Self-efficacy of Natural and Allied Science College Teachers in a State University

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Abstract *–Self-efficacy studies on teachers have been mostly focused on the primary, secondary, preservice and graduate teaching assistant education. There is, however, a very limited study in the tertiary level especially amongst science teacher self-efficacy. Thus, this study explored the predictors of the performance of science teachers in a state university. The self-efficacy of the science teachers in the different domains of science teaching vis-a-vis their profiles were determined. Data were obtained from the responses of the Likert-type questionnaire which was adapted from the European Commission Competency of Science Teachers. The twenty-one respondents were tertiary teachers of natural and applied sciences in a state university. Regression analysis was applied to the data set in identifying the determinants of the performance of tertiary science teachers, evaluated at 0.05 level of significance. Findings showed that among the teacher profile variables (including gender, age, educational attainment, employment status, and years of teaching) only the type of program taught has correlation with the four domains of science teaching namely nature and concept of science, scientific inquiry, general skills in teaching and curriculum. Using the independent t test, it has been shown that there is no significant difference in the self-efficacy between natural and allied science teacher, as these teachers show very high self-efficacy. However, they should undergo reimmersion and seminars on the importance of the pedagogy of education as most college science teachers do not have formal background in teaching education.*

Keywords *– competency, science teaching domains, self-efficacy, college science teachers*

INTRODUCTION

Self-efficacy is the individual's self-belief to execute the behavior necessary to accomplish a task and effect a favored outcome as professed by Bandura [1]-[3]. Teachers with the grasp of high efficacy tend to be more proactive in planning and organizing. They dwell more time teaching in areas they are more competent with and less time in areas their efficacy is low. High efficacious teachers are less critical to the errors of their students and do more mentoring to the struggling students [4]-[6].

In a study by Ross [7], it was suggested that teachers with high efficacy learn and use new approaches and strategies for teaching, use management techniques that enhance student autonomy, provide special assistance to low achieving students, build students' self-perceptions of their academic skills, set attainable goals, and persist in the face of student failure.

Mojavezi and Tamiz [8] in their study on the impact of teacher self-efficacy in the English language revealed that students' motivation and achievement have positive correlation with teacher self-efficacy. This result is in consonance with studies of Tournaki & Podell [9] and Wolters & Daugherty [10].

Several studies of teachers' self-efficacy and their impact to students have been made like the study of DeChenne et al. [11] on graduate teaching assistants preparedness; changes in science teaching self-efficacy among primary teacher education students [12]; beliefs of science preservice teachers as compared to the general student population [13]; teaching in diverse classrooms [14]; efficacy information and student achievements [15] and several others. These various studies however, are mostly focused on the primary, secondary, preservice and graduate teaching assistant education. Furthermore, there is very limited study in the college level especially amongst science teacher self-efficacy.

Several factors which are inherent to the science teacher could affect his/her self-efficacy in teaching. As such only the age, gender, program taught, employment status and years teaching in the tertiary level are considered for evaluation in this study.

OBJECTIVES OF THE STUDY

Most science teachers have not undergone formal trainings in teaching or are lacking in subjects dealing with the pedagogy in teaching in their baccalaureate

degrees. The pedagogy in education is formally taught in teacher education. This study therefore, is interested in the self-efficacy of the college science teachers as this might affect their interaction with and satisfaction of their students. They are evaluated based on their profiles against several domains in science teaching.

This study is anchored on Albert Bandura's Self-efficacy Theory. The aim of this study is to determine if there is significant relationship between teacher profile variables to self-efficacy in science teaching, tested at 0.05 level of significance. Particularly, if there is significant relationship between teacher profile variables to each of the domains of self-efficacy.

The following null hypotheses were tested at 0.05 level of significance. There is no significant relationship between teacher profile variables to self-efficacy in science teaching. Particularly, there is no significant relationship between teacher profile: understanding nature and concept of science; scientific inquiry; general skills of teaching; curriculum; assessment; and professional practice.

METHODS

This study employed quantitative design since the purpose of this research is to measure the self-efficacy of the different science teachers teaching in their field of specializations. The study was conducted in the main campus of Negros Oriental State University. The twenty-one respondents were teachers in the various fields of science, particularly in natural and applied sciences. In the conduct of the study, the respondents were told that their participation is optional and that the information gathered from the study will be held in utmost confidentiality. A Likert-type questionnaire administered to the respondents was made from the various competencies derived from the Competency of Science Teachers Socrates Programme of the European Commission. This was adapted and revised to include only the competencies which are applicable to the population of the study that allowed to measure the respondents' attitude towards self-efficacy in science teaching. The questionnaire also gathered information on the demographic data, highest educational attainment and years of teaching among other teacher profiles. Statistical tools like frequency count, average and regression analysis were used to identify the determinants (profiles) of the performance (self-efficacy) of tertiary science teachers evaluated at 0.05 level of significance.

RESULTS AND DISCUSSION

The profiles of the science teachers in this study include gender, age, program taught (categorized as 1-natural science, 2-allied science), education (1-baccalaureate, 2-masters, 3-doctorate), employment status (1-guest instructor, 2-regular temporary, 3-regular permanent), academic rank (1-guest instructor, 2-instructor, 3-assistant professor, 4- associate professor, 5-professor) and years of teaching (Table 1).

Table 1. Profile of Science Teachers.

Profile	N/%	Profile	N/%
Sex		Employment	
Male/	7/33%	status	
Female	14/66%	Guest Instructor	12/57%
		Regular	9 /43%
Age		Rank	
Upto 25	3/14%	Guest Instructor	12/57%
26 – 30	4/19%	Instructor	1 /5%
31 – 35	4/19%	Assistant Prof	6 /29%
36 – 40	3/14%	Associate Prof	2 /10%
41 – 45	3/14%		
46 – 50	2/10%		
50 up	2 /10%		
Education		Years teaching	
Baccalaureate/	5/24%	Up to 5	9/43%
Master/	11/52%	6 – 10	7/33%
Doctorate	5/24%	11 – 15	2 /10%
		16 – 20	1/5%
		20 up	2 /10%

The college science teachers' self-efficacy for all domains in science teaching rated very high (Table 2). With maximum mean of six, all determinants have values greater than five. This means that all science teachers have high self-regard with confidence and proficiency in the different programs they taught.

Table 2. College science teachers' over all teaching self-efficacy in different science domains.

Domain	Overall Mean	Self-efficacy Interpretation*
Nature & Concept of Science	5.48	Very high
Scientific Inquiry	5.50	Very high
General Skills in Teaching	5.20	Very high
Curriculum	5.48	Very high
Assessment	5.49	Very high
Professional Practice	5.35	Very high

**1.00-1.82 No self-efficacy; 1.83-2.66 Very low; 2.67-3.49 Low; 3.50-4.32 Moderate; 4.33-5.15 High; 5.16-6.00 Very high.*

Analysis of data showed a strong correlation, r = 0.75 [16] between teacher profile and science teaching self-efficacy (Table 3). As the teacher gain more years in teaching, attain higher educational qualification and move higher in the academic ranking, he may improve his knowledge, skills and aptitude which positively affecting his self-efficacy in the field of science he is teaching.

Table 3. Over all regression statistics between teacher profiles and science teaching self-efficacy

Regression Statistics	
Multiple R	0.754142
R Square	0.568731
Adjusted R Square	0.281218
Standard Error	0.440724
Observations	21

Of the variables in teachers' profile as indicators of the self-efficacy in science teaching, only the Program variable has P-value less than 0.05 (Table 4). The Program variable in which the teachers taught in this study is categorized into (1) as natural science (biology, chemistry and physics) and (2) as the allied sciences (psychology, nursing and pharmacy). This could mean that the type of Program or Baccalaureate Degree taught may have a significant impact on the teaching self-efficacy.

The formula derived from the regression coefficients would be

self-efficacy = -0.64803*Program + 0.020792*Age + 0.085767*Gender + 0.012748*Education – 0.19492*EmploymentStatus + 0.530256*Rank – 0.07073*YearsinNORSU – 0.07788*TotalyearsTeaching

with the type of Program taught having the greatest impact on the self-efficacy in science teaching.

This study revealed that gender and years in teaching (experience) had no significant correlation to self-efficacy. This is in contrast to the study of Aktas, et al. [15] which showed that both gender and experience variables among biology teachers positively and significantly predict education process self-efficacy perception. The study of Aktas however, was on the secondary biology teachers. DeChenne, et al. [10] and Hoy [17] on their study with graduate teaching assistants also showed that teaching experience act as source of teaching-efficacy and important shapers of efficacy judgment. Similar study of Tschannen-Moran and Hoy [18] among preschool to high school teachers showed experience is salient in self-efficacy beliefs.

Table 4. Coefficients and p-values of the various teacher profile indicators

	Coefficients	*P-value*
Intercept	5.805886	1.39E-07
Program	-0.64803	0.022286
Age	0.020792	0.826791
Gender	0.085767	0.707067
Education	0.012748	0.962353
Employment Status	-0.19492	0.752601
Rank	0.530256	0.406466
Years in NORSU	-0.07073	0.878035
Total years teaching	-0.07788	0.791249

It is interesting to note why the type of Program taught has the biggest impact among the indicators. The areas in this study are divided into six domains in science teaching which are 1-the nature and concept of science, 2-scientific inquiry, 3-skills of teaching, 4-curriculum, 5-assessment and 6-professional practice.

Taking the regressions based on each domains, the correlations range from moderate, r = 0.55 for assessment, to strong correlation, r = 0.780013 for skills of teaching (Table 5).

As to what domains does the variable Program taught has impact on, the regression between the indicators and the individual domains in science teaching elicited four domains having p-values less than 0.05 (Table 6). These are the nature and concept in science, scientific inquiry, general skills in teaching and curriculum.

Table 5. Regression statistics by domains between teacher profiles and science teaching self-efficacy

	Nature & Concept	Scientific Inquiry	Skills of Teaching	Curriculum	Assessment	Professional Practice
Multiple R	0.696612	0.722511	0.780013	0.739626	0.551346	0.660647
R Square	0.485269	0.522022	0.60842	0.547047	0.303983	0.436454
Adjusted R Square	0.142115	0.20337	0.347366	0.245079	-0.16003	0.060757
Standard Error	0.499031	0.505985	0.607814	0.472526	0.600134	0.480841
Observations	21	21	21	21	21	21

Table 6. *P-values* by domains of the various teacher profile indicators

	P-values					
	Nature & Concept of Science	Scientific Inquiry	General Skills of Teaching	Curriculum	Assessment	Professional Practice
Program	0.02838	0.025029	0.01449	0.020669	0.71545	0.331505
Age	0.215101	0.621822	0.933282	0.33016	0.627775	0.82935
Gender	0.902982	0.560961	0.500789	0.459071	0.615922	0.689377
Education	0.639789	0.147913	0.906531	0.383493	0.626303	0.597277
Employment Status	0.623343	0.271487	0.962917	0.263509	0.696439	0.799605
Rank	0.310517	0.177106	0.675986	0.130066	0.862555	0.804959
Years in NORSU	0.996569	0.148062	0.854857	0.805952	0.769195	0.746767
Total years teaching	0.286339	0.553872	0.908866	0.745192	0.546472	0.807291

A possible explanation to this observation could be that it is more inherent to the natural sciences than in the allied sciences the activities presented in the questionnaire. For example, allied science teachers would have personnel assistants in the preparation and conduct of laboratory activities while natural science teachers would have a more hands on approach. Another possible reason would be that there would be less scientific instruments to operate on in the allied sciences (e.g. psychology).

Table 7. t-Test between natural and allied sciences self-efficacy

	Variable 1	*Variable 2*
Mean	5.205742	5.673684
Variance	0.372828	0.058818
Observations	11	10
Hypothesized Mean Difference	0	
df	13	
t Stat	-2.34631	
P(T<=t) one-tail	0.017734	
t Critical one-tail	1.770933	
P(T<=t) two-tail	0.035469	
t Critical two-tail	2.160369	

Nevertheless, does it mean that natural science teachers are more self-efficacious than their allied science counterparts? To test that there is no significant difference in the means of self-efficacy between the natural and allied sciences an independent t-Test was used (Table 7). Since t Stat -2.34631 < t Critical two-tail 2.160369, the observed difference between the self-efficacy in natural and allied sciences is not convincing enough to say that self-efficacy differs significantly. This is also evident in the Program overall mean of all the domains having very high self-efficacy ratings (Table 8).

Table 8. Teaching self-efficacy in different science domains for the natural and allied sciences.

	Program mean and self-efficacy interpretation			
	Natural		Allied	
Nature & Concept of Science	5.74	Very high	5.25	Very high
Scientific Inquiry	5.77	Very high	5.29	Very high
General Skills in Teaching	5.61	Very high	4.87	High
Curriculum	5.73	Very high	5.30	Very high
Assessment	5.56	Very high	5.45	Very high
Professional Practice	5.68	Very high	5.48	Very high

CONCLUSION AND RECOMMENDATION

Several studies have shown that teacher self-efficacy, which according to Bandura is the teacher's confidence in his/her ability to promote students' learning, have positive correlation with student motivation and achievement. However, there is limited or none at all study of teacher self-efficacy amongst college science teachers. This study had shown that science teachers have inherent specialized skills they derived from the programs they graduated from as shown by the very high self-efficacy values in the various science teaching domains measured. However, among the predictors (gender, age, program taught, education, employment status, academic rank and years

of teaching) only the type of program taught has significant effect on the self-efficacy of college science teachers. The nature and concept of science, scientific inquiry, general teaching skills and curriculum are domains that affected positively correlates with the identified with the type of program taught as predictor. Nonetheless, the self-efficacy between natural and allied science teachers did not differ significantly as shown by t-Test and supported by the very high self-efficacy ratings among them.

Indeed, having teachers with very high self-efficacy, the students should be confident that their science teachers will deliver the preferred outcome of motivating the students towards goal achievement. Although all teachers have very high self-efficacy, the administration of the institution should promote faculty development as deemed needed by the teachers to further improve their skills set. They should undergo reimmersion and seminars on the importance of the pedagogy of education as most college science teachers do not have formal background in teaching education. Further studies should also be conducted to determine the self-efficacy of the teachers in the other fields in tertiary education.

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