Initial Impact of Certificate Program for Non-specialists Teachers in Chemistry: Implications to Reforms in Teachers' Continuing Professional Development[1]

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ABSTRACT

This study examined the competencies and capabilities of teachers who are non-majors in Chemistry after attending the Certificate Program of two terms which ran for 6 weeks for each term. The course content covered among others the least learned content topics and processes based on the results of the 2005 National Achievement Test. The delivery of the course was an integration of content, strategies, and assessment. The use, care, and improvisation of equipment and learning support materials were included. Specifically, this study explored the capabilities of teacher participants in terms of increased content knowledge, enhanced competence in teaching, and assessment of learning, and continued professional enhancement. The participants-respondents of the study were trained chemistry teachers, their immediate supervisors, and their students. Findings of the study showed that teachers gained significantly in terms of content knowledge from the training. The content knowledge was, to a great extent, retained by the teacher-participants as they actually conduct research investigatory projects, and hands-on laboratory activities in their classes. Further, the participants showed improved classroom management skills, teaching, and assessment skills. Results also revealed that trained teachers enhanced their ability in conducting laboratory activities using improvised materials and equipment. They were also able to assess student learning by using a variety of ways and were able to evaluate students' performance through authentic means. Implications of this study are discussed with respect to areas or competencies that need to be developed further among chemistry teachers in the local and national contexts of educational reforms.

Keywords: *continuing professional development, non-specialist teachers, educational reform*

Background of the Study

Teachers play a very important role in the teaching–learning process. They are the frontliners in developing functionally literate Filipino students. They also act as bridge between the scientists and the students for they facilitate the latter's understanding and comprehension of the scientists' work and developed theories. However, it is sad to note that in some cases, teachers can also be a source of misconceptions as mentioned by Dr. L. M. Rabago during the launching of the book *Addressing Misconceptions in Mathematics and Science* on December 9, 2008 at UPNISMED.

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According to Juliet Benedicto, in her article "Good Teachers Are Hard to Find", Korea, Japan, Hong Kong, Taiwan, Indonesia, Malaysia, and Brunei have become economic giants economically in such a short span of time. This is because these countries put emphasis on the training and pooling of their manpower resources, harnessing in such a way that they become productive and progressive. This includes the upgrading of their teachers by creating programs that may be of great benefit to their educational system.

Fraser (1994) cited different authors to recommend six topics in improving science education. These are:

First, Duit and Treagust recommend the "Students' Conceptions Constructivist Teaching Approaches". Science teaching should start with the students' conceptions rather than the teacher's view or the scientist's view; curricula should also consider students' conceptions and present science in the social context; assessment procedures should emphasize understanding rather than recall; and new media, such as computer and software, to provide students with opportunities to construct their own knowledge.

Second, Hostein and Walberg recommend that science teaching should involve a variety of instructional techniques including well-designed teacher' demonstrations, laboratory work, computer simulations, and field trips. Students' outcomes should also be assessed thoroughly both in classroom and in laboratory. Distance education should be used as an effective method in both high-income and low-income countries and teachers should be trained in using "wait-time" of appropriate duration.

Third, Weltch recommends that "Student Assessment and Curriculum Evaluation" are needed and thus emphasis in the evaluation of student learning should be supplemented by greater attention to formative and summative curriculum evaluation. The focus on student achievement should be extended to encompass attitudes, inquiry skills, problem solving, and understanding of the nature of science. Paper-and-pencil evaluation instruments should be complemented by the use of alternative and authentic evaluation techniques such as in-depth interviews, portfolio assessments, and practical performance tests. The usefulness of formative curriculum evaluation should be improved by seeking highly specific information that can provide and guide improvements and by using separate students and curriculum evaluation instruments.

Fourth, Tobins emphasizes that "Teacher Changes Teacher Performance Assessment" must be given great attention and recommended that teachers should observe one another's classes and discuss what did and did not work. Teachers should also conceptualize new teaching rules in terms of beliefs in power relationships and identify constraints that prevent teachers from implementing the curriculum, as they would prefer. Professional practice schools should develop as a collaborative partnership between schools, universities, and the community. Moreover, portfolio and simulations should be used in the assessment of teacher's performance.

Fifth, Plomp and Voogt recommend that introducing computers should be accompanied by a support structure, which incorporates competence, developing the training of consultant, the provisions of network facilities and building of organizational capacities. Teachers inexperienced in computers in the classroom should receive in-school training in which they can observe good examples of educational computer use and have hands-on experience. Courseware should likewise support the existing goals of the curriculum and include advice on its appropriate use. Formative evaluation courseware in the classroom setting should also be given attention as a basis for making needed improvements.

Lastly, Parker recommends that gender equity must be implemented; thus, the school science curriculum should be compulsory and broad based and include consideration of gender stereotypes and career education aimed at breaking down these stereotypes. Resources in science education should avoid gender bias in language and choice of examples and include case studies of successful woman scientists; science teachers, administrators, teacher educators, and teacher trainees should undertake educational programs that make them aware of the problems of gender stereotyping and give them the skills to counter it. Gender bias should be avoided in the content and mode of assessment in science.

For the Philippines, the understanding of science and technology is critical to meet the demands and challenges of the 21st century. It is the driving force required to realize the vision of this country to be released from the clutches of poverty and to empower the citizenry to be confident of their future. Without a science-literate population, the outlook for a better world is not promising (Paris, 2006).

The country cannot escape the demand to harness its science and technology capability as a way of developing competitiveness if it wants to improve its way of life (Paris, 2006). In this aspect, teachers play a great role and are challenged to help build the future.

Because of the crucial role teachers play in the learning of the students, the Department of Education (DepEd) through the Bureau of Secondary Education (BSE) and the Regional Offices, in partnership with the Department of Science and Technology (DOST), through the Science Education Institute (SEI) called for a capability-building program. This is an upgrading program for high school science teachers, who are, in this case the chemistry teachers who are no non majors or minors in this discipline. This is also a way of addressing the very poor performance of high school students as reflected by the results in international assessments. These are further confirmed by the outcome of the national tests administered by the Department of Education. In the 2005 National Achievement Test (NAT), for example, less than 2% of the one million graduating high school students were found to have mastered the competencies in science.

Many factors have been identified by researchers and educators behind the low performance in science of students. Poor economic condition and lack of instructional materials are reasons to reckon with. Still, the Department of Education believes that the teacher himself is the most critical factor. A survey of teachers indicates that many of those teaching chemistry in particular are not specialists in the field. Thus, a Certificate Program is deemed important and hence was conducted.

The training was a 24-unit program leading to a minor in chemistry. It was a 6-week course, which ran for two terms. The first term offered the subjects General Chemistry, Inorganic Chemistry, Organic Chemistry, and Biochemistry. The second term offered Analytical Chemistry, Qualitative Chemistry, Quantitative Chemistry, Physical Chemistry and Science Investigatory Project. Each of the courses was credited four (4) units in the undergraduate level at the West Visayas State University College of Education. The course content was drafted to cover the least learned or mastered content topics and processes based on the results of the 2005 National Achievement Test. The delivery of the course was an integration of content, strategies, and assessment. The use, care, and improvisation of equipment and learning support materials were also included. During the last term of the course, the teacher participants were made to come up with a simple science investigatory project.

Theoretical Framework

This research endeavor is anchored on an outcomes-based evaluation model (McNamara, 1998). This model is designed to evaluate the extent to which programs are bringing about the outcomes needed by the students/ participants. Outcomes are benefits to students from the teachers' participation in the program. They are usually in terms of enhanced learning (knowledge, perception/attitudes or skills) or conditions, to mention, self-reliance, resourcefulness, and others. The expected outcome of the Certificate Program is the improved capabilities of teachers who are non-majors in chemistry; that is, teachers will have increased knowledge of content, skills, and enhanced competence in teaching and assessment for learning as well as continued professional enhancement. Thus, this study explored the participants' patterns of behavior indicative of improved teaching capabilities.

The Problem

The study aimed to determine the effect of the upgrading program in improving the capability of teachers who are non-majors in chemistry.

Specifically the study sought answers to the following queries:

1. To what extent have the teachers gained content knowledge from the training?
2. To what extent have the teachers retained the content knowledge gained from the training?
3. Is there a significant difference in the chemistry test scores of the participants before the training and one year after the training?
4. Is there a significant difference in the Chemistry test scores of the participants immediately after the training and one year after the training?
5. What is the degree of teacher utilization of the chemistry content learned in the training?
6. What is the level of performance of the chemistry trained teachers in
   a. teaching the subject?
   b. assessing learning?
7. Is there an improvement in the skills of the chemistry teachers in test construction?
8. What is the extent of teacher participation in the professional enhancement?
9. What support has the school management provided to the chemistry teacher participants after the training?

METHODOLOGY

This was a quantitative-qualitative study. The quantitative part made use of descriptive and inferential analyses. The qualitative part employed a narrative inquiry approach. A narrative inquiry (Connelly & Clandinin, 1990, 2000) as a way of understanding learning experiences enabled the researchers and the participants to live, tell, re-examine, reflect on, and retell stories – stories of classroom experiences which made the researchers and the participants understand their teaching experiences. Thus this study pertains to classroom "stories lived and told" (Connelly & Clandinin, 2000, p. 20)

Participants-Respondents of the Study

The respondents of the quantitative part of the study were the 173 trained chemistry teachers from all parts of Region VI. This number constituted approximately 84% of those who participated in the training for non-specialist chemistry teachers who wanted to improve their chemistry content/ knowledge. Of the 173 respondents, the greater number came from Iloilo and Negros Occidental (46% and 23%, respectively), 14% came from Aklan, 12% from Capiz and the rest, from Guimaras and Antique.

For a deeper understanding of the impact of the certificate program to trained teachers' teaching practice as well as of their students, 18 of the 173 participants were observed and interviewed. The immediate supervisors as well as five (5) students of the 18 teacher respondents were also participants in the study. The students were chosen by random sampling while the 18 teacher participants were chosen by stratified proportionate sampling; that is, all the provinces in Region 6 were represented in the sample.

Data-gathering Instruments

Six validated instruments were utilized to gather data needed for the study. A chemistry test was used as pretest and posttest as well as to gather data regarding teachers' retention of content knowledge gained. A rating scale was used to gather data on teachers' competence and professional enhancement. A rating sheet was used to evaluate the competence of teachers in assessing learning with the teacher's old and new test questions as sources of evidences. Observations and interview guides were used to gather data to validate those that were gathered using rating scales and rating sheets.

Data Analysis

The data gathered using the six instruments were used to shed light to the following: initial content knowledge; gained as well as retained content knowledge; degree of teacher utilization of the content knowledge learned in the training; the level of performance of the trained teachers in teaching the subject and assessing learning; the improvement on the skills of the teachers on test construction; the extent of teacher participation in the professional enhancement and on the provision of support by the school management to the teacher participants after the training.

The degree of teacher utilization of the content learned in the training, teacher performance in teaching the subject, level of performance of trained chemistry teachers in assessing learning, teachers' participation in the professional enhancement, school management support to teachers after the training, teachers' utilization of the content learned in terms of preparation and teaching skills; and performance in teaching the subject, teaching skills, management, evaluation skills and student reaction were interpreted using the following scale:

4.20 – 5.00	very high extent
3.40 – 4.19	high extent
2.60 – 3.39	average extent
1.80 – 2.59	low extent
1.00 – 1.79	very low extents

Teachers' skills improvement in test construction was interpreted using the scale below:

4.20 – 5.00	very much improved
3.40 – 4.19	much improved
2.60 – 3.39	moderately improved
1.80 – 2.59	less improved
1.00 – 1.79	least improved

RESULTS

As to the extent to which the teachers gained content knowledge and likewise retained such knowledge from the training, the posttest scores with the corresponding initial (pretest) scores are shown in Table 1. Before the training commenced, the pretest was given to the teacher participants. Immediately after the training, posttest 1 was administered to the participating teachers. To find out the extent to which the teachers retained the content knowledge gained from the training, posttest 2 was given more or less one year after the training.

Table 1. *Pretest and Posttest Mean Scores of Teacher Participants*

	No. of Items	*Mean*	*SD*
Pretest	100	48.86	18.65
Posttest 1	100	80.77	21.57
Posttest 2	100	84.14	15.50

Legend: 80 and above - very high extent
60-79.99 - high extent
40-59.99 - average extent
20-39.99 - low extent
Below 20 - very low extent

Table 1 shows that the initial content knowledge (mean pretest scores) of the participants in chemistry subject is at almost 50% of the total items. This proves and shows a low content knowledge of a non-chemistry teacher to educate the students in the subject. The effect of the certificate program on the participants after the training shows that there was a very high extent of knowledge gained. There was an increase of 31.91% to the initial average content knowledge after the training as shown by the posttest1 mean score of 80.77. Findings further indicate that the certificate program was effective in improving the non-major teachers' content knowledge in chemistry. The retention of the participants' content knowledge was measured through the posttest2 mean scores. Posttest 2 scores *mean* of 84.14 of participants indicates that participants showed very high extent retention of the content knowledge gained after the training. Participants also show an increase of 4.17% of the content knowledge (posttest 2 mean scores) after a one-year period. This can be explained by the fact that teachers have by now gained their momentum after a one-year period and that they were able to apply inside the classrooms what they had learned. Recall of concepts, strategies and skills learned is easier and more meaningful to be utilized in their respective lessons. The scale below was used for the interpretation of the extent of knowledge gained or retained.

Comparison of Participants' Scores Before and After the Training

The significance of the differences in the pretest – posttest 1 and posttest 1 - posttest2 mean scores were determined using paired sample *t-test*. Table 2 shows the results.

Table 2. *Paired Samples t-test Results on the Mean Scores of Participants in Pretest - Posttest1 and Posttest1 – Posttest2*

	Test	Mean Scores	*t*-value	df	*p*-value
Pair 1	Pretest Posttest1	48.86 80.77	33.059	172	0.000
Pair 2	Posttest1 Posttest2	80.77 84.14	19.287	172	0.086

The statistical analysis for the pretest-posttest1 above shows a significant difference, t (172) = 33.06, p = .000. This indicates that the upgrading program seemed to have contributed to a significant increase in the performance of the teacher-participants in terms of content knowledge in chemistry. The considerable increase in the test mean score is reflective of the learning gains of the participants during the training.

The statistical analysis for the posttest1-posttest2 showed no significant difference, t (172) = 19.287, p = 0.086. This indicates that the retained knowledge was not significantly different from the acquired knowledge in the training. Moreover, the increase of the scores from posttest1 to posttest2 is reflective of the retained content knowledge gained by the teachers.

Table 3. *Content and Knowledge Gained by the Participants after the Upgrading Program*

Personal Benefits	n (90)	%	Professional Benefits	n (90)	%
1. developed self-confidence and self-worth in teaching difficult topics in chemistry	32	36	1. gained professional competence as a chemistry teacher	55	61
2. broadened their knowledge about chemistry content	22	24	2. earned additional units for postgraduate studies	12	13
3. gained more friends and met new qualified trainers and renewed acquaintances	9	9	3. developed creativity in teaching chemistry and became more realistic, resourceful, and innovative in using the latest technology	5	6
4. gained more exposure	5	6	4. able to produce well-rounded students	2	2
5. learned how to love and appreciate the subject	4	4	5. the training earned credits at the national level	1	1

Degree of Teacher Utilization of the Content Learned in the Training

The data in Table 3 show the mean and standard deviation of the items included in the teachers rating sheet by the immediate supervisor for content utilization. Results revealed that teachers' take every opportunity to introduce related content/concepts learned in the training; use with confidence concepts learned in the training to enhance learning and apply previously learned concepts to new situations to a high extent. These were evidenced by their *means* that range from 4.11 to 4.17 and *standard deviation* of 0.38 to 0.58. Likewise, the overall teachers' utilization of the content learned in the training was high, M=4.13, SD=0.48.

Furthermore, the degree of utilization of the content learned in the training by the chemistry teachers can also be observed and exhibited by the teachers in the way they plan and prepare for their lessons. These data are also shown in Table 3.

Table 4.
Utilization of the Content Learned to Actual Teaching and in Planning and Preparation of Science Lessons.

Criteria	Mean	Descriptive Rating	SD
A. The teacher . . .			
1. introduces learned content/concepts in actual teaching.	4.17	High Extent	0.38
2. uses with confidence learned concepts to enhance learning.	4.11	High Extent	0.58
3. applies previously learned content/concepts to new situations.	4.11	High Extent	0.47
Content Utilization (Over-all)	**4.13**	**High Extent**	**0.48**
B. The teacher . . .			
1. prepares a well-organized lesson plan.	4.78	Very High Extent	0.43
2. analyzes and identifies specific learning tasks.	4.78	Very High Extent	0.43
3. selects appropriate learning experiences and activities that enhance creativity.	4.67	Very High Extent	0.48
4. prepares a variety of teaching aids for specific purposes.	4.50	Very High Extent	0.92
5. provides learning situations that address the development cognitive, affective and psychomotor domains.	4.61	Very High Extent	0.50
6. plans learning experiences/activities which provide maximum student participation.	4.83	Very High Extent	0.38
Planning and Preparation Skills (Over-all)	**4.69**	**Very High Extent**	**0.52**

It can be observed that trained chemistry teachers prepare well-organized lesson plans; analyze and identify specific learning tasks written in attainable behavioral terms; select appropriate learning experiences and activities reflecting creativity; prepare a variety of teaching aids for specific purposes; provide learning situations that address the cognitive, affective and psychomotor domains; and plan learning experiences/ activities which provide maximum student participation to a very high extent. These were evidenced by the *means* that range from 4.50 to 4.83 and *standard deviations* of 0.38 to 0.92.

The data obtained from the ratings of the teachers' immediate supervisors and those obtained from the class observations were triangulated with the data given by the trained teachers, supervisors and students during the interview. The data obtained from the ratings were consistent with the answers given in the interview.

In the interview, chemistry trained teachers claimed that the training really prepared them to teach the subject and they were able to utilize the significant knowledge they had gained. Immediate supervisors of chemistry trained teachers also claimed that the trained teachers had significant improvement or changes gained from the training in terms of content utilization and lesson planning. Likewise, the students claimed that their chemistry teachers were able to explain the subject well and provided correct answers or explanations to their queries.

Level of Performance of the Trained Teachers in Teaching the Subject

The delivery of the upgrading course focused not only on content but also on strategies. The chemistry-trained teachers were exposed to varied teaching strategies which they can apply in their own classrooms. The data in Table 5 show the extent to which the trained chemistry teachers performed in terms of teaching strategies used in their classrooms.

It can be gleaned from the data that the chemistry-trained teachers applied varied and appropriate methods and strategies learned in the training to a very high extent, as proven by the *mean* score of 4.28 and a *standard deviation* of 0.46. Conversely, results revealed that the teachers used models, known facts, realia, and relationships to explain their thinking to a very high extent, as indicated by the *mean* score of 4.33, the highest mean score among the criteria.

Furthermore, the chemistry trained teachers linked the conceptual knowledge to procedural skills; stimulate interest by employing thought-provoking questions, motivation, or activities; and express ideas orally, both in writing and in demonstrating to a high extent. These were evidenced by the *mean* ratings that range from 4.06 to 4.17 and *standard deviations* between 0.51and 0.58.

In general, the level of performance of trained chemistry teachers is indicated by the *mean* score of 4.19 with a *standard deviation* of 0.54 which implies that the chemistry-trained teachers used a variety of teaching strategies in teaching chemistry to a high extent.

Table 5. *Teacher Performance in Teaching the Subject*

Criteria	Mean	Descriptive Rating	SD
The teacher			
1. applies varied and appropriate methods and strategies learned in the training.	4.28	Very High Extent	0.46
2. uses models, known facts, realia, and relationships to explain his/ her thinking.	4.33	Very High Extent	0.59
3. links conceptual knowledge to procedural skills.	4.17	High Extent	0.51
4. stimulates interest by employing thought-provoking questions, motivation, or activities.	4.11	High Extent	0.58
5. expresses ideas orally, both in writing, and in demonstrating.	4.06	High Extent	0.54
Teaching Strategies (Over-all)	**4.19**	**High Extent**	**0.54**

The level of performance of the trained chemistry teachers can be viewed in terms of teaching skills that they exhibit when teaching chemistry. These data on teaching skills are shown in Table 6.

It can be observed that the trained chemistry teachers present ideas/concepts clearly within the students' intellectual level, use instructional aids and devices effectively, relate the subject matter to actual experiences and integrate with other fields, relate new lesson to previous and future lessons, stimulate interest to learn more about the subject matter, pose challenging and thought-provoking questions, restate difficult questions to elicit desired responses, respond effectively to questions, provide appropriate reinforcement (verbal or non-verbal), provide opportunities to develop mental curiosity and the ability to question, and provide activities to meet individual differences. These teaching skills were rated to a very high extent by the supervisors as shown by the *means* that range from 4.39 to 4.78. Moreover, the overall rating of teachers in teaching skills was to a very high extent (M=4.61, SD=0.67).The results are presented in Table 6.

Table 6. *Performance in the Utilization of Teaching Skills*

Teaching Skills	Mean	Descriptive Rating	SD
The teacher			
1. presents ideas/concepts clearly within the students' intellectual level.	4.67	Very High Extent	0.69
2. uses instructional aides and devices effectively.	4.44	Very High Extent	0.92
3. relates the subject matter to actual experiences and integrates with other fields.	4.56	Very High Extent	0.86
4. relates new lesson to previous and future lessons.	4.65	Very High Extent	0.71
5. uses varied and interesting methods and strategies.	4.50	Very High Extent	0.62
6. stimulates interest to learn more about the subject matter.	4.72	Very High Extent	0.57
7. poses challenging and thought-provoking questions.	4.61	Very High Extent	0.61
8. restates difficult questions to elicit desired response.	4.78	Very High Extent	0.55
9. responds effectively to questions.	4.78	Very High Extent	0.55
10. provides appropriate reinforcement (verbal or non-verbal).	4.72	Very High Extent	0.57
11. provides opportunities to develop mental curiosity and the ability to question	4.50	Very High Extent	0.71
12. grabs every opportunity to use problem-solving processes and critical thinking.	4.39	Very High Extent	0.78
13. provides activities to meet individual differences	4.56	Very High Extent	0.62
Teaching Skills (Over-all)	**4.61**	**Very High Extent**	**0.67**

The level of performance of trained chemistry teachers in teaching the subject can also be measured by the ways on how they manage the class. The data for the teachers' management skills are presented in Table 6.

It can be noted that all item indicators for teachers' management skills were demonstrated by the trained chemistry teachers to a very high extent. These were manifested by the following: the teachers handle classroom problems with fairness and understanding, M = 4.95; maximize class period for learning activities, M = 4.89; maintain a responsive and disciplined classroom atmosphere, M = 4.83; and show respect for and consideration of students' opinions and suggestions, M = 4.78. Furthermore, the trained chemistry teachers establish systematic routine activities for effective classroom management, M = 4.72; keep classroom clean, comfortable and conducive

to learning, $M = 4.72$; and use appropriate management strategies, $M = 4.82$. All these were practiced to a very high extent. It is also shown in Table 7 that low *standard deviations* range from 0.24 to 0.51 which indicate consistent scores.

Table 7. *Performance in Classroom Management*

Management Skills	Mean	Descriptive rating	SD
The teacher			
1. maintains a responsive and disciplined classroom atmosphere	4.83	Very High Extent	0.51
2. keeps classroom clean, comfortable and conducive for learning	4.72	Very High Extent	0.46
3. handles classroom problems with fairness and understanding	4.94	Very High Extent	0.24
4. shows respect for and consideration of students' opinions and suggestions	4.78	Very High Extent	0.55
5. establishes systematic routine activities for effective classroom management	4.72	Very High Extent	0.46
6. maximizes class period for learning activities	4.89	Very High Extent	0.32
7. uses appropriate management strategies	4.82	Very High Extent	0.39
Management Skills (Over-all)	**4.81**	**Very High Extent**	**0.42**

Another way of measuring the level of performance of the trained chemistry teachers is the extent to which students react during classroom discussions. The indicators are shown in Table 8.

The data in Table 8 reveal that the students show interest in the lesson, $M = 4.82$; relate the lesson to actual experiences, $M=4.22$; show honesty and integrity in all their activities, $M=4.72$; participate in classroom discussion and interactions, $M = 4.72$; and respect the opinions of others on certain issues, $M = 4.61$. The students exhibited these behaviors during class discussions to a very high extent. However, students express ideas effectively in English or Filipino, $M = 4.11$ to a high extent. The overall students' interaction with teachers was to a very high extent, $M = 4.53$.

Table 8. *Learners Behavior in Response to Teacher's Action*

Criteria	Mean	Descriptive rating	SD
The students			
1. show interest in the lesson	4.82	Very High Extent	0.53
2. express ideas effectively in English or in Filipino	4.11	High Extent	0.68
3. relate the lesson to actual experiences	4.22	Very High Extent	0.73
4. show honesty and integrity in all their activities	4.72	Very High Extent	0.46
5. participate in class discussion and interactions	4.72	Very High Extent	0.46
6. respect the opinion of others on certain issues	4.61	Very High Extent	0.50
(Over-all)	**4.53**	**Very High Extent**	**0.56**

The data on the level of performance of the trained chemistry teachers in teaching chemistry as evaluated by the researchers, immediate supervisors, and students were triangulated by the data obtained from interviews of their supervisors, students, and the teachers themselves.

The data from the interview showed that the trained chemistry teachers had enhanced their ability in conducting laboratory activities. Trained chemistry teachers and their immediate supervisors claimed that they were actively and frequently performing laboratory activities because of their improved skills in improvising apparatuses and finding substitute chemicals. Using a rating scale of 1 to 10, both the trained chemistry teachers and the immediate supervisors gave an average rating of 8, in terms of level of teaching competence.

Level of Performance of the Trained Teachers in Assessing Learning

Assessment is an important part of a teaching-learning process. Teaching in the classroom becomes more productive and meaningful when followed by an accurate assessment of its results. To attain these ends, teachers should be aware of the criteria for evaluating their performance in assessing learning and most importantly they know their level of performance in assessing learning.

The data in Table 9 show that trained the chemistry teachers use a variety of ways to assess learning outcomes of students through pencil-and-paper tests to a very high extent as revealed by the mean score, $M = 4.22$ and standard deviation, $SD = 0.43$. Likewise, the trained teachers require appropriate special tasks/enrichment/ follow-ups, like assignments, and projects, to a very high extent. To a high extent, teachers also evaluate students' performance through authentic means, e.g. portfolio, journals, debates, exhibits, and investigatory projects. The overall teacher performance in assessing learning was to a high extent, $M = 4.15$.

Table 9. *Performance in Assessment of Learning*

Assessment Skills	Mean	Descriptive rating	SD
The teacher…			
1. uses a variety of ways to assess learning outcomes	4.22	Very High Extent	0.43
2. evaluates students' performance through authentic means, e.g. portfolio, journals, debates, exhibits, MIPs, etc...	3.89	High Extent	0.58
3. requires appropriate special tasks/ enrichment/ follow up like assignments, projects, etc.	4.33	Very High Extent	0.49
Assessment of Learning (Over-all)	**4.15**	**High Extent**	**0.50**

Table 10 presents the data on assessment of students' learning and performance. These data illustrate teachers' evaluation skills as observed by the researchers.

It can be observed from the data that the trained chemistry teachers keep a record of all test results and accomplishments; rate fairly and objectively; utilize evaluation results to improve their instruction; give appropriate exams in actions and quizzes; and use a variety of ways in measuring students' outputs and achievements to a very high extent, with means that range from 4.56 to 4.83. All had very considerable deviation from the mean which range from 0.55 to 0.77.

Overall, the teachers' evaluation skill was rated to a very high extent. This was shown by the *mean* and *standard deviation* of 4.70 and 0.61, respectively.

Table 10. *Teachers' Evaluation Skills*

Criteria	Mean	Descriptive rating	SD
The teacher…			
1. keeps a record of all test results and accomplishments.	4.78	Very High Extent	0.55
2. gives appropriate exams in actions and quizzes.	4.67	Very High Extent	0.59
3. rates fairly and objectively.	4.83	Very High Extent	0.51
4. utilizes evaluation results to improve instruction.	4.67	Very High Extent	0.77
5. uses a variety of ways in measuring students' outputs and achievements.	4.56	Very High Extent	0.62
Evaluation Skills (Over-all)	**4.70**	**Very High Extent**	**0.61**

Improvement in Teachers' Skills in Test Construction

Enhancing the skills of chemistry teachers in test construction is one of the concerns of the upgrading program. The application, clarity, correctness and reliability of a test depend on the teachers' skills in test construction. As revealed by the data in Table 11, chemistry trained teachers had improved much in their test constructions skills after the training (M=3.80, SD=0.62).

Likewise, from the evaluation criteria of the test construction skills, it can be gleaned that the trained chemistry teachers include questions that measure laboratory skills and concepts; proportionate number of items to time period given; test questions that measure more practical applications rather than total recall; grammatically correct, direct-to-the-point, and concise test questions; test questions that are clearly printed with readable fonts; clear and simple instructions; pertinent test items rated using rubrics; items that utilize graphs and figures for analysis; items which utilize higher-order thinking skills; and items which focus on value content, awareness of current issues, and attitude of the students towards pertinent topics. These were evidenced by the *means* that range from 3.44 to 3.94 and *standard deviations* between 0.43 and 1.16.

On the other hand, test questions that conform to the lesson objectives and to the table of specifications were very much improved.

Table 11. *Teachers' Skills in Test Construction*

Evaluation Criteria	Mean	Descriptive Rating	SD
1. The test questions conform to the lesson objectives and to the table of specifications.	4.83	Very Much Improved	0.38
2. The test includes items that utilize graphs and figures for analysis.	3.94	Much Improve	1.16
3. The test includes questions which measure laboratory skills and concepts.	3.65	Much Improved	0.61
4. The number of test items is proportionate to the time period given.	3.78	Much Improved	0.43
5. The test questions measure more practical applications rather than total recall.	3.56	Much Improved	0.62
6. The test questions are grammatically correct, direct to the point, and concise.	3.88	Much Improved	0.48
7. The test questions are clearly printed, with readable fonts and the instructions for each component are clear and simple.	3.78	Much Improved	0.73
8. The test includes items which utilize higher order thinking skills.	3.44	Much Improved	0.51
9. Pertinent test items are rated using rubrics.	3.50	Much Improved	0.51
10. The test includes items which focus on value content, awareness of current issues, and the attitude of the student towards pertinent topics.	3.61	Much Improved	0.78
Skills in Test Construction (Over-all)	**3.80**	**Much Improved**	**0.62**

Teachers' Participation in the Professional Enhancement

As molders of young minds and life-long educators, the teachers should grab every opportunity for professional enhancement. Some opportunities for professional enhancement are shown in Table 12. It can be seen that teachers' attendance in meetings, seminars, and workshops was to a high extent; while affiliation in organizations and committees; writing resource materials (activity sheets and modules); and extending expert services as resource person, judge, adviser (Science Investigatory Project SIP, etc.) are to an average extent. Over-all, the teachers' participation in the professional enhancement was to an average extent (M=3.34, SD=0.92)

Table 12. *Teachers' Participation in the Professional Enhancement*

Indicators	Mean	Descriptive Rating	SD
The teacher participant			
1. attends meetings, workshops or seminars	4.00	High Extent	0.69
2. extends expert services as resource person, judge, adviser (MIP, etc.)	3.00	Average Extent	0.97
3. writes resource materials (activity sheets and modules).	3.06	Average Extent	1.06
4. affiliates in organizations and committees	3.28	Average Extent	0.96
Participation in the Professional Enhancement (Over-all)	**3.34**	**Average Extent**	**0.92**

School Management Support to Teacher Participants after the Training

Whenever legally possible, the support of the school management is a must to the teacher participants in chemistry of the upgrading program especially in terms of promotion. As shown in Table 13, promotion for teachers was moderately extended by the school management (M=3.27, SD=1.03).

However, there was a high extent of school management support in teachers' and students' incentives for SIPs, contests, and other projects. Likewise, facilities in technological innovations and laboratory rooms, tables, equipment, and references were supported by the school management to a high extent. Mean ratings that range from 3.50 to 3.88 support the claim. Over-all, the school management support to teacher participants after the training was to a high extent (M=3.56, SD=1.06).

Table 13. *School Management Support to Teacher Participants after the Training*

Financial	Mean	Descriptive Rating	SD
The school management provides support on:			
A. Promotion	3.27	Average Extent	1.03
B. Incentives for SIP, contests and other projects			
B.1. Teacher	3.56	High Extent	1.20
B.2. Students	3.56	High Extent	1.10
C. Facilities			
C.1. Technological, Innovations, e.g. LCD, TV, computers	3.89	High Extent	0.96
C. 2. Laboratory rooms, tables, equipment, references, etc.	3.50	High Extent	0.99
Over-all	**3.56**	**High Extent**	**1.06**

CONCLUSION

The teacher participants gained a substantial content knowledge from the training. This implies that the certificate training was effective in improving the content knowledge of non-specialists teachers in chemistry. The utilization of the knowledge learned in the training might be one of the factors that lend to a very high retention of and slight increase in the participants' content knowledge gained even one year after the training.

With the content knowledge gained, the trained chemistry teachers are now more able and skillful in terms of lesson planning and preparation skills. As a popular adage goes: "We cannot give what we do not have." Having gained confidence, the trained chemistry teachers in showed a consistently high rating in performance level among the supervisors, the students, and the teachers themselves. They are now more able to use a variety of ways to assess student learning outcomes. It can be said that the trained chemistry teachers showed a marked improvement in test construction.

As part of the school management support program, the trained chemistry teachers were given opportunities for professional enhancement, growth, and development.

Implications to Science Teacher Education, Continuing Professional Development and Research

This study revealed several implications on the importance of certificate trainings in improving the content knowledge and pedagogical competencies of non-specialist teachers in chemistry.

The chemistry teachers in this study developed awareness of how content can be taught in terms of their planning and preparation skills. The trained teachers also developed the ability of conducting laboratory activities using improvised materials and equipment. They were likewise also able to assess student learning using a variety of ways and to evaluate students' performance through authentic means. It is clear that the training stimulated in them aspects of professional commitment that has made them more open-minded, creative, and responsible.

One relevant source of teachers' learning to teach is experience. How teachers learn, and from what and from whom is one important issue in the current efforts for teacher education reform (Arellano, 2002).

If science teachers are to be reflective of their teaching practice covering issues – from subject matter, to learners, to learning/ teaching context, to curriculum, to assessment, and so forth – they should be provided with opportunities to do so. In this study, the teachers were asked about their teaching experiences after having attended the Certificate Program. Making teachers reflect on their own teaching practices could be a good source of feedback for school administrators. Continuing research effort for teacher education reform should, therefore, focus on teachers' classroom experiences.

There is need to cultivate a culture in teaching where there is teacher empowerment-empowerment related to professional competencies. This is so because "the one who feels empowered is most likely to empower others; and the one who experiences a sense of competence is most likely to instill that same confidence in others (Roeser, 2002). On-going professional development, by attending short-term courses, colloquia, and symposia can help heighten teachers' awareness and knowledge of evolving best practices in teaching. Clearly, attending professional development courses/ trainings will help equip teachers with the capability of reflective practice and being creative practitioners.

After all, "it is teachers who, in the end, will change the world of the school by understanding it" (Stenhouse, L. in Rudduck, 1988).

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