system has changed in response to market needs following the industrial revolution from an individual or group learning system to a mass learning system in order to match the needs of mass production systems. Hence, the education system adopted the concept of mass production developed by the manufacturing industry to cope with the changes in the manufacturing sector. This influence of the business environment and management principles on the education system can be extended to more recent concepts such as the supply chain concept [1].Thus, the idea of applying a business concept to higher education is not a new one. The education system has successfully benefited from business concepts such as Total Quality Management, Quality Assurance and Enterprise Resource Planning solutions. It also benefited from the system design methodology used in systems engineering in analyzing existing education and designing new curricula [12].

The same two educational management practices used in Ref [4], i.e., development and assessment were utilized and applied in this study on the trifocal functions of the educational system which are instruction, research and extension. Furthermore, the same four aspects of programs establishment, teacher education institution culture, faculty capabilities, and facilities were utilized but were defined in the context of Teacher Education Institutions. The strategies to operate supply chain management (SCM) in the service industry, like educational institutions are the same as in the manufacturing industry. Three business forces, including e□commerce, globalization and customer expectations support the three levels of decisions, namely strategic, planning and operating, used in the SCM [13]. As such, the four factors were also investigated at strategic, planning, and operating levels.

Programs Establishment (PE). Programs relevant to the trifocal functions of the HEI are established and assessed in terms of their development and assessment. The academic programs, Bachelor in Elementary Education and Bachelor in Secondary Education, are the primary programs under the teacher education program. CHED Memorandum Order (CMO) no. 30 series of 2004 [14] and its addendum CMO no. 52 series of 2007 [15] set the Policies and Standards for the Undergraduate Teacher Education Curriculum. Diversification among TEIs' occurs through the offering of different specializations. Universities have to attempt product differentiation, i.e., programs establishment. Hands□on experience, industrial placements, social demand, provision of IT facilities, and innovative academic methods all demonstrate attempts to differentiate programs establishment.

Faculty Capabilities (FC). Section 3 of CHED Memorandum Order No 52 s. 2007 provides the requirements for faculty under Teacher Education [15]. As a rule, a master's degree in education or an allied discipline is required for teaching in the tertiary level and 100% of the full-time and a minimum of 50% of the part-time faculty must have a Master's degree in the discipline or its equivalent at any given point in time. Moreover, faculty members teaching the professional education courses in a teacher education program must be a holder of a valid certificate of registration and professional licensure examination for teachers (LET) as provided for in Section 11 of RA 8981 (PRC Modernization Act of 2000) where it is stated under Persons to Teach examination on All Professions that all subjects for Licensure examination shall be taught by persons who are holders of valid certificate of registration and valid professional licenses of the profession and who comply with the other requirements of the Commission on Higher Education and of a master's degree in education or from any of the allied fields [16].

The same Memorandum Order also states that the HEI must have a system to support faculty development. It should require the faculty members to complete doctoral degrees in education and other allied fields; attend continuing education seminars, workshops, conferences and others; undertake research activities related to the teacher education program and to publish the research outputs in refereed publication, and give lectures and present papers in national/international conferences, symposia and seminars.

The institution must also provide opportunities and incentives such as a) tuition subsidy for graduate studies; (b) study leave with pay; (c) deloading to finish a thesis or carry out research activities; (d) research grants; (e) travel grants for academic development activities such as special skills training and attendance in national/international conferences, symposia and seminars, awards, recognition; and (f) other merit incentives.

Teacher Education Institution Culture or TEI Culture (TC). In this study the term Teacher Education Institution Culture or TEI Culture refers to the shared values, meaning, interpretations, and understanding of various organizational events among organizational

members. Organizational culture serves as a guide to members to behave in ways shown to be effective over time; adds a sense of predictability and order to uncertainties in the environment; and provides a general understanding of how, when, and why members behave in certain ways. Teaching practices, diversity and the relationship among stakeholders contribute to school culture. In other words, the culture of the Teacher Education Institution is viewed as the existence of interplay between and among three factors namely: a) the attitudes and beliefs of persons both inside the institution and in the external environment; b) the cultural norms of the institution; and c) the relationship between persons in the institution. Each of these factors may present barriers to change or a bridge to long-lasting implementation of improvement in the institution.

Facilities (FA). Under the Manual of Regulations for Private Higher Education (MORPHE) issued in 2008 and made applicable even to state and local universities and colleges in the provisions of CHED Memorandum Order No. 30 series of 2009, all higher education institutions are required to have their own institutional site and buildings, adequate auditoriums, lecture rooms and gymnasiums which are sufficiently equipped for instruction purposes and conform to the standards set in the Manual. Moreover, HEIs' should also maintain a library or libraries with adequate collections and materials that conform to the standards set by the CHED. Specific requirements for facilities are set for the teacher education program such as classroom requirements and size, laboratory requirements and educational technology laboratory requirements [17].

Also adopted was the concept of three decision levels in SCM, this concept would be adopted for the higher educational institutions [4].

Strategic Level: Strategic level decisions are the highest level. Here a decision concerns general direction, long term goals, philosophies and values. These decisions are the least structured and most imaginative; they are the most risky and of the most uncertain outcome, partly because they reach so far into the future and partly because they are of such importance.

Planning Level: Planning level decisions support strategic decisions. They may be medium range, medium significance, with moderate consequences.

Operating Level: Operating level decisions are every day decisions, used to support planning level decisions. They are often made with little thought and are structured. Their impact is immediate, short term, short range, and usually low cost. The consequences of a bad operational decision will be minimal, although a series of bad or sloppy operational decisions can cause harm. Operational decisions can be pre□programmed, pre□made, or set out clearly in policy manuals.

The study was conducted to propose a Supply Chain Management (SCM) model for Teacher Education Institutions (TEIs). Specifically, it sought to (1) determine extent do the stakeholders perceive the concept of supply chain management in trifocal functions of TEIs (Instruction, Research and Extension) in terms of development and assessment such as program establishment, TEIs culture, faculty capabilities and facilities?; (2) develop the general structural equation model accounting for the relations between the variables which determine the supply chain management in TEI's?

To propose Supply Chain Management (SCM) model for Teacher Education Institutions (TEIs), the study adopted the theoretical framework of Integrated Tertiary Educational Supply Chain Management (ITESCM) model and modified in the context of trifocal functions of Higher Education Institutions in the Philippines. The hypothesized SCM model is found in Figure 1.

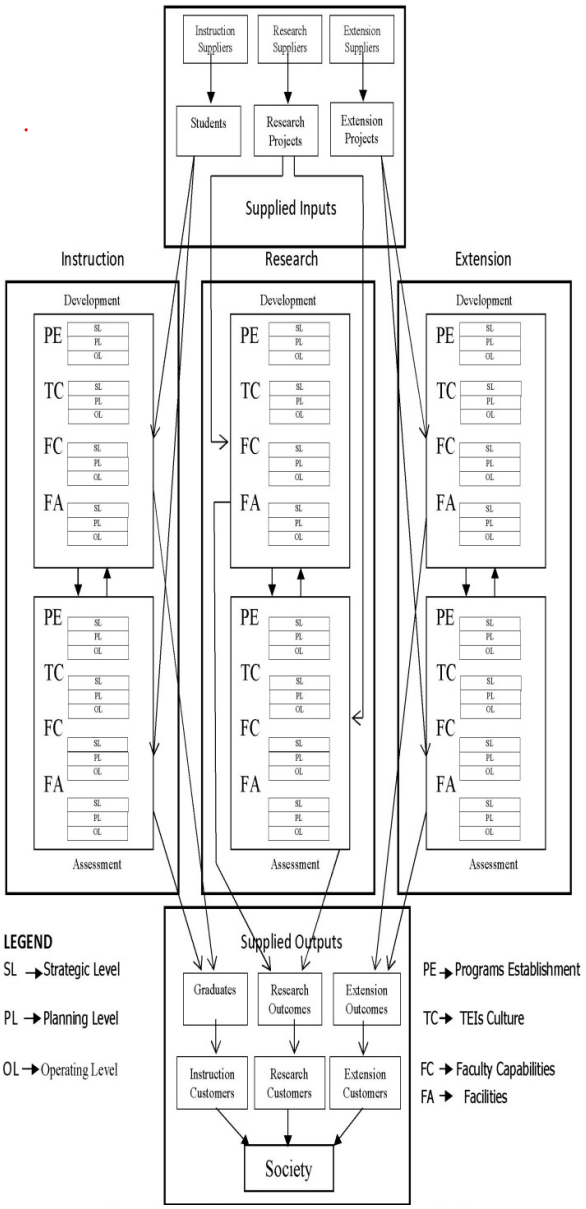

Figure 1. Hypothesized Supply Chain Management Model

3. Methodology

The study utilized cross-sectional, explanatory research design because its primary objective is to develop or test a theory about phenomenon and collected from respondents at a single point in time or during a single relatively brief time period. The participants of the study are 863 respondents from seven (7) HEIs (six colleges and one university) offering teacher education program in Olongapo and Zambales in the Philippines. Respondents' distribution are 111 administrators and faculty, 588 second year to fourth year students and 164 graduates.

The main instrument used in gathering the needed data was adopted from existing studies and modified in the context of trifocal functions of Higher Education Institutions in the Philippines.

The partial least square–structural equation modeling (PLS-SEM) has been utilized to develop the model accounting for the relations between the variables which determine the supply chain management in TEIs [18]. The study used WarpPLS v5.0 software to investigate the interrelationships among all variables.

4. Findings

4.1 Respondent-TEIs' Profile

Table 1 presents the information of the participating Teacher Education Institutions in this study. In terms of type of institution, 6 of the 7 participating schools or 85.7% have college status, 103 or 92.8% of the participants occupy teaching positions and there were 69 or 62.2% who were ranked as instructors. When it comes to the highest educational attainment, 46 or 41.4% of the participants have bachelor's degree with master's units with 72 or 64.9% having full time status. An equal number of 2 participant schools or 28.6% have a student population of 100 and below and more than 500, respectively.

Table 1

Teacher Education Institutions Information

Variable	Category	Frequency	Percent
Type of Institution	College	6	85.7
	University	1	14.3
Position in the Institution	Administrative Position	8	7.2
	Teaching Position	103	92.8
Academic Rank	Professor	12	10.8
	Associate Professor	21	18.9
	Assistant Professor	9	8.1
	Instructor	69	62.2
Highest Educational Attainment	Doctoral Graduate	20	18.0
	Master's Graduate with Doctoral Units	16	14.4
	Master's Graduate	14	12.6
	Bachelor's Degree with Master's Units	46	41.4
	Bachelor's Degree	15	13.5
Status of Faculty	Full Time Faculty	72	64.9
	Part Time Faculty	39	35.1
Student Population	100 and below	2	28.6
	101 to 200	1	14.3
	201 to 300	1	14.3
	301 to 400	0	0
	401 to 500	1	14.3
	More than 500	2	28.6

4.2 Mean Rating on the Importance of Trifocal Functions of TEIs

Table 2 shows the mean rating on the importance of trifocal functions of TEIs in the educational management practices. The instruction development, research development, extension development and instruction assessment, research assessment and extension assessment of teacher education institutions were all absolutely important with a mean rating of 3.44, 3.39, 3.40, 3.41, 3.40 and 3.41 respectively.

Table 2

Mean Responses of Participants on the Importance of the Trifocal Functions of Teacher Education Institutions in the Educational Management Practices

4.3 Educational Management Practices

Construct	Mean	Descriptive Rating	Construct	Mean	Descriptive Rating
Instruction Development	**3.44**	**Absolutely Important**	***Instruction Assessment***	**3.41**	**Absolutely Important**
Program Establishment	3.41	Absolutely Important	Program Establishment	3.40	Absolutely Important
TEIs Culture	3.46	Absolutely Important	TEIs Culture	3.40	Absolutely Important
Faculty Capabilities	3.48	Absolutely Important	Faculty Capabilities	3.42	Absolutely Important
Facilities	3.41	Absolutely Important	Facilities	3.43	Absolutely Important
Research Development	**3.39**	**Absolutely Important**	***Research Assessment***	**3.40**	**Absolutely Important**
Program Establishment	3.36	Absolutely Important	Program Establishment	3.40	Absolutely Important
TEIs Culture	3.41	Absolutely Important	TEIs Culture	3.38	Absolutely Important
Faculty Capabilities	3.42	Absolutely Important	Faculty Capabilities	3.41	Absolutely Important
Facilities	3.38	Absolutely Important	Facilities	3.40	Absolutely Important
Extension Development	**3.40**	**Absolutely Important**	***Extension Assessment***	**3.41**	**Absolutely Important**
Program Establishment	3.34	Absolutely Important	Program Establishment	3.37	Absolutely Important
TEIs Culture	3.40	Absolutely Important	TEIs Culture	3.41	Absolutely Important
Faculty Capabilities	3.43	Absolutely Important	Faculty Capabilities	3.43	Absolutely Important
Facilities	3.41	Absolutely Important	Facilities	3.44	Absolutely Important

In the educational management practices, the study defined instruction development, instruction assessment, research development, research assessment, extension development and extension assessment for the

Teacher Education Institutions to provide the conclusions of research issue items. The research results, showed significant relationships among twelve hypotheses in educational management practices to produce graduates, research outputs and extension outputs. The study presents instruction model, research model and extension model. From the three research models, the following hypotheses are established. Hypotheses 1 to 4 stands for the instruction model, hypotheses 5 to 8 for research model and hypotheses 9 to 12 for extension model. (H1) There is a significant relationship between instruction development and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H2) There is a significant relationship between instruction assessment and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H3) There is a significant relationship between instruction development and instruction assessment;(H4) Instruction development and Instruction assessment have significant impact on graduates;(H5) There is a significant relationship between research development and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H6) There is a significant relationship between research assessment and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H7) There is a significant relationship between research development and research assessment; (H8) Research development and Research assessment have significant impact on research outputs; (H9) There is a significant relationship between extension development and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H10) There is a significant relationship between extension assessment and its factors in terms of program establishment, TEIs culture, faculty capabilities and facilities; (H11) There is a significant relationship between extension development and extension assessment; and, (H12) Extension development and Extension assessment have significant impact on extension outputs.

4.3.1 Model for Instruction

The study identified graduates as final outputs of the instruction as one of the trifocal functions of Teacher education Institutions. Instruction part is divided into two segments including instruction development and instruction assessment in the instruction model. There are four subgroups under instruction development including IDPE, IDTC, IDFC and IDF those are representing program establishment, TEI culture, faculty capabilities and facilities. On the other hand, instruction assessment also has four subgroups composed of IAPE, IATC, IAFT and IAF those are representing program establishment, TEI culture, faculty capabilities and facilities.

For hypotheses 1 and 2, the model confirmed the significant relationship for both instruction development and instruction assessment among its factors, specifically in terms of program establishment, TEIs culture, faculty capabilities and facilities. This was testified by the computed p-values wherein all of which have a p-value of 0.000. For hypothesis 3, significant relationship exists between instruction development and instruction assessment with a p-value of 0.000 and a path coefficient of 0.789.

The multiple linear regression equations below illustrate the inter relationships among different variables to justify hypothesis 4.

Multiple Linear Regression (MLR) Equations

Instruction Development = 0.289 IDPE + 0.285 IDTC + 0.284 IDFC + 0.282 IDF Eq. [1]

Instruction Assessment = 0.284 IAPE + 0.284 IATC + 0.282 IAFC + 0.275 IAF Eq. [2]

Graduate = 0.529 Instruction Development + 0.529 Instruction Assessment Eq. [3]

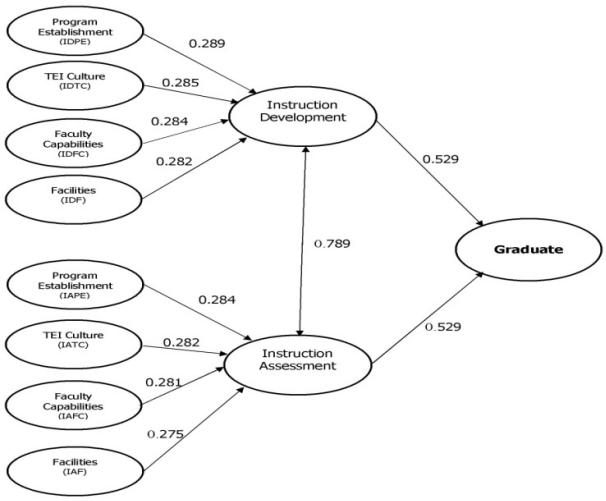

Figure 2. Model for Instruction

From the research findings, equation 1 states that program establishment (IDPE) with path coefficient of 0.289 is the most significant factor in instruction development. On the other hand, equation 2 presents that program establishment is highly contributed to instruction assessment with a path coefficient of 0.284. Finally, equation 3 depicts that both instruction development and instruction assessment with path coefficients of 0.529 are highly contributed to the graduates of teacher education programs of the institutions. From equation (1), (2) and (3),

Graduates = 0.529 Instruction Development + 0.529 Instruction Assessment

= 0.529 [0.289 IDPE + 0.285 IDTC + 0.284 IDFC + 0.282 IDF] + 0.529 [0.284 IAPE + 0.282 IATC + 0.281 IAFC + 0.275 IAF]

= 0.153 IDPE + 0.151 IDTC + 0.150 IDFC + 0.149 IDF + 0.150 IAPE + 0.149 IATC + 0.149 IAFC + 0.145 IAF

The above equation shows the significant relationship among all factors namely program establishment, TEI culture, faculty capabilities and

facilities in instruction development as well as instruction assessment to produce the graduates of teacher education programs. The p-value is 0.000 among all factors for both instruction development and instruction assessment. The result shows that instruction development and instruction assessment have significant impact on graduates. Program establishment for both instruction development and instruction assessment highly contribute in producing graduates in the teacher education institutions.

4.3.2 Model for Research

The study identified research outputs as one of the final outcomes in trifocal function of Teacher education Institutions. Research part is divided into two segments including research development and research assessment in the research model. There are four subgroups under research development including RDPE, RDTC, RDFC and RDF representing program establishment, TEI culture, faculty capabilities and facilities. On the other hand, research assessment also have four subgroups composed of RAPE, RATC, RAFT and RAF representing program establishment, TEI culture, faculty capabilities and facilities.

For hypotheses 5 and 6, the model confirmed the significant relationship for both research development and research assessment among its factors, specifically in terms of program establishment, TEIs culture, faculty capabilities and facilities. This was testified by the computed p-values wherein all of which have a p-value of 0.000. For hypothesis 7, significant relationship exists between research development and research assessment with a p-value of 0.000 and a path coefficient of 0.823.

The multiple linear regression equations below illustrate the interrelationships among different variables to justify hypothesis 8.

Multiple Linear Regression (MLR) Equations

Research Development = 0.285 RDPE + 0.278 RDTC + 0.280 RDFC + 0.280 RDF Eq. [4]

Research Assessment = 0.276 RAPE + 0.286 RATC + 0.281 RAFC + 0.283 RAF Eq. [5]

Research Outputs = 0.524 Research Development + 0.524 Research Assessment Eq. [6]

As the findings show, equation 4 states that program establishment (RDPE) with path coefficient of 0.285 is the most significant factor in research development. On the other hand, equation 5 represents that TEIs culture (RATC) is highly contributed to research assessment with a path coefficient of 0.286. Finally, equation 6 depicts that both research development and research assessment with path coefficients of 0.524 highly contribute to the research outputs of teacher education programs of the institutions. From equation (4), (5) and 6),

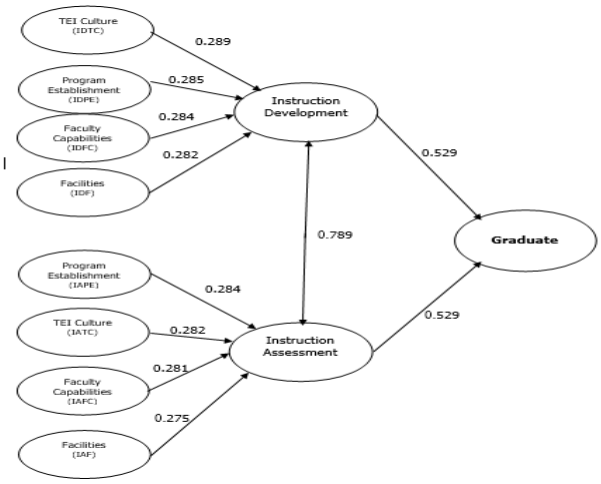

Figure 3. Model for Research

Research Outputs = 0.524 Research Development + 0.524 Research Assessment

=0.524 [0.285 RDPE + 0.278 RDTC + 0.280 RDFC + 0.280 RDF] + 0.524 [0.276 RAPE + 0.286 RATC + 0.281 RAFC + 0.283 RAF]

=0.149 RDPE + 0.146 RDTC + 0.147 RDFC + 0.147 RDF + 0.145 RAPE + 0.150 RATC + 0.147 RAFC + 0.148 RAF

The above equation shows the significant relationship among all factors namely: program establishment, TEI culture, faculty capabilities and facilities in research development as well as research assessment to produce research outputs for teacher education programs. The p-value is 0.000 among all factors for both research development and research assessment. The result shows that research development and research assessment have significant impact on research outputs. Program establishment for research development as well as TEIs culture in research assessment highly contribute in producing research outputs in the teacher education institutions.

4.3.3 Model for Extension

The study identified extension outputs as one of the final outcomes in trifocal function of Teacher education Institutions. Extension part is divided into two segments: extension development and extension assessment in the extension model. There are four subgroups under extension development: EDPE, EDTC, EDFC and EDF representing program establishment, TEIs culture, faculty capabilities and facilities. On the other hand, extension assessment also has four subgroups composed of EAPE, EATC, EAFT and EAF representing program establishment, TEIs culture, faculty capabilities and facilities.

For hypotheses 9 and 10, the model confirmed the significant relationship for both extension development and extension assessment among its factors, specifically in terms of program establishment, TEIs culture, faculty capabilities and facilities. This was testified by the computed p-values wherein all of which have a p-value of 0.000. For hypothesis 11, significant relationship exists between extension development and extension assessment with a p-value of 0.000 and a path coefficient of 0.847.

The multiple linear regression equations below illustrate the interrelationships among different variables to justify hypothesis 12.

Multiple Linear Regression (MLR) Equations

Extension Development = 0.283 EDPE + 0.282 EDTC + 0.279 EDFC + 0.279 EDF Eq. [7]

Extension Assessment = 0.275 EAPE + 0.275 EATC + 0.276 EAFC + 0.276 EAF Eq. [8]

Extension Outputs = 0.520 Extension Development + 0.520 Extension Assessment Eq. [9]

As the findings show, equation 7 states that program establishment (EDPE) with path coefficient of 0.283 is the most significant factor in extension development. On the other hand, equation 8 represents that faculty capabilities and facilities are highly contributed to extension assessment with both have a path coefficient of 0.276. Finally, equation 9 depicts that both extension development and extension assessment have the same value of path coefficients equivalent to 0.520 which highly contribute to the extension outputs of teacher education programs of the institutions. From equation 7, 8 and 9,

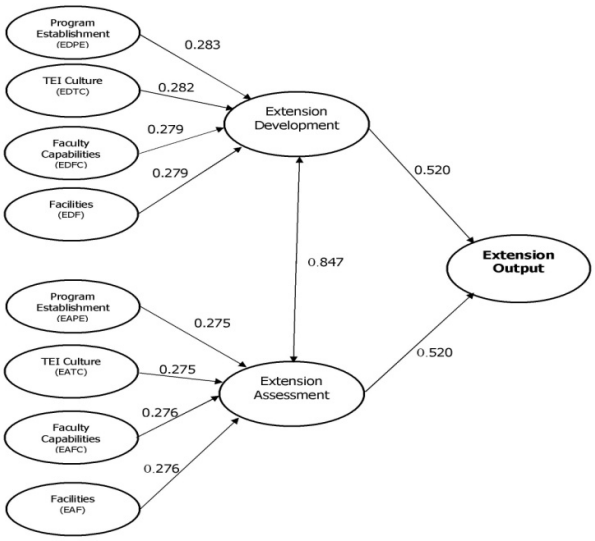

Figure 4. Model for Extension

Extension Outputs = 0.520 Extension Development + 0.520 Extension Assessment

=0.520 [0.283 EDPE + 0.282 EDTC + 0.279 EDFC + 0.279 EDF] + 0.520 [0.275 EAPE + 0.275 EATC + 0.276 EAFC + 0.276 EAF]

=0.147 EDPE + 0.146 EDTC + 0.145 EDFC + 0.145 EDF + 0.143 EAPE + 0.143 EATC + 0.144 EAFC + 0.144 EAF

The above equation shows the significant relationship among all factors namely program establishment, TEIs culture, faculty capabilities and facilities in extension development as well as extension assessment to produce extension outputs for teacher education programs. The p-value is 0.000 among all factors for both extension development and extension assessment. The result shows that extension development and extension assessment have significant impact on extension outputs. Program establishment for extension development as well as faculty capabilities and facilities in research assessment highly contribute in producing extension outputs in the teacher education institutions.

4.4 Output of the Overall Supply Chain Management Model

Figure 5 presents the output of the overall supply chain management model, represented by instruction supply chain, research supply chain and extension supply chain in terms development and assessment. The model fit measure of diagram shows the result of chi-square (2863.199), degree of freedom (129), RMSEA (0.157), CFI (0.633), GFI (0.711) and AGFI (0.616). The evaluations of the existing output of the overall model does not meet the prescribed value of a good fit or acceptable fit. The diagram also shows the path coefficients of the variables which determine the supply chain management in TEI's with a p-value having less than 0.05 which indicates significant relationship among the variables.

The output of the overall supply chain management model explains the relations between the variables which determined the supplied inputs and supplied outputs of Teacher Education Institutions. In the supplied inputs of the model below there are three main inputs for the TEIs, namely students, research projects and extension projects which have been evolved from instruction suppliers, research suppliers and extension suppliers.

Hypothesis 13: There is a significant relationship between instruction suppliers and students.
Hypothesis 14: There is a significant relationship between research suppliers and research project.
Hypothesis 15: There is a significant relationship between extension suppliers and extension project.

The model confirmed the insignificant relationship in the supplied inputs which are the hypotheses 13, 14 and 15 of the study. Supplied inputs do not confirm the significant relationship between instruction suppliers and students based on the p-value of 0.059. Also, research suppliers and research projects show non-

significant relationship which has a p-value of 0.335. Lastly, based on the p-value of 0.176, extension suppliers have no significant relationship on extension projects.

On the other hand, the model confirmed the significant relationship under the supplied outputs which are the hypotheses 16 to 21.

Hypothesis 16: There is a significant relationship between graduates and instruction customers.
Hypothesis 17: There is a significant relationship between research outcome and research customers.
Hypothesis 18: There is a significant relationship between extension outcome and extension customers.
Hypothesis 19: There is a significant relationship between instruction customers and society.
Hypothesis 20: There is a significant relationship between research customers and society.
Hypothesis 21: There is a significant relationship between extension customers and society.

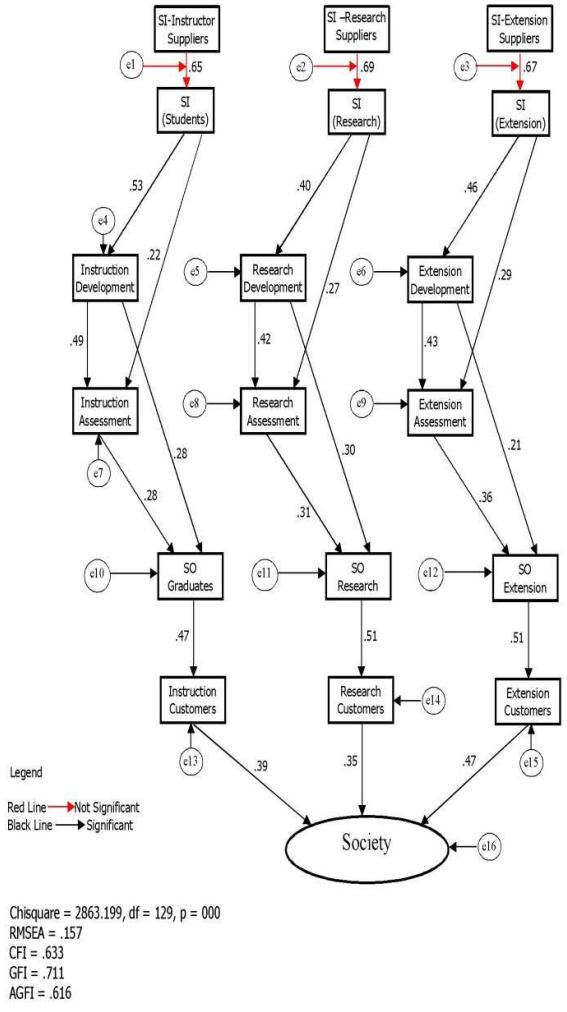

Figure 5. Output of the Overall Supply Chain Management Model

The graduates are positively associated with instruction customers with p-value of 0.000. Research outcome has a positive correlation with research customers having a p-value of 0.000. Extension outcome has a positive impact on the extension customers with a p-value of 0.000. For instruction customers, research customers and extension customer's show positive impact on the society as the end consumer of teacher education institutions. This was affirmed by the computed p-values where all of which have a p-value of 0.000.

4.5 Updated Output of Supply Chain Management Model

From the output of the overall supply chain management model, the study conducted a model trimming for the purpose of getting a more parsimonious model, which fits the data even better. In this approach, the study used clues from the data itself to improve the model by determining the highest modification indices of the overall model. For this purpose, the study included additional relationship between SI-Student and SI-Research, SI-Student and SI-Extension, SI-Research and SI-Extension, SI-Student and SO-Research, SI-Student and Extension Development, SI-Research and Research Customers, SI-Extension and Research Development, SI-Extension and Extension Customers, Instruction Development and Instruction Customers, Instruction Development and Extension Customers, Instruction Development and SO-Extension, Research Development and Instruction Development, Research Development and Instruction Assessment, Instruction Assessment and Extension Customers, Research Assessment and Research Customers, Research Assessment and Extension Development, Extension Assessment and Society, SO-Research and SO-Extension, SO-Research and Society, SO-Extension and SO-Graduates, Research Customers and Instruction Customers, Research Customers and Extension Customers and Extension Customers and Instruction Customers from the hypothesized model. All the additional relationships were significant at the level of 0.05.

In the updated model, the result shows the value of chi-square (665.209), degree of freedom (104), RMSEA (0.078), CFI (0.926), GFI (0.926) and AGFI (0.879) which is more than higher modification indices than the output of the overall model. Regarding recommendations for model evaluations, the updated output of supply chain management model meets the prescribed value of an acceptable fit. Updated output of supply chain management model has been illustrated in Figure 6. The Teacher Education Institutions could apply this updated model as basis to strengthen their outputs in instruction, research and extension for the betterment of the society.

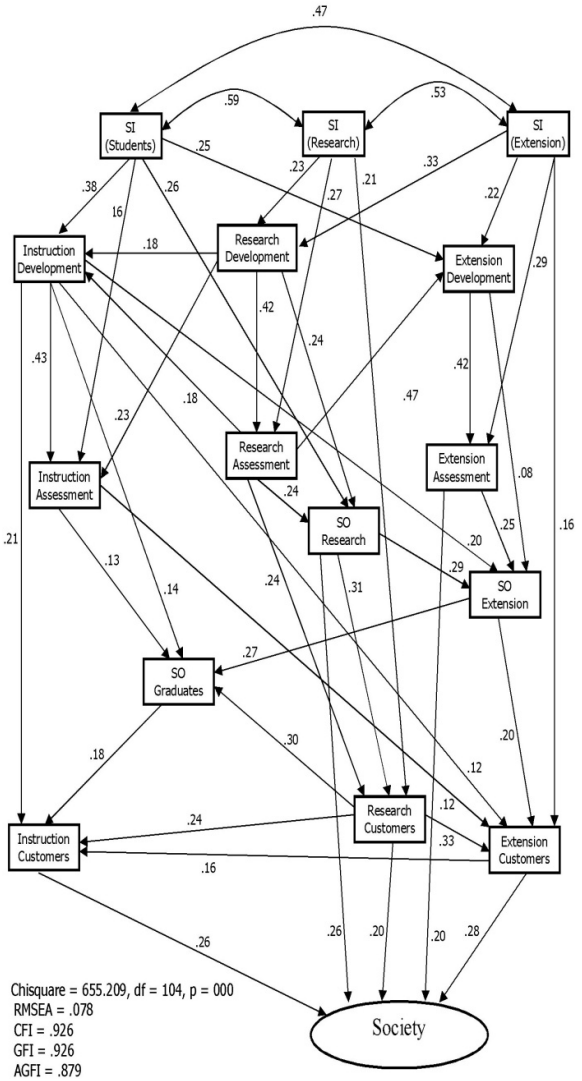

Figure 6. Updated Output of Supply Chain Management Model

5. Discussion

Under the instruction model, the research results showed that taken together, instruction development and assessment significantly impact graduates which was identified as final output of instruction being one of the trifocal functions of Teacher Education Institutions. Moreover, while it was found that there is a significant relationship among all factors (program establishment, TEI culture, faculty capabilities and facilities) in instruction development as well as instruction assessment to produce quality graduates of teacher education programs, the results showed that program establishment is the most significant factor in instruction development and highly contribute to instruction assessment. Both instruction development and instruction assessment are highly contributed to the graduates of teacher education programs of the institutions.

The outputs of teacher education programs are future teachers. The Teacher Education and Development Program (TEDP) conceptualizes a teacher's career path as a continuum that starts with entry to a teacher education program and concludes when a teacher reaches retirement from the service. As earlier put, the quality of the four factors determines the quality of the trifocal functions' development and assessment. In line with this, the quality of the factors also redounds to the quality of the outputs. As such, the quality of the pre-service training education which forms the foundation of a teacher's career is dependent on the quality of the four factors which in turn leads to quality teacher aspirants. This leads to the final result under the instruction model which is that among the factors, program establishment highly contributes to instruction development and instruction assessment in producing the graduates in the teacher education institutions. This study shows that more than faculty, facilities and TEI culture, program establishment influences to a large extent to instruction development and assessment in producing the outputs. Thus, institutional efforts must focus primarily on the programs being established.

The basis for the development of research is the nature and kind of programs established by the institution. Particularly, programs relevant to this function should be aligned with the specializations being offered by the institution. This would ensure a seamless approach for the promotion of research culture and enhancement of research capability of teachers and students.

Program establishment is the most significant factor in research development. In encouraging research development in a TEI, strategies and initiatives must first be established to support the research initiatives of faculty. This may include research capability programs, research funding and system of awards and recognition. Furthermore, when it comes to research assessment, the TEI's culture factor is highly contributory because when the faculty members are ready to subject their research outputs for peer review and external refereeing, then quality is ensured.

The relationship between research development and research assessment is likewise affirmed in this study. There is strong evidence that teachers and teacher educators need to engage in research, in the sense of keeping up to date with the latest developments in their academic subject and on effective instructional techniques to inform their pedagogical content knowledge. There is also strong evidence that teachers and teacher educators need to be equipped to engage in enquiry-oriented practice, which means having the capacity, motivation and opportunity to use research-related skills to investigate what is working well and what isn't fully effective in their own practice [19]. In relation to the results of the study, not only should the teacher educators be engaged in the development of research, they should also be engaged in its assessment, i.e., in order to check its relevance and use to the stakeholders. Research assessment may be in the form of monitoring of research utilizations and/or studies on their impact to the community.

The results of the study have proven that research development and research assessment significantly impact research outputs in TEIs. Moreover, there is significant relationship among all factors namely program establishment, TEI culture, faculty capabilities and facilities in research development as well as research assessment to produce research outputs for teacher education programs was confirmed. Among the factors, however, program establishment in research development highly contributes to the research outputs while TEIs culture in research assessment highly contributes to the same in teacher education institutions. Generally speaking, in order for teachers to become effective teachers, they must be able to generate action research to improve instruction.

Considering that majority of the HEIs in the country are teaching institutions and that only a small percentage meet the requirements as graduate-capable HEI and doctoral and research universities and considering the continuing efforts of the Commission on Higher Education in encouraging research cultures in HEI as guided by the National Higher Education Research Agenda, it can be said that most HEI's need to improve their research capabilities. HEIs must not just remain as consumers of knowledge but producer of knowledge through research.

In establishing and nurturing research culture in TEIs, this educational supply chain study showed that the key to quality research outputs is quality inputs. That is, quality in terms of the factors – faculty, facilities, program establishment and TEI culture including quality in terms of research development and research assessment.

With this, extension is of equal importance with the other functions of instruction and research in the development of future educators. The commitment to civic engagement should be encouraged in teacher education programs as the knowledge and "know-how" is vital to supporting the society that creates and sustains higher education as an institution. Through service learning, the teacher education programs can assist teacher candidates become members of a democratic public who possess the knowledge, skills, values, and attitudes they require in order to become change agents that impact their students and communities [6]. Basically, this is the essence of community extension.

In accordance with the previous discussion of the instruction and research models, providing the kind of environment where community extension can flourish and where all of the specified factors such as facilities, faculty program establishment and TEI culture provide support to this extension environment, TEIs extension development and assessment will also flourish. The significant relationship between extension development and extension assessment may also be explained in the same manner as in the previous models. Undertaking extension assessment provides basis for making informed decisions about the establishment of extension programs.

It is noticeable that different factors highly contribute to the different functions. For extension development, program establishment is the most significant factor while in extension assessment, it is faculty capabilities and facilities. It is because that only research talents and facilities such as the use of statistical software and competence of a researcher would ensure a satisfactory conduct of a functional research for developing quality extension programs. Ref [20] provides for the components of an Integrated Extension Program which covers TEIs namely training programs, technical assistance and advisory services, communication/information services, community outreach activities and technology transfer and utilizations. Research capability building activities and programs are necessary to realize outcomes. Extension development in any TEI is, thus, dependent on the programs established in the institution. Generally, the specific vision and mission guide extension programs of the TEIs since these programs are undertaken in the light of the strategic directions of the institution.

Finally, the results of the study have proven that extension development and extension assessment significantly impact extension outputs in TEIs. Moreover, the significant relationship among all factors namely program establishment, TEI culture, faculty capabilities and facilities in extension development as well as extension assessment to produce research outputs for teacher education programs was confirmed. Among the factors, however, program establishment in extension development highly contributes to the extension outputs while in research assessment, faculty capabilities and facilities highly contributes to the same in teacher education institutions.

6. Conclusion

The output of supply chain management model is called Productivity and Advancement of Graduates through Unified and Innovative Outputs – Instruction, Research and Extension or PAGUIO-INREX Model. This model emphasizes the importance of the trifocalized function of higher education to the formation of productive and competent graduates of Teacher Education Institution which in turn can contribute to the progress and development of the country. The PAGUIO-INREX Model, when used as a basic frame of reference in the formation and development of graduates, is aligned with the thrust of Philippine Education in terms of relevance, responsiveness and effectiveness in the delivery of quality educational programs and services.

Guided by this, TEIs should first, ensure the quality of their teacher educators, their outputs. This is the best form of marketing for TEIs which will ensure the viability of the program, through higher enrolment rates, and the employability of its graduates. Second, the TEIs should also ensure that quality of researches and extension activities as this will not only redound to positive outcomes which will benefit the target community, research publications that will benefit both the institution and the teacher educator and also possible funding from external organizations.

Given that the majority of the HEIs in the country are teaching institutions as concluded in Ref [2], the

PAGUIO-INREX model may be applied in order to balance the thrust of TEIs vis-a-vis their trifocal functions generally by shifting to a holistic focus, meaning, giving balanced importance not only to instruction but also to research and extension as reflected on the institutional programs. Furthermore, the model may also be applied in addressing the issue of mismatch in the output of TEIs with that of the industry guided by the significant relationships among the educational management practices of development and assessment as well as among the supplied inputs and outputs as reflected in the output model.

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