INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2021, Vol. 2, No. 10, 870 – 881
http://dx.doi.org/10.11594/ijmaber.02.10.03

Research Article

Assessment of Science, Technology, Engineering and Mathematics Strand of the K-12 Program among Selected Public Schools in Zone 2 Division of Zambales

Lyra Castillo Honrado[1]* and Adelia D. Calimlim[2]

[1]New Taugtog National High School, Department of Education, Taugtog, Botolan Zambales, Philippines
[2]President Ramon Magsaysay State University, Iba Zambales, Philippines

Article history:
Submission October 2021
Revised October 2021
Accepted October 2021

**Corresponding author:*
E-mail:
lyra.honrado@deped.gov.ph

ABSTRACT

The study determined the impact of the STEM Strand implementation of senior high schools in the Division of Zambales. The study was limited to fifty secondary public-school teachers in Zone II.The study revealed that majority teacher-respondents, are generally young with only a minimum number of trainings attended. STEM trends, there were more males than females and a larger are married. There were no significant differences in the success of the STEM schools in Palauig, Botolan and Iba in the following domains: college preparation; integrated and innovative technology use; STEM-rich informal experiences; connections with industry and the world of work; well-prepared STEM teachers and professionalized teaching staff and positive school community and culture of high expectations for all. Based on the summary of findings and the conclusions arrived at, the researcher has offered the following recommendations that professional learning in the form of learning action cells and lesson study should be provided to relatively novice STEM teachers in order to expose them to effective instructional strategies and impact their actual classroom practices as opposed to cascading in-service trainings. Greater involvement of these partners through planning, implementation, and review should be targeted instead of only involving them for immersion activities. A more intensive evaluation of the STEM implementation following the Context-Input-Process-Product approach should be conducted to strengthen and confirm the findings of the study. A more study that would monitor the whole system as opposed to the present investigation's focus on teacher perception would lend greater credence to the results.

Keywords: *Assessment of science, K-12 program, stem strand, public schools, Zone 2, Zambales.*

How to cite:
Honrado, L. C. & Calimlim, A. D. (2021). Assessment of Science, Technology, Engineering and Mathematics Strand of The K-12 Program Among Selected Public Schools in Zone 2 Division of Zambales. *International Journal of Multidisciplinary: Applied Business and Education Research*. *2* (10), 870 – 881. doi: 10.11594/ijmaber.02.10.03

Background

The inclusion of the Science, Technology, Engineering, and Mathematics (STEM) Strand in the Academic Track of the Department of Education (DepEd) Senior High School Curriculum was actually in accordance with the provisions of the 1987 Philippine Constitution. The emphasis in mathematics and science, as evidenced by the different DepEd policies geared at massive improvement in the field, has been existent for quite some time now. This was due to the widespread belief that an advanced science and technology sector would eventually bring progress to the nation.

The second year of implementation during School Year 2017-2018 of the Senior High School, particularly the STEM strand, requires a careful examination on whether the new prescribed curriculum has so far attained its goals and whether it needs improvement or revision.

It goes without saying that any curriculum change initiative must be backed by careful evaluation. It must be remembered that massive inputs in terms of teachers, equipment, and materials have already been made in the past few years. The sheer magnitude of resources used must be matched by desired outcomes for our learners.

Moreover, while the STEM curriculum has been carefully studied prior to implementation, no curriculum was perfect. And with a careful analysis of the actual student outcomes in relation to the desired outcomes, the areas for improvement can be identified. But on the other hand, aside from the challenges faced by the implementers, successes must also be celebrated and duplicated. This study will be able to satisfy both the implementers and the teachers.

Today, knowledge and information were emphasised more, and more knowledge is more specialised and is expanding, and information and communication technology influence the way of working and communicating (Binckly et al., 2012). Therefore, workers in the STEM field need new knowledge and skills, such as flexibility, multidisciplinary problem-solving, teamwork and communication (Partnership for 21st Century Skills, 2009). In response to these developments, STEM education in several countries is changing as well. First, education is being changed by putting an emphasis on the promotion of positive attitudes towards STEM and by efforts to increase the number of students choosing STEM courses and careers in several countries (Bettinger, 2010). Second, more emphasis is given to twenty-first century skills that emphasise the connection of classroom knowledge with the outside world (Krapp & Prenzel, 2010). In order to meet these new demands, it is not only necessary to keep students motivated, but also to increase motivation for STEM among groups of students who usually do not choose STEM (Angell et al., 2003).

Significance of the Study

This study determined the teaching competence of STEM teachers and identified the contributory factors to the successful implementation of the STEM program from the secondary schools in Zone 2 Division of Zambales. Results of this study were of utmost importance to the school officials, teachers, students, researchers, parents and policy makers.

The STEM Strand was one of the crown jewels of the Senior High School Program determined its impact among teachers at this early juncture would allow curriculum planners and instructional leaders to identify possible flaws and made necessary adjustments in its implementation.

School Administrators. It was also important to find out the contributory factors to the successful implementation of the STEM program. The results of this study became instrumental in deciding for instance to allocate more resources into the problematic areas and to ensure that the school personnel were fully equipped to handle the requirements of the program.

Teachers. The result of this study pushed them to pursue further studies related to their fields. This enabled them to device and employ better instructional methods and techniques to improve their performance.

Students. With an improved level of competence of the Senior High School Instruction, students received higher quality of STEM education and they would be motivated to exert maximum effort in their studies.

Researcher. This investigation shed light and contributed to theory building which was related to teaching competence. Likewise, it served as baseline information for the construction of rating scales and other evaluating materials to determine the level of successful implementation of STEM education.

Local Government and Stakeholders. The findings of this study informed the local government units and other stakeholders what interventions or assistance they could extend to individual schools and the whole schools division in general.

Finally, this was the first attempt to evaluate a curricular program at the local level. This was a necessary first step in evidence-based decision making at the policy level.

As the Senior High School Program was still in its infant stages, it was necessary to find out problems on the one hand and the bright spots on the other. The results of this study provided a clear baseline from which to base possible improvements.

Statement of the Problem

This study intended to determine the general impact of the STEM Strand implementation of selected public senior high schools in the Division of Zambales. Specifically, it was attempted to answer the following questions:

1. How may the teacher-respondents be described in terms of the following profile variables:
   1.1 Age;
   1.2 Sex;
   1.3 Status;
   1.4 Educational Attainment;
   1.5 Number of Trainings and
   1.6 Subjects taught in STEM?
2. How may the implementation of STEM Strand in the Senior High Schools be described in terms of:
   2.1 college preparation;
   2.2 reform instructional strategies;
   2.3 integrated and innovative technology use;
   2.4 STEM rich informal experiences;
   2.5 connections with industry and the world of work;
   2.6 dynamic assessment systems for continuous improvement;
   2.7 well-prepared STEM teachers and professionalized teaching staff and
   2.8 positive school community and culture of high expectations for all?
3. Is there a significant relationship in the implementation of the STEM strand as the described domains in the problem no.2:
   3.1 college preparation;
   3.2 reform instructional strategies;
   3.3 integrated and innovative technology use;
   3.4 STEM rich informal experiences;
   3.5 connections with industry and the world of work;
   3.6 dynamic assessment systems for continuous improvement;
   3.7 well-prepared STEM teachers and professionalized teaching staff and
   3.8 positive school community and culture of high expectations for all?

Scopes and Limitations

The study determined the impact of the STEM curriculum in the implementing schools in the Division of Zambales through the perceptions of teachers.

The study limited to the survey instrument designed to collect general information regarding the implementation of STEM strand in public secondary schools. Since this study conducted only during Quarter 1 of School Year 2018-2019 and since it's not the purpose of the study to do a long-term analysis of the STEM implementation, the survey questions had been narrowed to the eight domains as stated above. Secondly, the researcher predicated this study on the assumption that the responses in the self-reported surveys would be truthful and free of bias.

The conclusions and recommendations generated based on findings of this study found true only for the respondent schools.

The respondents in the study included the teachers STEM implementers in the municipalities of Zone II, Division of Zambales. These include four (4) public SHSs, namely: Botolan

National High School, New Taugtog National High School, Zambales National High School and Rofulo Landa National High School. These schools included in the list of recognized Senior High Schools that offered STEM strand since School Year 2016-2017.

Methods

Research Design

This study determined the impact of the implementation of the STEM strand in selected public Senior High Schools in Zambales as perceived by the SHS STEM teachers. It also determined whether there is a significant relationship in the perceptions of teachers and profile variables as to the implementation of the STEM strand.

Towards the attainment of these goals, the descriptive quantitative survey design was selected. Since the intent of the study is to seek the perceptions of a large percentage of a target population, the chosen of this design, characterized by the inclusion of as many respondents as possible.

Survey research is a specific type of field study that involves the collection of data from a sample of elements drawn from a well-defined population using a questionnaire. Studying a representative sample through field research is relatively easy and surprisingly practical. Using the basic tenets of probability theory, survey researchers have developed several efficient strategies for drawing representative samples that are easy to contact. And when samples have been selected in such a manner, social psychologists can confidently generalize findings to the entire population (Visser et al., 2014).

A map of the research locale is presented below.

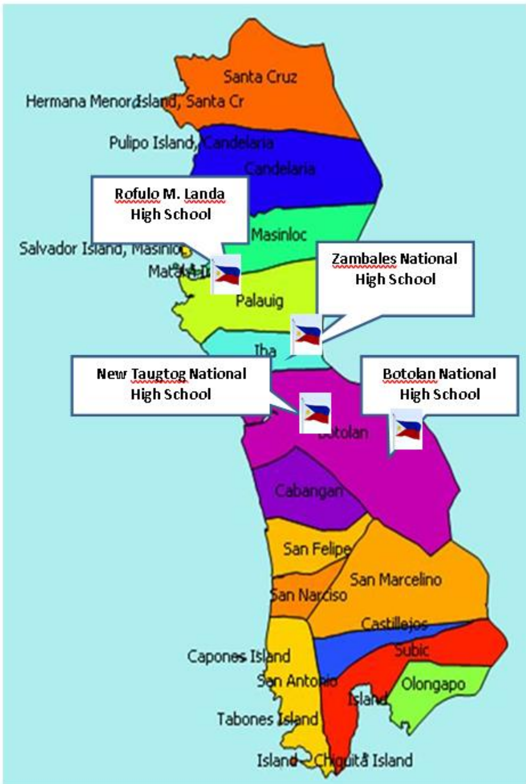

Figure 1. Map of Zone II, DepEd Zambales

Respondents and Location

The target population of this study were the teachers of the six public senior high schools (SHSs) that have offered the Science, Technology, Engineering and Mathematics (STEM) Strand since the first year up to the present of

SHS implementation in the School Year 2016-2017 and 2018-2019.

The research locale is the clustered municipalities of Palauig, Iba and Botolan. There are four public senior high school implementers of STEM. These include Rofulo M. Landa High School, Zambales National High School, New Taugtog National High School and Botolan National High School.

Out of this population, a cluster sample selected to compose 50 SHS STEM Teachers. From among the 6 STEM implementers in the province, the four SHSs from the municipalities of Iba, Botolan, and Palauig conveniently selected. From these four schools, 50 SHS STEM Teachers were randomly selected.

Instruments

The STEM Inventory, adopted from the Project Opportunity Structures for Preparation and Inspiration (OSPrI) by the George Washington University, was the primary instrument that would be used to answer the research questions in the present study.

The instrument was used originally in the in-depth qualitative case studies of inclusive science high schools (ISHSs) in the US. Their research team identified 14 critical components that characterize the ISHSs developed it into a STEM Inventory that a school can use to improve its STEM education program. The STEM Inventory would provide an overview of the STEM opportunities offered to students and suggest areas for growth and improvement.

For the purpose of the present impact assessment, only eight (8) components would be used, namely: college preparation; reform instructional strategies; integrated and innovative technology use; STEM rich informal experiences; connections with industry and the world of work; dynamic assessment systems for continuous improvement; well-prepared STEM teachers and professionalized teaching staff; and positive school community and culture of high expectations for all.

Data Collection

Initially, the researcher should seek permission to float the two questionnaires from the Office of the Schools Division Superintendent, DepEd Division of Zambales. The questionnaires then would be personally administered to the randomly selected participants in their schools in June 2018. This was to ensure a high degree of retrieval of the survey instruments.

In accordance with the universal ethical standards of conducting research, the voluntary informed consent of the research participants would be observed. The purpose, benefits, and possible risks, of the study, especially the need for participants' inclusion, would be adequately explained prior to the administration of the instruments. In addition, participants would be informed of their right to withdraw from the study at any point and would be honored throughout the duration.

The researcher recognized that the participants were entitled to privacy and thus would hold participants' data in anonymity and confidentiality unless they specifically and willingly waive this right in writing.

In order to minimize discomfort of participants in the study, the researcher personally, administered the instruments in their stations. Care would be taken to ensure that their participation in the study would not, in any way, interfere with their regular functions. Their teaching schedules would be gathered beforehand to minimize disruption of their routines in schools.

Full compliance with the highest standards of research would be observed in the study. The researcher would not resort to falsifying research findings, sensationalizing findings in a manner that sacrifices intellectual capital for maximum public exposure, nor to distorting findings by selectively publishing some aspects and not others.

Data Analysis

Quantitative data on the domains of the STEM inventory would be analyzed by computing the means and standard deviations of the individual total scores as well as the means and standard deviations for each of the domains. Data was analysis for inferential and descriptive statistics used both Statistical Package for

Social Sciences (SPSS) version 22 and Microsoft Excel.

The statistical tools used in the analysis and interpretation of data and hypotheses testing included the following:

Frequency and Percent Distribution. This was employed to determine the frequency counts and percentage distribution of the raw scores of the respondents.

Percentage – This was used to determine the frequency counts and percentage distribution of personal related variables of the respondents using the formula:

Percentage (%) = F/N x 100
Where: % = percentage
F = Number of observation
N = Total Number of Respondents

Weighted/Arithmetic Mean. This was utilized to determine the average of the responses using the formula:

WM = Wi x F / N
Where:
WM = Weighted Mean
Wi = Weighted Scale
F = Frequency
N = Total Number of Respondents

Interpretation of Data

Likert (1932) developed the principle of measuring attitudes by asking people to respond to a series of statements about a topic, in terms of the extent to which they agree with them, and so tapping into the cognitive and affective components of attitudes.

Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions. These ordinal scales measure levels of agreement/disagreement (Bowling, 1997).

A Likert-type scale assumes that the strength/intensity of experience is linear, i.e. on a continuum from strongly agree to strongly disagree and assumes that attitudes can be measured. In its final form, the Likert Scale is a five (or seven) point scale which is used to allow the individual to express how much they agree or disagree with a statement.

The survey questionnaire responses were analyzed using the rating scale analysis below:

Table 1. Rating Scale Analysis of the STEM Questionnaire

Rating Scale Analysis of the STEM Questionnaire

Arbitrary Values	Statistical Limits	Verbal Description for the Status of Agreement/Disagreement
5	4.20 – 5.00	Strongly Agree
4	3.40 – 4.19	Agree
3	2.60 – 3.39	Undecided
2	1.80 – 2.59	Disagree
1	1.00 – 1.79	Strongly Disagree

Standard Deviation. Since the mean was chosen as the measure of center, this was used to measure the spread of how far the observations were from their mean. It was the square root of the variance.

MANOVA. This was used in determining if there was a significant difference between the two or more groups of respondents.

To test the null hypotheses, the significance of the obtained t-value or Multivariate Analysis of Variance (MANOVA) or F value had been determined by referring to the tabular value of t and F, respectively. If the observed value of t or F equals or exceeds the value of the table, the observed value is significant at the level indicated. The null hypothesis can therefore be rejected. On the other hand, the observed value of t or F is smaller than or does not come up to the values of the table, the null hypothesis is accepted.

Decision Rule

The hypothesis would be tested using the t-test at the 95% level of confidence. The null hypothesis would be tested and if the p-value obtained is less than 0.05, then the null hypothesis would be rejected. However, if the p-value obtained is greater than 0.05, then the null hypothesis would be accepted.

Result and Discussion

This chapter presents the gathered and processed data in a tabular form, analyzed and provided interpretation in order to give a clear and better understanding on the problems asked in earlier Chapter 1.

Significant Difference of Means in Critical Domains of STEM Implementation Due to Profile Variables

This part explored the possible relationship between profile variables to key components of STEM implementation. The independent variables included sex, civil status and teaching experience. Meanwhile the dependent variables included reform instructional strategies, dynamic assessment systems and well-prepared teachers.

1. Sex A multivariate analysis of variance (MANOVA) was conducted in order to determine if sex significantly affected the means for reform instructional strategies, dynamic assessments systems, as well as well-prepared teachers.

Table 2. Descriptive Statistics according to Sex

	Sex	Mean	Std. Deviation	N
Reform Instructional Strategies	Male	4.5370	.38844	27
	Female	4.5174	.38806	23
	Total	4.5280	.38441	50
Dynamic Assessment Systems for Continuous Improvement	Male	4.4741	.38490	27
	Female	4.4000	.39543	23
	Total	4.4400	.38756	50
Well-Prepared Teachers and Professional Teaching Staff	Male	4.3852	.41944	27
	Female	4.4435	.52728	23
	Total	4.4120	.46801	50

As can be seen from Table 2 above, there is a seeming difference in the means of male (N = 27) and female (N = 23) respondents as far as the three domains are concerned. The standard deviations are equal among the two sexes across the domains.

Table 3 below shows the MANOVA results. Despite the differences in the means, there was no statistically significant difference in reform instructional strategies, dynamic assessment systems and well-prepared teachers based on respondents' sex, F (3, 46) = 0.665, $p = 0.578 > 0.05$; Wilk's $\Lambda = 0.958$, partial $\eta^2 = 0.042$. This means that the scores of teachers in the three domains are unaffected by sex.

Table 3. Multivariate Tests for Sex

Effect		Value	F	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.995	3077.155^b	46.000	.000	.995
	Wilks' Lambda	.005	3077.155^b	46.000	.000	.995
	Hotelling's Trace	200.684	3077.155^b	46.000	.000	.995
	Roy's Largest Root	200.684	3077.155^b	46.000	.000	.995

	Effect	Value	F	Error df	Sig.	Partial Eta Squared
Sex	Pillai's Trace	.042	.665b	46.000	.000	.042
	Wilk's Lambda	.958	.665b	46.000	.000	.042
	Hotelling's Trace	.043	.665b	46.000	.000	.042
	Roy Largest Root	.043	.665b	46.000	.000	.042

This finding contrasts with research that indicates that there are significant differences between the two sexes as far as instructional self-efficacy and performance is concerned (Klassen & Chiu, 2010). That female teachers had greater workload stress, greater classroom stress from student behaviours, and lower classroom management self-efficacy. However, the similarity between the sexes in the present study can perhaps be attributed to strong gender parity policy in the STEM implementers in the target municipalities. This has led to a seeming equality between the sexes even though STEM used to be a male-dominated program.

2. Civil Status A multivariate analysis of variance (MANOVA) was also conducted in order to determine if civil status significantly affected the means for reform instructional strategies, dynamic assessments systems, as well as well-prepared teachers.

Table 4 presents the descriptive statistics of the respondents grouped according to civil status. It can be gleaned that among the three categories, there is seeming difference in the means of males (M = 4.50, SD = 0.372) and females (M = 4.39, SD = 0.398) as far as dynamic assessment systems is concerned.

Table 4. Descriptive Statistics for Civil Status

	Status	Mean	Std. Deviation	N
Reform Instructional Strategies	Single	4.5238	.42884	21
	Married	4.5310	.35667	29
	Total	4.5280	.38441	50
Dynamic Assessment Systems	Single	4.5048	.37212	21
	Married	4.3931	.39815	29
	Total	4.4400	.38756	50
Well-prepared teachers	Single	4.4286	.36489	21
	Married	4.4000	.53652	29
	Total	4.4120	.46801	50

However, the following Table 5 shows the MANOVA as regard civil or marital status. As in the respondents' sex, there was no statistically significant difference in reform instructional strategies, dynamic assessment systems and well-prepared teachers based on civil status, F (3, 46) = 0.464, p = 0.709 > 0.05; Wilk's Λ = 0.971, partial η2 = 0.995. This result signifies that the null hypothesis that the means in reform instructional strategies, well prepared teachers and dynamic assessment systems are not significantly different.

Table 5. Multivariate Tests[a]

Effect		F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	3025.369b	3.000	46.000	.000	.995
	Wilks' Lambda	3025.369b	3.000	46.000	.000	.995
	Hotelling's Trace	3025.369b	3.000	46.000	.000	.995
	Roy's Largest Root	3025.369b	3.000	46.000	.000	.995

	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Status	Pillai's Trace	.464[b]	3.000	46.000	.709	.029
	Wilks' Lambda	.464[b]	3.000	46.000	.709	.029
	Hotelling's Trace	.464[b]	3.000	46.000	.709	.029
	Roy's Largest Root	.464[b]	3.000	46.000	.709	.029

These results are parallel with (Odanga et al., 2015) the influence of marital status on teachers' self-efficacy was not significant. However, this finding differs with that of reported that there was a significant influence of marital status on teachers' self-efficacy in favor of the married teachers (islahi & Nasreen, 2013). It was also contrary to those study findings that indicated that there was a significant influence of marital status on teachers' self-efficacy in favor of the single (Tyagi, 2013).

While there is the general belief that married teachers in the Philippines are generally more stable and satisfied with their jobs, it now appears that civil status does not affect the teachers' contribution to the success of STEM implementation.

3. Number of Trainings Attended Finally, a MANOVA was similarly conducted in order to find out if the number of trainings significantly affected the means for reform instructional strategies, dynamic assessments systems, as well as well-prepared teachers.

Table 6 shows the number of trainings attended by the respondents of the study. There are comparable values between the means of different domains. What is interesting is whether the differences between the means are statistically significant.

Table 6. Descriptive Statistics for Number of Trainings

	No. of Trainings	Mean	Std. Deviation	N
Reform Instructional Strategies	No Training	4.7667	.42740	6
	1 Training	4.4739	.40476	23
	2 Trainings	4.4950	.33003	20
	3 or more Trainings	5.0000		1
	Total	4.5280	.38441	50
Dynamic Assessment Systems	No Training	4.5333	.37238	6
	1 Training	4.3826	.38571	23
	2 Trainings	4.4600	.40575	20
	3 or more Trainings	4.8000		1
	Total	4.4400	.38756	50
Well-prepared teachers	No Training	4.5000	.51381	6
	1 Training	4.3174	.42603	23
	2 Trainings	4.4750	.50977	20
	3 or more Trainings	4.8000		1
	Total	4.4120	.46801	50

The result of the test of significance (MANOVA) for this question is shown in Table 7 below. As in the respondents' sex and civil status, there was no statistically significant difference in reform instructional strategies, dynamic assessment systems and well-prepared teachers based on number of trainings, $F(3, 44) = 0.690$, $p = 0.716 > 0.05$; Wilk's $\Lambda = 0.872$, partial $\eta 2 = 0.995$. What this implies is that despite being seemingly commonsensical, there is no significant difference in means due to the number of trainings. This means that the trainings that the teacher respondents attended did not significantly affect their school's implementation of the STEM strand.

Table 7. Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.983	865.986[b]	3.000	44.000	.000
	Wilks' Lambda	.017	865.986[b]	3.000	44.000	.000
	Hotelling's Trace	59.045	865.986[b]	3.000	44.000	.000
	Roy's Largest Root	59.045	865.986[b]	3.000	44.000	.000
No.ofTrainings	Pillai's Trace	.131	.702	9.000	138.000	.706
	Wilks' Lambda	.872	.690	9.000	107.235	.716
	Hotelling's Trace	.143	.678	9.000	128.000	.727
	Roy's Largest Root	.108	1.657[c]	9.000	46.000	.189

a. Design: Intercept + No. of Trainings

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

It must be mentioned that the trainings provided by the Department of Education followed the "Cascade" Method. This method of echoing national trainings to the regional level and then down to the division level, is still largely used for in-service training, as it can deliver many trained teachers quickly and economically. However, despite of its advantages, it is often criticized for its ineffectiveness, because the message is often distorted through long-distanced one-way process, and it hardly makes change at classroom.

This weakness of the cascade model of in-service training, the only one that the Department of Education can afford at the moment, explains why the increased number of trainings are not translated to better STEM implementation as described in terms of reform instructional strategies, dynamic assessment systems and well prepared teachers.

Conclusion and Recomendation

Summary

For Research Question No. 1, The frequencies and percentage distribution were used to describe the demographic profile of the respondents. The same statistics were computed for the performance ratings of the teacher respondents in Research Question No. 3.

For Research Question No. 2, means and standard deviations were calculated to determine the levels of self-efficacy in its three domains, namely: college preparation; reform instructional strategies; integrated and innovative technology use; STEM rich informal experiences; connections with industry and world of work; dynamic assessment system for continuous improvement; well-prepared STEM teachers and professionalized teaching staff; positive school community and culture of high expectations for all.

In Research Question No.3, the multivariate analysis of Variance (MANOVA) were computed to test for differences among the demographic profiles of sex, number of prior trainings attended.

Conclusions

Based on the findings, the following conclusions were drawn:

1. The senior high school STEM teachers in Botolan, Iba, and Palauig are generally relatively young (a clear majority falling under the classification of early adulthood) with only a minimum number of trainings attended. Surprisingly, but in consonance with global STEM trends, there were more males than females. And larger percentages are married.
2. Based on teacher perceptions, the initial implementation of the STEM strand of the senior high school curriculum has been successful. While there are significant rooms for improvement, there is high confidence that the four (4) STEM implementers in Botolan, Iba, and Palauig have what it takes to succeed in STEM.
3. Among the domains of successful STEM implementation, there is a need to increase ties with the community in general and

with STEM related industries. There is also a need to improve the college preparation provided by the schools to its students. There were no significant differences in the success of the STEM schools in Palauig, Botolan and Iba in the following domains:

a. college preparation?
b. reform instructional strategies?
c. integrated and innovative technology use?
d. STEM rich informal experiences?
e. connections with industry and the world of work?
f. dynamic assessment systems for continuous improvement
g. well-prepared STEM teachers and professionalized teaching staff?
h. positive school community and culture of high expectations for all?

Recommendations

Based on the conclusions, the following recommendations are forwarded:

1. Professional learning opportunities in the form of learning action cells and lesson study should be provided to relatively novice STEM teachers in order to expose them to effective instructional strategies and impact their actual classroom practices as opposed to cascading in-service trainings.
2. The relative success of the implementation of STEM in the four participating schools should be taken with grain of salt. It is perhaps wise to dwell on the best practices of these schools so that these can be replicated by prospective implementers. And administrators and supervisors should look forward to continuous improvement.
3. Memoranda of agreement (MOA) and/or Memoranda of Understanding (MOU) with industry partners should be reviewed in order to maximize collaboration. Greater involvement of these partners through planning, implementation, and review should be targeted instead of only involving them for immersion activities.

A more intensive evaluation of the STEM implementation following the Context-Input-Process-Product approach should be conducted to strengthen and confirm the findings of the study. A more longitudinal study that would monitor the whole system as opposed to the present investigation's focus on teacher perception would lend greater credence to the results.

Acknowledgement

I would like to express my deepest thanks and jovial gratitude to the following persons who had extended their strenuous support and contributed their knowledge and expertise to make this study possible:

Dr. Domingo C. Edaño, the Director of Graduate School, for his advices and guidance;

Dr. Thelma Q. Meer, Dr. Novrina Bigilda A. Orge and Mr. Federico R. Ganaden, my panelists, for the technical and workable feedback which allowed my research to move forward;

Ms. Adelia D. Calimlim, my thesis adviser, for the unwavering support, insightful comments, and remarks in the development of the study;

Dr. Edna Marie A. Punzalan, for her expertise in Statistics;

Dr. Geofrey S. Sepillo, for patiently sharing his technical expertise;

Dr. William Roderick R. Fallorin, EPS in Math and Ms. Rea Araña, for their untiring help by giving an inspirational advice and support;

RMTU Professors in MAED, for their encouragement to continue;

Dr. Romeo A. Alip, CESO V, Schools Division Superintendent and to the School Principals of Rofulo Landa National High School, Zambales National High School, Botolan National High School and New Taugtog National High School for their approval to conduct this study;

Teacher – Respondents from the secondary schools of Zone 2, who had willingly shared their precious time in answering the questionnaires;

My family, NTNHS Community and friends, for the inspiration to finish this study;

References

Angell, C., Guttersrud, Ø., Henriksen, E. K., & Isnes, A. (2003). Physics: Frightful, but fun—Pupils' and teachers' views of physics and physics teaching. Science Education, 88(5), 683–706.

Atkinson, R. D., & Mayo, M. (2010). Refueling the U.S.: Refresh approaches to science, technology, engineering and mathematics (STEM) education. Resource document. The Information Technology and Innovation Foundation, Washington, DC.

Bettinger, E. (2010). To be or not to be: Major choices in budding scientists. In C. T. Clotfelter (Ed.), American universities in a global market (pp. 69–98). Chicago: University of Chicago Press.

Binckly, M., Erstad, O.,Herman, Miller-Ricci, M., J.,Raizen, M., & Rumble, M. (2012). Defining twentyfirst century skills. In Assessment and teaching of 21st century skills. doi 10.1007/978-94-007-2324-5_2.

Binckly, M., Erstad, O.,Herman, Miller-Ricci, M., J.,Raizen, M., & Rumble, M. (2012). Defining twentyfirst century skills. In Assessment and teaching of 21st century skills. doi 10.1007/978-94-007-2324-5_2.

Bowling, A. (1997) Research Methods in Health. Buckingham: Open University Press

Islahi, F. and Nasreen, N.,2013. Universal Journal of Educational Research, v1 n4 p.285-293.

Klassen , R. M., & Chiu, M. M. (2010) . Effects on teachers' self- efficacy and job satisfaction: Teacher gender, years of experience, and job stress. Journal of EducationalPsychology, 102(3), 741-756.

Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods and findings. International Journal of Science Education, 33, 27–50.

Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods, and findings. International Journal of Science Education, 33, 27–50.

Odanga S., Raburu, P., & Aloka, P., (2015). Academic Journal of Interdisciplinary Studies: Influence of Gender on Teachers' Self-Efficacy in Secondary Schools of Kisumu County, Kenya, E-ISSN 2281-4612 ISSN 2281-3993.

OECD. (2006). The Organization for Economic Cooperation and Development: Evolution of student interest in science and technology studies policy report.

Partnership for 21st Century Skills (2009). A Framework for Twenty - First Century Learning.

Tyagi, A., (2013). Department of Materials Science Programme: Electrocatalytic activity of nano carbon forms.

Visser, P., Krosnick, J., & Lavrakas, P. (2014). Survey Research. In H. Reis, & C. Judd (Eds.), *Handbook of Research Methods in Social and Personality Psychology: Second Edition.* Cambridge University Press.

Voogt, J., & Roblin, N. P. (2010). Discussion paper: 21st century skills.