International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Enhancing Science Curriculum in Technical Vocational Education: A Study in the Philippines

Cheryl Ann F. Gicana

College of Education, Arts and Sciences, Capiz State University-Pontevedra, Capiz, Philippines Telefax No. (036) 6340-144 Telephone No. (036) 6340-144, 09989759902,
Email: *cafgicana[at]capsu.edu.ph*

Abstract: ***The Strengthened Technical Vocational Education program is a curriculum specifically followed by secondary technical-vocational schools in the Philippines. Technical Vocational Education (TVE) as a subject contains many competencies that are science-based. Therefore, one of the ways of augmenting students' performance in their TVE subject is to help them improve their science competence. This study aimed at enhancing the science curriculum of the Strengthened Technical-Vocational Education Program of the secondary technical-vocational schools in Aklan, Antique, Capiz, Kalibo, Iloilo, and Negros Occidental provinces. Results showed that, in terms of their performance in the National Competency assessment, secondary arts and trades school and secondary fisheries school performed "Satisfactorily", while it was found out that for three consecutive school years secondary technical-vocational schools had "No takers" of the National competency assessment. In addition, it was also revealed that many science-based topics in the TVE subjects were only "Partially mastered" by students while few topics were "Moderately mastered". From the identified least mastered TVE competencies, science topics that were found suited to them were also identified. These science topics included: cell structure and function, human digestion, health and nutrition, spoilage of food, basic personal hygiene practices, electricity, conversion of units, plant classification and morphology, and animal classification and morphology.***

Keywords: Technical and Vocational Education, Science Curriculum, Students' performance

1. Introduction

In the recent implementation of the K to 12 curricula in the Philippines, an emphasis is given to the secondary technical vocational high schools. In fact, technical vocational education is one of the tracks to be offered during the Grades 11 and 12 of the Senior high school. With this, it is very obvious that the government realized the importance of technical skills that could help students improve their lives. But before they (the students) can do this they first have to pass the National Competency assessment.

The researcher being a faculty and a science teacher of a secondary technical vocational school has thought of a way that could help improve the performance of students. Science is everywhere. It is inculcated in all subjects being a body of knowledge. Every skill that will be developed among students would always have an accompanied science concepts that would help students understand the skill deeper. In every technology that students will encounter in their TVE class would always have an accompanied scientific concept. As Lankard (1993) states that helping students learn more about science and technology and become more skilled at problem solving and analysis has been the goal of recent educational efforts. Many of these initiatives involve integration of academic subjects with vocational education. In this way, students have the opportunity to apply their academic knowledge to specific occupational tasks and to solving problems typically encountered in business and technical fields.

Students who have advanced knowledge in science content would find it easier and be able to explain a certain skill, procedure or concept behind a certain technical-vocational skill. With this, the researcher finds it necessary to enhance students' science knowledge to help improve their TVE competence. Hence, this study.

2. Statement of the Problem

This study aimed to enhance the science curriculum of the strengthened technical vocational education program. Specifically, it sought to answer the following questions:

1) What is the level of national competency performance of the technical vocational schools for the past three school years?
2) What is the level of national competency performance of technical vocational schools when classified according to:
   a) Arts and Trades School
   b) Agriculture School
   c) Fishery School
3) What unit of competencies in TVE subjects showed to be least learned by the students?
4) What scientific principles or concepts could be integrated in the least mastered competencies of TVE subject?

This study was conducted to enhance the science curriculum of secondary technical-vocational (tech-voc) schools. To this end, science instructional materials were produced. These science instructional materials contain topics with classroom activities which are anchored on the least mastered competencies of TVE subjects of technical-vocational schools.

In producing a reliable and quality science resource material this research followed the ADDIE Instructional Design Model illustrated in Figure 1.

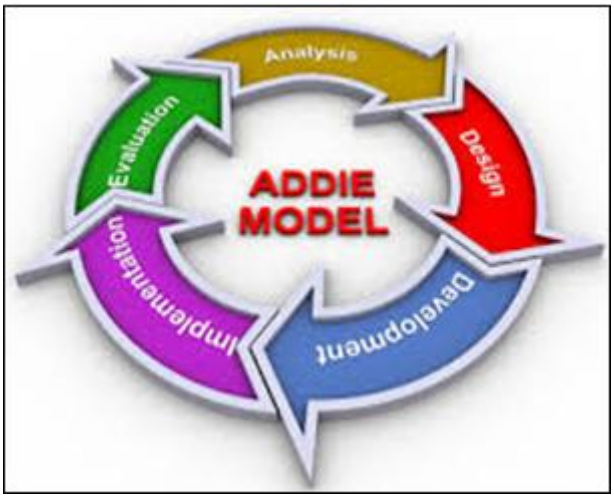

Figure 1: The ADDIE Instructional Design Model

The ADDIE model is an acronym referring to the major processes that comprise the generic processes: Analysis, Design, Development, Implementation, and Evaluation. This model provides instructional designers with a framework in order to make sure that their instructional products are effective and that their creative processes are as efficient as they can possibly be. In short, it aims to ensure that learning does not occur in a haphazard manner, but is developed using a process with specific measurable outcomes (Davis, 2013).

ADDIE is a five-step instructional model used to develop units for training within larger workshops. As an instructional design model or IDM, ADDIE was described initially in 1975. ADDIE is used to remind instructors about how to plan their workshops and courses. IDMs, such as ADDIE, are popular in the private sector and in industry-based training. The goal of instructional design is to ensure quality, consistency and effectiveness of learning and also to support the philosophical orientation of instructors and learners. One of the challenges of current design is to incorporate forms of social learning and other interactive pedagogies into classes.

3. Methodology

The researcher employed varied steps in conducting the study. The study utilized a researcher-made multiple-choice test to determine the least mastered competencies in TVE subjects. Survey is a systematic gathering of data for a particular purpose from various sources, including questionnaires, interviews, observations, existing records and electronic devices. The process is usually preliminary to statistical analysis of the data (Dictionary, 2013).

The participants in this study came from secondary technical-vocational schools in Aklan, Antique, Capiz, Iloilo and Negros Occidental, all are provinces in the Western Visayas part of the Philippines. A secondary technical-vocational school may either be an Arts and Trades school, Agriculture school, and Fishery school. Each these school has its own different fields of specialization being offered to students.

For Arts and Trades technical-vocational schools the following fields of specialization are being offered: Electricity, Electronics, Automotive, Furniture and Cabinet Making (FCM), Shielded Metal Arc Welding (SMAW), Drafting, Food Trades, Cosmetology, Garments, and Internet Computer Fundamentals (ICF).

Agriculture schools offers Horticulture, Animal Production, Agricultural Crop Production, and Food/Fish Processing while secondary fishery schools offer Fish Capture, Food/fish processing and Fish Culture.

This study involved the school administrator/Principal/technical-vocational department head teacher and the fourth year / grade 10 students taking up technical-vocational training to each of their field of specialization. Table 1 below shows the secondary technical-vocational schools in Aklan, Antique, Capiz, Iloilo and Negros Occidental.

Random selection was used in identifying the respondents of the study. First, stratified sampling was made which grouped schools into three – arts and trades, agriculture, and fishery. Slovin's formula was used in identifying the number of schools that would be involved in this study. Once the number of schools to be included was attained, fishbowl technique was employed to determine which specific school would serve as respondent schools for the three types of technical-vocational schools.

The researcher used a researcher-made test questionnaire to determine the least mastered STVE competencies listed in the Technical Key Competencies for technical-vocational secondary schools. The test was composed of science items which are found in the competencies of the TVE subject.

For each field of specialization, the researcher examined which competencies were found to be common to all the courses offered in each specialization. Then, science test items were developed, anchored or based on these common competencies. One questionnaire was made for each specific type of technical-vocational school. The said researcher-made test questionnaires were subjected to validation by the following: (1) an Education Program Supervisor in Science, (2) a Master Teacher in Science, (3) an expert in Agriculture who is also teaching in technical-vocational school, (4) An expert in Fishery and a Faculty of higher education, and (5) Faculty of Arts and Trades technical vocational school.

The researcher-made tests, after revision, were then distributed to three different technical-vocational schools for pilot testing and were subjected to item analyses. The researcher-made tests were then subjected to reliability test to ensure test validity. The three types of tests had Cronbach alpha values of $\alpha = 0.924$, $\alpha = 0.864$, and $\alpha = 0.845$, for Arts and Trades, Agriculture, and Fishery schools respectively.

To determine the least mastered competencies in technical vocational education subjects, the researcher summed up the total number of respondents who were able to answer the test item correctly and solved for its percentage. The test items were then categorized using the following rating scale:

Percentage of Respondents Able to Answer the test	Competency
80.01 -100.00%	Mastered
60.01 – 80.00%	Moderately Mastered
40.01 - 60.00%	Partially Mastered
20.01 – 40.00 %	Slightly Mastered
0.00 – 20.00 %	Not Mastered

The researcher also requested school administrators for data on the performance of schools in the National Competency assessment for the past three consecutive school years. The school's performance level on the National Competency Assessment was categorized as follows:

Level	Percentage of Passing	Description
I	0-20.00	Very Low
II	20.01-40.00	Low
III	40.01-60.00	Satisfactory
IV	60.01-80.00	High
V	80.01-100.00	Very High

The criteria used in describing school's level of performance in the national Competency assessment were patterned from DepEd Order #2, series 2015 as used in Guidelines on the Establishment and Implementation of the Results-based Performance Management System in the Department of Education. This was used because as of this time, the criteria for identifying school's performance, specifically those of technical-vocational schools in their performance in the National Competency assessment, has not yet been established.

The conducted this study in two phases.

Phase 1: This phase consisted of (1) the making of some preliminaries and (2) the assessment of the secondary technical vocational schools. The preliminaries in this study consisted of the following: identification of the common STVE competencies for the each type of technical-vocational schools, construction of Science test items based on the identified common competencies of the technical-vocational schools, validation of the researcher-made test by several experts in their respective fields, pilot-testing of the Science test items to establish the reliability of the test and restructuring of the Science test items in preparation for the final conduct of the study.

Furthermore, in this phase, assessment of the secondary technical-vocational schools was done. The secondary technical-vocational schools were evaluated in terms of their performance in the National Competency assessment for three consecutive school years. Moreover, students' mastery of the STVE competencies was also assessed using the validated researcher-made science test. At this stage, identification of least mastered STVE competencies in each type of technical-vocational schools was made. Based on the identified least mastered TVE competencies, the science topics were then decided. These science topics were chosen and were found to suit in the least mastered competencies of a secondary technical-vocational school.

*Phase 2:*This phase was concerned with designing, developing, implementing and evaluating the Science resource material. Based on the needs that were identified in the first phase of this study, that is the least mastered STVE competencies, a science resource material was designed. The module was made for use by teachers either: as part of the lesson or to be given to students as homework. The science resource materials were in the form of modules and were developed through several steps: the making of the researcher-made science modules, the validation of the modules by the science teachers and TVE teachers of secondary technical-vocational school through a teacher-workshop, and the revision of the modules as the comments and suggestions of science and TVE teachers were incorporated in the final version of the modules. In this phase also, pilot-testing of the developed module was undertaken to determine the acceptability of the modules by the students and the usefulness of the modules for teacher's use. After implementing the modules, students and teachers involved in the pilot-testing evaluated the modules. The evaluation process solicited students' and the teacher's ideas as feedback on the use of the modules.

This study employed descriptive statistics in the analysis of data gathered. To determine the performance of school and that of each field of specialization in the National Competency assessment, the researcher used frequencies, means and percentages. To determine the learning competencies or outcomes that were not mastered by the students, the researcher employed frequency counts and percentages.

4. Results and Discussions

This chapter is divided into two phases: (1) the assessment of the secondary technical vocational schools in Aklan, Antique, Capiz, Iloilo, and Negros Occidental (2) development of the science resource material.

Phase I, assessment of the secondary technical-vocational schools answers the first four specific objectives of the study, namely: (1) What is the level of the national competency performance of the technical-vocational schools for the past three consecutive school years? (2) What is the level of national competency performance of technical-vocational schools when classified according to: arts and trades school, agriculture school, and fishery school? (3) What units of competencies in TVE subjects are shown to be the least learned by the students? (4) What scientific principles or concepts could be integrated in the least mastered competencies of TVE subject? These served as bases in developing a science resource material anchored on the least mastered STVE competencies as a means of enhancing the science curriculum of a secondary technical-vocational school.

Phase II, development of science resource material, discusses the steps involved in developing the science modules. The modules included science topics which were found to suit on least mastered STVE competencies.

Phase I

Table 4 presents the National Competency performance of the secondary technical-vocational schools in Aklan, Antique, Capiz, Iloilo and Negros Occidental for the past three consecutive school years. It can be noted that the

secondary technical-vocational schools were are at level III with "Satisfactory" performance.

When classified according to their field of specialization, Arts and Trades schools and Fishery schools, showed a Level III ("Satisfactory") performance in the NC assessment. From the table, it can be seen that secondary Agriculture schools have no takers of the NC assessment for the past three consecutive years.

Table 3: Secondary Technical-Vocational Schools' Performance in the National Competency Assessment for the Past Three Consecutive Years

Tech- Voc School	2012- 2013	2013- 2014	2014- 2015	Over- all	
				Rating	Description
Arts and Traders					
No. of Takers	106	138	280	54.17	Satisfactory (Level III)
No. of Passers	60	57	157		
Percentage (%)	56.60	50.00	56.07		
Fishery					
No. of Takers	7	4	38	55.08	Satisfactory (Level III)
No. of Passers	3	3	18		
Percentage (%)	42.86	75.00	47.37		
Agriculture					
No. of Takers				None	Satisfactory (Level III)
No. of Passers					
Percentage (%)	None	None	None		
Over- all				54.64	

On the other hand, students' performance in the secondary technical-vocational schools was also assessed through a researcher-made science test. The results are shown in the subsequent tables.

Table 4 shows the students' level of mastery in STVE competencies for the secondary Arts and Trades schools. It can be observed that majority of the STVE topics were "Partially Mastered" (40.01-60.00%), with only one topic as "Moderately Mastered" (60.01 – 80.00).

Table 4: Mastery Level in STVE Competencies of Secondary Arts and Trades Technical-vocational Schools

STVE Competencies	Percentage of Students with Correct Answer (N=372)	Description
1) Identify causes of spoilage	41.06	Partially Mastered
2) Communicate information about personal and public hygiene	45.70	Partially Mastered
3) Perform electrical fundamentals	51.12	Partially Mastered
4) Explain the process of digestion, absorption and metabolism	52.10	Partially Mastered
5) Prevent and control spoilage of food	54.30	Partially Mastered
6) Emphasized the importance of a balanced diet	54.53	Partially Mastered
7) Identify the nutrients needed by the body, their functions and possible sources	54.93	Partially Mastered
8) Perform mensuration and calculations	55.47	Partially Mastered
9) Observe proper waste disposal	55.96	Partially Mastered
10) Recording information	58.94	Partially Mastered
11) Follow workplace procedure for health, safety and security purposes	63.91	Partially Mastered

Table 5 shows the least mastered TVE competencies in Agriculture. As shown in the table, students have "Partially Mastered" (40.01 – 60.00) their topics in their TVE subject.

Table 5: Mastery Level in STVE Competencies of Secondary Agriculture Technical-Vocational Schools

STVE Competencies	Percentage of Students with Correct Answer (N=68)	Description
1) Identify causes of food spoilage	41.50	Partially Mastered
2) Determine plant classification and Nomenclature	41.67	Partially Mastered
3) Prevent and control food spoilage	42.50	Partially Mastered
4) Classify different agents of food spoilage	43.33	Partially Mastered
5) Explain Agriculture and its branches	44.17	Partially Mastered
6) Distinguish vegetative growth, reproductive growth and development	46.25	Partially Mastered
7) Select and secure the types of breeds of farm animals to raise	47.00	Partially Mastered
8) Apply the methods and principles of food preservation	47.50	Partially Mastered
9) Identify cell structure and function	50.00	Partially Mastered

Table 6 shows the students' level of mastery in STVE competencies for secondary Fishery schools. It was found out that topics, such as analyzing different causes of food spoilage, determination of animal classification and nomenclature, and communicating information about personal and public hygiene are only "Slightly Mastered" (20.01 – 40.00) by students. The rest of the topics are

"Partially Mastered" (40.01 -60.00) by the students in secondary fishery schools.

Table 6: Mastery level in STVE Competencies of Secondary Fishery Technical-vocational Schools

STVE Competencies	Percentage of Students with Correct Answer (N=68)	Description
1) Determine animal classification and nomenclature	21.74	Slightly Mastered
2) Communicate information about personal and public hygiene	28.26	Slightly Mastered
3) Analyze different causes of food spoilage	36.78	Slightly Mastered
4) Identify non-meat ingredients and their functions	40.49	Partially Mastered
5) Perform basic estimates and calculations	41.49	Partially Mastered
6) Explain the basic morphology of fish	43.11	Partially Mastered
7) Introduce food preservation and processing	53.62	Partially Mastered

After identifying the least mastered competencies in STVE, the science topics or Science concepts were then determined. These Science topics or concepts are found to be suited to the identified least learned competencies in TVE. Table 7 shows the combined least mastered TVE competencies for Arts and Trades, Agriculture and Fishery schools and the Science topics which are found appropriate for them.

Table 7: Least Mastered Competencies in TVE and the Science topics Integrated and Included in the Science Modules

Least Mastered TVE Competencies	Science Concepts/Topics
Prevent and control spoilage of food	Spoilage of Food
Identify cause of spoilage	
Prevent and control food spoilage	
Classify different agents of food spoilage	
Perform mensuration and calculations	Unit Conversion
Perform basic estimates and calculations	
Perform electrical fundamentals	
Identify the nutrients needed by the body, their functions and possible sources	Health and Nutrition
Emphasized the importance of a balanced diet	
Explain the process of human digestion, absorption and metabolism	Human digestive System
Identify cell structure and function	Cell Structure and Function
Determine plant classification and nomenclature	Plant Classification and Morphology
Distinguish plants' vegetative growth, reproductive growth and development	
Determine animal classification and Nomenclature	Animal Classification and Morphology
Explain the basic morphology of a fish	
Communicate information about personal and public hygiene	Hygiene

5. Conclusions

From the several findings made, it can, therefore, be concluded that the secondary technical-vocational schools in Aklan, Antique, Capiz, Iloilo and Negros Occidental are striving hard to perform well in the National Competency assessment as shown by the satisfactory, and nearly high, performance in the said assessment. With the attention given to the secondary technical-vocational schools, being one of the strands in the K-12 Senior High School curriculum, it is not impossible for secondary schools to further improve in their NC assessment.

Of the three types of tech-voc schools, only the Agriculture schools have no takers for the NC assessment. This may be due to the fact that the assessment center for Agriculture is quite far from the schools where Agriculture is offered. Also if the schools would invite the assessor to come and assess the students,, the budget to shoulder the assessor's travel expenses would not be enough considering very few students are to be assessed.

Considering the number of students and the number of takers of NC assessment, Fishery and Agriculture schools have fewer students, and as some teachers would say they are decreasing in number. This may be due to the reality that Agriculture and Fishery courses have become unpopular and unattractive to students. Even schools offering agriculture and fishery specializations are diminishing. This may be due to the present demand in the job market. Most of the skills in demand today are those from the courses offered in the Arts and Trades specialization.

It can also be concluded that there are TVE competencies not mastered by some students which, if not attended, may become one of the reasons that would hinder students from passing the theoretical aspect of the NC assessment. In view thereof, science teachers and TVE teachers must address this "gap" by working together in the development of coordinated science and STVE lessons as found in the science modules.

The Science modules received a positive response among students of secondary technical-vocational schools during the pilot testing. Most of them perceived the modules to be entertaining and easy to understand. Also science teachers evaluated the modules and described their level of difficulty as suitable to the reading and understanding levels of students for whom the modules are intended to be used

References

[1] Alli, R., Villasis, S., (2012). *Human resource inventory and environmental scanning of agriculture,*

fishery and natural resources in Western Visayas, Philippines. West Visayas State University Research Journal, (1), 2

[2] Angeles, B. (2004). *Innovative strategies in technical and vocational education training for accelerated human resource*. ISBN: 978-92-9257-021-7. Retrieved from: www.adb.org/publications/innovative-strategies-tvet-accelerated--hrd-south-asia- bangladesh

[3] Bates, T. (2014) *Is the ADDIE model appropriate for teaching in a digital age?* Retrieved from:www.tonybates.ca/2014/09/09/is-the-ADDIE-model-appropriate-for- teaching-in-a-digital-age

[4] Bol, L.; Stephenson, P.L.; Nunnery J.A., (1998). *The influence of experience, grade level and subject area on teachers' assessment practices*. The journal of educational research, Vol. 91, Issue 6. Retrieved from: http://www.tandfonline.com/doi/abs/10.1080/00220679809597561

[5] Carroll, S. (2014). *Types of research designs you can use for your dissertation*. Retrieved from: www.dissertation_statistics.com/research_designs.html

[6] Caulder, J. (1991). *Classroom of the future*, keynote presentation at the National Vocational Agriculture Teacher Association National Convention, Los Angeles, CA.

[7] Davis, A. (2013). *Using instructional design principles to develop effective information literacy in instruction: The ADDIE model*. Retrieved from: http://www.instructionaldesigncentral.com/html/IDC_instructionaldesigndefinitio n.htm

[8] Dictionary, (2013). Retrieved from: http//dictionary.sensagent.com/methodology%survey/en_en

[9] Diez, M.E. (1997). *Assessment as a leader in education reform*. The honor society of Phi Kappa Phi: Celebration of Excellence, Retrieved from: http://web4.infotrac.galegroup.com/itw/informark, March 25, 2014

[10] Dyankov, A. (2013). *Current issues and trends in technical and vocational education*. Retrieved from: unesdoc.unesco.org/images/0010/001085/108579Eo.pdf, Janaury o4, 2016.

[11] Fegarido, R.B. (2005). *Performance of Dumalag vocational-technical school in the TESDA national competency assessment and certification*. Unpublished Master's Thesis, Capiz State University, Roxas City.

[12] Grant, Michael M. (2010). *Comparing instructional design models*. Retrieved from: http://www. Instructionaldesign.org/models/index.html, January 03, 2016

[13] Instructional Design Expert (2009). Retrieved from: www.instructionaldesignexpert.com/ addie.htm/#Vr71kP197IU , August 12, 2015

[14] International Network of Quality Assurance Agencies in Higher Education (INQAAHE) (2001). Retrieved from: http://www.qualityresearchinternational.com/ glossary/assessment.htm, August 25, 2014

[15] Juliano, R. (2005). *A future scenario for fisheries education in the Philippines*. Retrieved from: www.pemsea.org/eascongress/international_ conference/ presentation/ _t5_2

[16] Kearsley, Greg and Culatta, Richard (2005). *Instructional design*. Retrieved from: http://www.instructionaldesign.org, January 08, 2016

[17] Law, D. A. (1990). *Implementing agricultural literacy programs*, The Agricultural Education Magazine, 62(9), 5-6, 22.

[18] Lettmayr, C. (2011). *The benefits of vocational education and training*. Louxemburg Publication Office of the European Union. Retrieved from: file:///C:users/client/downloads/5510_en.pdf

[19] Mayfield, Milton, (2011). *Creating training and development programs: Using the ADDIE method*. An International Journal,(25) ISS: 3, pp.19-22 Retrieved from: http://www.emeraldinsight.com/doi/abs/10.1108/14777281111125363 October 18, 2015

[20] Merriam Webster Dictionary (2015) Retrieved from: http:www.merriam_webster.com/ dictionary/competency, January 08, 2016

[21] QEPSE-Leonardo. (2011). *Glossary*, Retrieved from: http://www. qepse.eu/index.php?option=com_content&task=view&id=26&Itemid=41, March 05, 2013.

[22] Peano, S., De Dios, B.V., Mendoza, U., (2008). *Investment in technical vocational education and training (TVET) in the Philippines*. Retrieved from: http://www.unesco.org/iiep/PDF/pubs/2008/TVET_Philippines. pdf, August 21, 2013

[23] Quality Assurance Agency for Higher Education (QAA). (2006). *Code of practice for the assurance of academic quality and standards in higher education, Section 6: Assessment of students* (2nd ed.). Retrieved from: http://www.qaa.ac.uk/academicinfrastructure/odeOfPractice/section6/COP_AOS. pdf, February 2, 2011.

[24] Rodriguez, A. (2012). *Strengths with the ADDIE instructional design model*. Retrieved from: www.slideshare.net/albertorodriguez5150/strengths-in-the-ADDIE-model