Level of Development and Research Publication Productivity among State University and Colleges Faculty: A Predictive Model

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Abstract

This study aimed at developing a model for predicting research publication productivity among faculty members of state universities and colleges based on the domains specified in the VITAE Researcher Development Framework. Using the quantitative predictive cross-sectional design, a regression model on research publication productivity was developed and validated based on the research development needs of faculty. Research publication productivity was positively correlated with the four domains, namely: knowledge and intellectual abilities; personal effectiveness; research governance and organization; and engagement, influence, and impact. Multiple regression analysis with split-validation analyses were conducted to support the validity of the full model with the two domains found as significant predictors of research publication productivity, namely: Knowledge and Intellectual abilities, and Research Governance and Organization. The developed and validated regression model provides a predictive model of research publication productivity with 52.7% explanatory power, this indicates that there are still other factors to be accounted by the model to increase the research publication productivity of the faculty members.

Keywords: regression analysis, research publication productivity, level of development, state universities and colleges, VITAE Researcher development framework

Introduction

Higher education institutions (HEIs) play a vital role in the transmission, production, and extension of knowledge in society and the world at large. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has emphasized the responsibility of HEIs in fostering a positive link between the intellectual and educational aspects to the development of society. In Europe, policies such as the Bologna Process and Lisbon Strategy, including the Modernization of Agenda for Universities reflect their stance on the significance of HEIs in ensuring knowledge production through research and innovation as well as for the continuous education of its workforce (Barrett, 2013 & Keeling, 2006). In the United States of America, the increase in research activities does not solely constitute information advancement and discovery but also a means for HEIs to generate revenues created from the commercialization of research generated intellectual property (Huenneke, Stearns, Martinez, & Laurila, 2017). Also, in many developed countries with a well-developed system for research, university knowledge production becomes market-oriented and slanted toward fields of revenue-generating potential (Collins & Rhoads, 2010).

The Philippines, as a developing country, needs researchers to continuously cope with the constant demands of the academic labor market. Publication in the international and national refereed high indexed journal is not a very good indicator of research performance (Alcala, 22 May 2016 & Bernardo, 1997 cited by Calma, 2013). Valencia (2004) reported that selected universities in the country have an average research productivity of 20% which is equivalent to one international publication per faculty member in five years. Some researchers found out that even in some well-known research-intensive universities have scored low in completed research outputs and measurable results such as publications (Meek & Suwanwela, 2006; Tecson-Mendoza, Espaldon, Camacho, &

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Carascal, 2010). Additionally, Clemena (2006) posited that in terms of research output, 60.33% came from the National Capital Region (NCR), and Region 7 produces the next highest number of researches with 11.58%, while the rest of the regions contribute poorly.

Scholarly research publication has become a core requirement for institutional and personal development of faculty members in higher education institutions. Research has been considered for regulatory compliance for state universities and colleges (SUCs) leveling, program accreditation, faculty promotion, accreditation as a full-fledged professor, and other mechanisms as part of the national government strategies that aim to increase the research outputs of faculty members. Correspondingly, this present study examined factors influencing the research publication productivity of the SUCs faculty in terms of Knowledge and Intellectual Abilities (Domain A), Personal Effectiveness (Domain B), Research Governance and Organization (Domain C), and Engagement, Influence, and Impact (Domain D) based on the VITAE Researcher Development Framework (RDF) of UK Careers Research & Advisory Centre, (2010 & 2013). Moreover, in this study a regression model of research publication productivity was developed and validated based on the research development needs of SUC faculty among the identified four domains of the VITAE RDF.

Methodology

Research Design. This study used the quantitative predictive cross-sectional design to develop a regression model of research publication productivity using regression analysis based on the VITAE RDF. Consequently, a regression model of the research publication productivity of faculty members in SUCs was developed and validated based on the identified four domains of the VITAE RDF. Quantitative techniques were used in interpreting the data

gathered about the levels of development as well as their research publication productivity.

Research Environment. This study was carried out in six provinces of Region VIII's state colleges and universities which comprises four SUCs from Leyte, one in Biliran, one in Southern Leyte, two SUCs in Samar, one each in Northern and Eastern Samar.

Research Respondents. The respondents of this study were full-time faculty members with at least a Master's degree (Civil Service Commission Memorandum Circular No. 17, series of 2013) from the ten (10) SUCs, specifically the state universities and colleges in the six provinces in Region VIII. Respondents were those who have served the institution for at least three years.

To facilitate the administration of data collection and in order to come up with the desired faculty members, stratified proportional random sampling was employed based on the six provinces in Region VIII in which the sample size in each institution is proportional to the population size of the full-time faculty members.

Research Instrument. The survey instrument was divided into two parts: research publication productivity, and levels of development of the faculty members based on the VITAE RDF. Their research publication productivity was assessed using a point system based on their number of publications in local, national, and international levels. In terms of the levels of development, linear-scaling, was used based on the five phases of the VITAE RDF's researcher's level of development (Phase 1, Phase 2, Phase 3, Phase 4, and Phase 5). The phases are cumulative and represent distinct stages of levels of development.

The consistency of the items was assessed by using the Cronbach Alpha reliability coefficient. With an internal consistency reliability of 0.862, thus the total scores of research publication

productivity and mean scores of the domains were used in further statistical analyses.

Research Procedure. Transmittal letters were submitted to the University Presidents of all ten SUCs in Region VIII to seek approval for the conduct of the study. The appropriate approvals were obtained to enable the researcher to conduct the survey questionnaire and to gather the respondents' responses, notably regarding the research publication productivity and faculty respondent's level of development. Actual visits to the ten participating SUCs were made. Additionally, due to the lockdowns due to the COVID-19 pandemic , Google forms were used to collect the data to achieve the needed sample size. The researcher handled all instruments and maintained confidentiality and anonymity regarding all data.

Treatment of Data. On the level of development in the four domains indicated in the VITAE RDF and research publication productivity of the faculty members, the initial analysis was processed and summarized using descriptive statistics.

Correlation analysis was employed to determine which domains specified in the VITAE RDF are significantly associated with research publication productivity. Multiple regression analysis was used to identify significant predictors of research publication productivity, and formulate the model. Random split-validation analysis of approximately 50% of the sample was conducted to validate the predictive model on research publication productivity.

Results

Level of Development of Faculty Respondent. The characteristics of faculty respondents classified into the four domains based on the VITAE RDF, refers to a range of qualities and attributes in terms of cognitive capabilities, personal efficacy, research management as well as the ability to collaborate with others

that faculty members need in order to succeed in their professional and academic careers. These four domains, as shown in Table 1, are: Knowledge and Intellectual Abilities (A) - the complementary factor in the process of becoming a competent researcher emphasizing knowledge base, cognitive abilities, and creativity; Personal Effectiveness (B) - the contemplative domain of the RDF emphasizes understanding the self, reflecting on values, capabilities, and expertise on which are considered as important qualities of a researcher; Research Governance and Organization (C) – the extrinsic factor on the effective governance structures congruent with universities' goals, objectives, and organization culture that can make a major contribution to researcher's productivity; and Engagement, Influence, and Impact (D) - the socialization of researchers in their own research environments as assessed in terms of scholarly engagement as well as the cognitive breadth of the research impact.

Table 1. *Level of Development of Faculty Respondents along the Four Domains of VITAE RDF*

Domain	Phase 1 n (%)	Phase 2 n (%)	Phase 3 n (%)	Phase 4 n (%)	Phase 5 n (%)
A	44 (14.6%)	60 (19.9%)	**115 (38.1%)**	77 (25.5%)	6 (2.0%)
B	31 (10.3%)	63 (20.9%)	**108 (35.8%)**	89 (29.5%)	11 (3.6%)
C	54 (17.9%)	90 (29.8%)	**100 (33.1%)**	55 (18.2%)	3 (1.0%)
D	47 (15.6%)	79 (26.2%)	**108 (35.8%)**	58 (19.2%)	10 (3.3%)

As shown in Table 1, the faculty respondents' levels of development varied across Phases 1 to 5 in the four domains of VITAE RDF, with most of the respondents belonging to Phase 3, (35.7%) on the average. According to the VITAE RDF, this indicates that the faculty respondents have developed "detailed and

thorough knowledge/understanding of own and related subject areas – and becomes familiar with associated areas in other disciplines/research areas, analytical abilities, and the potential to innovate research projects" (pp. 3-7). Consequently, their perceived level of development indicates that the faculty have developed the knowledge on the "relevant funding sources and grant application, guidelines for the ethical conduct of the study, legal framework particularly in relation to ownership of data and the requirements of the Data Protection Act, copyright and IPR; rights of the participants to confidentiality and anonymity; fairness to recognize contributions and co-authorship; rules and regulations concerning academic malpractice in the institution" (pp. 12-15).

In accordance with the results, only about 23% to 26% of the faculty respondents considered themselves in Phase 4 or Phase 5 stages of development in these domains. With most of the respondents in Phase 3 development, this implies that the respondents are acquainted with their research areas and in other disciplines but they recognize their need for further professional development to enhance their knowledge and intellectual abilities; potential building for personal effectiveness-that is, more time in writing research paper while gaining work-life balance; trainings about planning and delivering research projects, relevant funding sources and grant application, financial management systems on research, and the institutional policy governing professional conduct and ethical competence in research; and capability development of working with colleagues/research teams.

Research Publication Productivity. Articles published in scholarly journals and books are frequently included in publications (Creswell, 1985). This refers to published research/articles in local, national, and international journals.

Table 2. *Research Publication Productivity of SUC Faculty for the Last Five Years, 2015-2020 (n = 302)*

Level	f (%)	No. of Publications		Mean
		Minimum	Maximum	
International	228 (75.5%)	1	6	2.68
National	267 (88.4%)	1	15	2.10
Local	193 (63.9%)	1	10	1.88
Grand Mean				2.22

Table 2 shows that out of 302 faculty respondents, only 193 (63.9%) respondents have published in local journals, 267 (88.4%) have published in national journals, and 228 (75.5%) in international journal. Of these who published, the least number of publication is 1 in all levels and the highest is 10, 15, or 6 research publications, at the local, national, or international journals, respectively in the last five years. Furthermore, research publication productivity of the faculty respondents, on the average throughout a five-year period, is around 1 to 2 publications at the local level while 2 to 3 publications at the national and international level. On the average, there are two publications per faculty member in five years.

Relationship between Research Publication Productivity and Teachers' Level of Development in the Domains of the VITAE RDF. The strength of prediction in a predictive model lies on the strength of relationships among the explanatory variables on research publication productivity as the dependent variable. Thus, correlation analysis is first done to investigate these relationships and determine which domains in the VITAE RDF are significantly correlated with the faculty respondents research publication productivity.

Table 3. *Relationship between Faculty Respondents Level of Development in the Domains of the VITAE RDF and Research Publication Productivity*

Variable	RPub	A	B	C	D
RPub	-				
A	0.277**	-			
B	0.236**	0.876**	-		
C	0.159**	0.812**	0.868**	-	
D	0.162**	0.753**	0.873**	0.876**	-

Note: ** Correlation is significant at the 0.01 level (2-tailed)
RPub = Research publication productivity

These findings suggest that all correlation coefficients between the domains of the teacher's development characteristics and research publication productivity were significant at $\alpha = 0.01$. Positive correlation coefficient (r) values ranging from ($r(302) = 0.159$, $p < 0.01$) to ($r(302) = 0.277$, $p < 0.01$) implies that the faculty respondents' level of development in the four domains is significantly and positively correlated with research publication productivity.

Regression Analysis. The multiple regression analysis was used in this study to derive the research publication productivity model. Prior to the conduct of regression analysis and split-sample validation analysis, the data was examined for consistency with the assumptions and excluded outliers from the regression model as this can have a disproportionate effect on the estimated regression. As a result, only 152 cases were included in the validation analysis out of 302 total cases.

Table 4. *F-test of Regression Model*

Full Model	Sum of Squares	df	Mean Square	F	p-value
Regression	11512.830	4	2878.208	40.938	<0.001
Residual	10334.933	147	70.306		
Total	21847.763	151			

Table 4 shows the overall relationships between teacher' level of development in the four domains of VITAE RDF and research publication productivity using the full dataset. The regression sum of squares (SSR = 11512.830, df = 4) represents the amount of variation explained by the four domains in the research publication productivity model. Whereas, the residual sum of squares (SSE = 10334.933, df = 147) represents the unexplained variation. It could be deemed that there is a good fit in the model because the SSR is much larger than the SSE. Generally, the F-test of regression analysis is meaningful for the data in this study as the result shows that the model is statistically significant $F(4,151) = 40.938$, $p<0.001$, which support the relationship between the respondents' level of development in the four domains and research publication productivity model.

Table 5. *Faculty Respondents Level of Development in the Domains of VITAE RDF and the Explanatory Power of the Full Model*

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.726	0.527	0.514	8.38485

Table 5 shows the overall relationships between faculty respondents' level of development in the domains of VITAE RDF and research publication productivity. The Multiple R for the relationship between the four domains and research publication productivity is R = 0.726 which would be characterized as high based on the rule of thumb (Hopskin, 2000). Meanwhile, the proportion of variance in the research performance explained by the four domains included in the analysis is 52.7%. An R^2 of 0.527 means that differences in the level of teacher's development can explain 52.7% of the variation in research publication productivity.

The findings of the study constitute a good R-square based on the rule of thumb by several authors (Baruch, 2015; Fung, 2015; Cohen, 1988; Falk & Miller, 1992). The R-square value is supported by studies such as the attempts in predicting human behavior that R-

squared values are low because humans are heterogeneous and are harder to predict in terms of physical processes, attitudes, actions, and behavior (Jones, 2015). Chin (1998) recommended R^2 values for endogenous latent variables as 0.67 (substantial), 0.33 (moderate), 0.19 (weak). Thus, in this study it could be gleaned that the overall result of R^2 = 52.7% indicates a significant considerable predictability.

Table 6. *Full Regression Model of Research Publication Productivity*

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	3.704	2.706		1.785	0.076
A	0.846	0.113	1.292	7.474	<0.001
B	-0.012	0.142	-0.016	-0.084	0.933
C	-1.008	0.132	-1.091	-7.656	<0.001
D	0.145	0.091	0.221	1.588	0.114

As shown in Table 6, two out of four domains were statistically significant predictors of research publication productivity; namely: (A) ***Knowledge and Intellectual Abilities*** t(152) = 7.474, p<0.001, and (C) ***Research Governance and Organization*** t(152) = -7.656, p<0.001. The values of the standardized beta coefficients refer to the relative importance of each domain to research publication productivity model in which the coefficients have the same scale (absolute value). The findings suggest that in terms of the greatest relative importance of the domains to research publication productivity, knowledge and intellectual abilities were the most important domain to research publication productivity followed by research governance and organization; engagement, influence, and impact; and lastly personal effectiveness, as reflected in the standardized beta coefficients.

Based on the results in Table 6, the estimated regression parameter and the fitted model is:

$$Rpub = 3.704 + 0.846\mathbf{A} - 0.012\mathbf{B} - 1.008\mathbf{C} + 0.145\mathbf{D}$$

The model implies that the estimated positive coefficients (B) associated with research publication are knowledge and intellectual abilities, and engagement, influence, and impact suggest that these domains have direct contribution to increase research publication whereas negative (B) coefficients such as personal effectiveness, and research governance and organization implies an indirect contribution to research publication productivity outputs. The findings suggest that faculty members' poor publishing outputs may be related to a limited funding for professional development, potential building of the teachers to improve research-capability, long-term training programs for commercialization of research-generated intellectual property, and inadequate research funding, as well as weak research governance and organization.

To support the generalizability of the full regression model of research publication productivity, data splitting for both samples for purposes of cross validating the model was performed to estimate the coefficients and the accuracy of the model. A split-sample of regression analysis includes tests of relationships between teachers' level of development in the domains in VITAE RDF and research publication productivity with first and second split-sample validation which can be gleaned in Table 7.

Table 7. *Model Summary with First and Second Split-Sample Validation on Faculty Respondents Level of Development in the Domains of the VITAE RDF and Research Publication Productivity*

Validation	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	p value
First Split-Sample	0.728	0.530	0.504	8.11073	20.302	<0.001
Second Split-Sample	0.726	0.527	0.500	8.86249	19.507	<0.001

In both of the split-sample validation analyses, the relationship between the teacher's level of development in the domains in VITAE RDF and research publication productivity were statistically significant ($p<0.001$). Based on the R-squared values for the full model, the total proportion of explained variance in the relationship utilizing the full dataset is 52.7% compared to 53% for the first split sample validation and 52.7% for the second split sample validation. The split-sample validation analyses in terms of the total proportion of variance in the research publication productivity explained by the four domains was within ±5% of the variance explained in the model using the full dataset of 52.7%. Consequently, the required within 5% threshold are 50.4% - 55.7% and 50.1% - 55.3% for first and second validation analyses, respectively. Thus, the results of split-validation analyses support the validity of the full regression model on research publication productivity.

Table 8. *Split-Sample Validation Analyses*

Validation	Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
First Split-Sample	(Constant)	3.504	2.753		1.273	0.207
	A	0.757	0.143	1.243	5.295	<0.001
	B	0.057	0.177	0.081	0.320	0.750
	C	-0.959	0.200	-1.087	-4.806	<0.001
	D	0.128	0.136	0.203	0.938	0.351
Second Split-Sample	(Constant)	4.122	3.243		1.271	0.208
	A	0.999	0.194	1.421	5.156	<0.001
	B	-0.176	0.249	-0.227	-0.707	0.482
	C	-1.061	0.183	-1.104	-5.792	<0.001
	D	0.191	0.133	0.283	1.435	0.156

Results in Table 8 showed the variables entered into the regression model provided the same two predictor variables in the full dataset and were found to be significant ($p<0.001$) in the subsequent validation analyses. The results showed that the four domains entered in the regression model, knowledge and intellectual abilities, and research governance and organization are significant predictors of research publication productivity. In both validation analyses in terms of the relative importance of each domain to research publication productivity, ***Knowledge and Intellectual Abilities*** (Domain A) and ***Research Governance and Organization*** (Domain C) are significant predictors with greater explanatory power as reflected in the standardized beta coefficients.

The split-sample validation supports the findings of the regression analysis using the full dataset. Finally, a summary of validation results using full and split-sample data can be gleaned in Table 9.

Table 9. Summary of *Validation Results using Full and Split-Sample Data*

Summary Statistics	Full Dataset	Split 1	Split 2
ANOVA Significance	<0.001	<0.001	<0.001
R^2	0.527	0.530	0.527
RMSE	8.385	8.111	8.863
Significant Domains	Knowledge and Intellectual Abilities Research Governance and Organization	Knowledge and Intellectual Abilities Research Governance and Organization	Knowledge and Intellectual Abilities Research Governance and Organization

The overall relationship between the research publication and the set of teachers' development characteristics are statistically significant for both validation analyses. In terms of R^2, the value for each validation analysis is within the ±5% of the R^2 for the model using the full dataset. The Root Mean Squared Error (RMSE) measures the average error performed by the model in predicting the outcome for an observation which is also the square root of the Mean Square Error (MSE) in the Analysis of Variance (ANOVA) results. The results show that the full and split-validation datasets in terms of the amount of unexplained variation (RMSE) are comparable with slight difference. Moreover, the pattern of statistical significance for the coefficients of the domains for both validation analyses are the same with the full dataset, thus, the full model were able to meet the criteria for split-validation that could help explain the research publication productivity of the SUC faculty.

In accordance with the validation analyses, the results support the findings of the full dataset with the two domains as the

strongest predictors of research publication ***(Knowledge and Intellectual Abilities, and Research Governance and Organization)***. Therefore, each of these domain corresponding to teachers' development characteristics were considered as the strongest predictors observed in the full validated model and has a significant contribution in predicting the average research publication performance of the faculty in state universities and colleges.

Conclusion

The four domains of the VITAE Researcher Development Framework has provided the basis for assessing the teachers' level of development as the independent variables for predicting research publication among the faculty at state universities and colleges in Region VIII. The regression model developed and validated show that the domains that have the highest contribution to research publication productivity are Knowledge and Intellectual Abilities, and Research Governance and Organization. Therefore, these domains are the important consideration to address the research development needs for further trainings and professional development of the teachers to improve their research publication productivity. Finally, this study concludes that the developed regression model provides a predictive model of research publication productivity among faculty researchers of SUCs. Moreover, with 52.7% explanatory power, this indicates that there are still other factors of research publication productivity to be accounted by the model to increase the number of research publications of the faculty members.

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