The Condition of Secondary School Physics Education in the Philippines: Recent Developments and Remaining Challenges for Substantive Improvements

Antriman V. Orleans
Hiroshima University, Japan

Abstract

This study is aimed at assessing the state of Philippine secondary school physics education using data from a nationwide survey of 464 schools and 767 physics teachers and at identifying challenges for substantive improvements. Teacher-related indicators revealed academic qualification deficiency, low continuing professional involvements, substantial physics teaching experience, and good licensure status. Academic environment indices revealed that the number of physics classes per teacher is manageable, but the individual classes are large. Results also showed limited instructional materials and technologies, the unpopularity of professional mentoring, and favorable library and internet access. Based on these findings, challenges to developing a larger pool of competent physics teachers and equipping schools with relevant instructional devices were identified.

Introduction

The current state of science education in the Philippines, particularly in the basic education level, lags behind other countries in the world. The results of the Second International Science Study (SISS) and Third International Mathematics and Science Study (TIMSS) placed the Philippines in disadvantaged positions among participating nations (Philippine Department of Education, Culture, and Sports et al. 2000). In the SISS, the Philippines ranked almost at the bottom of the list of seventeen (17) nations which took part in this large-scale evaluation of educational achievement. Similar outcomes were revealed in the 1995, 1999 and 2003 TIMSS.

In the different science subject areas, achievements in physics of Filipino students appeared below the international standards (US Department of Education National Center for Education Statistics 2000, International Association for the Evaluation of Educational Achievement 2004). The Philippines ranked third and fourth to the last in the list of nations in the 1999 and 2003 TIMSS respectively. Findings of Philippine-based studies (Calacal 1999, Capistrano 1999, Orleans 1994, Figuerres 1985) also present the same conclusion of low student achievement in physics.

This poor student achievement has prompted educational researchers worldwide to continuously identify factors that can account for academic outcomes in the classroom. Some research suggests that factors inside and outside the classroom affect student achievement, however, experts claim that the key factor in what comes out at the end of schooling is what goes on in the classroom (California Education Policy Seminar & California State University Institute for Educational Reform 1998).

In most of the reports after that of Coleman in the United States of America (Coleman et al. 1996), research findings confirmed that teacher quality appears to be the most important factor influencing student performance (Goldhaber & Anthony 2003, Goldhaber 2002, Goldhaber, Brewer & Anderson 1999, Hanushek, Kain, & Rivkin 1999, Ferguson 1998, Wright, Horn & Sanders 1997). To illustrate, the data of the proportion of measured variance in mathematics test score gains from grades three to five, developed in the Harvard Journal on Legislation 28 in 1991, show that 51% of the influence on student achievement had to do with school factors and 49% with student background (e.g. parents' education, income, race, & location). Forty-three percent (43%) of the school factors were attributed to teacher quality alone (Darling-Hammond 1998). Similarly, studies on the collected student achievement data from the Tennessee Value-Added Assessment System (Sanders & Horn 1998, Wright et al. 1997, Sanders & Rivers 1996) and the data from a teacher evaluation system for the Dallas Public Elementary Schools (Jordan et al. 1997) confirmed that among other school-related factors, teacher quality has the greatest impact on students (Goldhaber & Anthony 2003).

Teacher academic preparation, certification type, and years of teaching experience, among others, are often taken as indicators of teacher quality (Goldhaber & Anthony 2003). Those teachers with sufficient academic preparation are seen to be competent in subject matter content and pedagogical skills enabling them to be effective in classrooms and produce larger student achievement gains (Darling-Hammond 2000). Licensed teachers are also considered to be effective (Hawk et al. 1985), because licensing typically requires prospective teachers hold a college degree in pedagogy and in the subject they wish to teach (Goldhaber & Anthony 2003). Veteran teachers, on the other hand, can better handle students and colleagues, and are more familiar with classroom practices (US Department of Education, National Center for Education Statistics 2000).

Experts also affirm that quality professional development involvement is an important factor in building teachers' capacity to teach effectively (Mayer et al. 2001, US Department of Education 1999, US Department of Education National Center for Education Statistics 1998). Studies revealed that student achievement is correlated to teachers' continued learning activities (Cohen & Hill 1997, Wiley & Yoon 1995, Brown et al. 1995). Teacher confidence, too, has been regarded by the International Association for the Evaluation of Educational Achievement (Schmidt & Cogan 1996) as being essential in qualifying teacher competence. This index has been considered in the TIMSS.

School-related variables are equally vital in the teaching-learning process. Competent teachers alone may hardly improve achievement, but they can advance student achievement significantly when in tandem with state-of-the-art instructional devices. With the increasing student enrollment, the exploding knowledge growth, the mounting forms of distraction facing students' learning, the differences in students' interests and approaches to learning, and the rising demands on students by the present society, both print and spoken forms of media can no longer suffice to achieve maximized learning. Varied and appropriate instructional materials are, therefore, needed to make instruction and studying more motivating and encouraging.

Research results confirm that instructional materials improved learning, if used appropriately. Laboratory manuals (Curammeng 1993, Capili 1987), workbook/work-text (Amid 1998, Flores 1989), learning modules (Ariota 1997, Plaza 1996), models (Tribiana 1991), audio-visual materials (Lontayao 1999, Logmao 1997, Undag 1996), computer-assisted instructional programs (Avila 1998, Corpuz 1998), and digital technologies such as computer hardware, software, and internet (UK Department of Education and Skills 2003, Becta 2003, Kington et al. 2003) are proven to be effective in modifying learners' behavior and in facilitating effective acquisition of knowledge and skills.

In sum, the above citations imply that constant evaluation of teacher competence and high quality instructional materials are required to ensure excellent delivery of instruction in the field. This assessment determines weaknesses and strengths in the system, and identifies relevant challenges that can solve the ailing condition of a country's education system. It can also serve as the basis for proposals and measures to prevent recurring predicaments.

The Current state of Philippine Secondary School Physics Education

In an attempt to capture the condition of Philippine secondary school physics education, this research did a national survey of 767 physics teachers in 464 schools, from the 1,000 target schools was conducted. The sample schools comprised of public (83%) and private (17%) schools supervised by the Philippine Department of Education (DepEd). Of these school samples 44% are situated in urban areas and 56% in rural districts. All 16 regions of the country are represented. Regions I to V including the Cordillera Administrative Region (CAR) and the National Capital Region (NCR) are in Luzon, the northernmost group of islands of the Philippine Archipelago; Regions VI, VII, and VIII are in the Visayas, the central island group; and, Regions IX to XII, the Autonomous Region of Muslim Mindanao (ARMM), and Caraga are in Mindanao. Among the regions, NCR is the most urbanized and the second most populated region. About 13% of the country's population lives in this small region with a land area of 636 sq km comprising of 12 cities and 5 municipalities, making it the most densely populated region in the country (Philippine NSO 2005). CAR has the smallest population, while Region IV has the largest. All regions, except NCR, are agricultural in nature, yielding primarily rice and other agricultural products. In terms of school distribution, Region IV has the greatest number of schools, holding 19% of the total public and private secondary schools in the country. ARMM has the least percentage of schools at 2%. The target schools were selected based on the total number of schools in each region. Figure 1 shows the location of these regions and the distribution of the participants in this study.

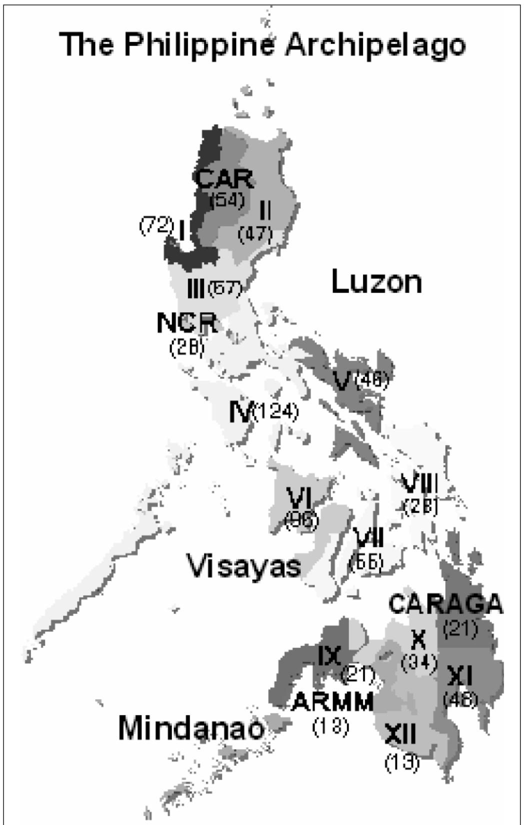

Figure 1: Regional Distribution of the Participants

School-Related Factors

School-related factors deemed to influence student achievement considered in the study are the following: number of physics classes in schools; class size; teacher access to professional help, libraries, and the internet; availability of instructional materials; and educational technologies that aid the teaching of physics.

Category		Ave. No. of Physics Classes	Ave. Class Size	Percentage Access		
				Professional Help	Libraries	Internet
School Classification	*Public Schools*	8.0 (8.0)	56.9 (12.7)	48%	90%	68%
	Private Schools	3.1 (2.1)	42.3 (11.2)	43%	96%	80%
School Setting	*Urban Schools*	11.0 (9.5)	56.0 (15.0)	51%	94%	89%
	Rural Schools	4.2 (3.2)	53.1 (12.3)	38%	89%	55%
National		***7.1 (7.5)***	***54.4 (15.6)***	***44%***	***91%***	***70%***

Table 1: Profile of Some School-Related Factors Considered

Note: Standard Deviations are enclosed in parenthesis.

Number of Physics Classes in Schools In the Philippine four-year secondary school curriculum, students take only one physics class everyday for 72 minutes per meeting in the fourth year. Covering topics from Mechanics to Modern Physics, this class stresses conceptual discussions rather than the mathematical aspect of the subject.

The average number of physics classes in Philippine secondary schools is 7.1; and a standard deviation of 7.5. Public schools reported substantially greater (at 95% confidence level) number of physics classes, at 8.0, than private schools with 3.1. Dispersion of the numbers of physics classes is also greater in public schools than in private schools, as indicated by the larger standard deviation of the former. Urban schools registered statistically higher class number, 11.0 classes, than those in rural schools, 4.2 classes. Superiority of urban schools over rural schools in terms of number of physics classes can be attributed to population density. Urban areas account for 48% of the country's population (Philippine NSO 2003). Variation in class numbers is smaller in rural schools than their urban counterpart. Data also show that an interaction effect exists between school classification and school setting. Public urban schools tend to have more physics classes than private rural schools. This occurrence can be accounted for by the high population density in urban areas and the heavy state subsidy for public school education. In addition, a significant variation in this statistic exists among the regional groupings with Region III (Central Luzon) registering the highest number of classes, 8.6, and Region XII (Central Mindanao) and ARMM the lowest, with 3.1.

Physics Class Size Large physics classes are a reality in the Philippines. The mean number of students per physics class is 54.4 with a standard deviation of 15.6. Public schools registered a higher class size, 56.9 students, than did private schools, 42.3 students. The almost-free education in public schools again explains this difference. School setting provided no effect on class size. On regional accounts, a substantial variation exists among the regions, the NCR with the lowest class size, 48.5, and Region XI (Davao), the highest, 63.1.

Teacher Access to Professional Help, Libraries, and the Internet Professional mentoring among Filipino physics teachers remains elusive. Only 44% of teachers reported getting help from colleagues/superiors. Urban school teachers reported a higher percentage, 51%, than those in rural schools, 38%. Public and private school teachers registered almost equal percentages, 48% and 43%, respectively. Moreover, this index does not vary significantly among different regional groups. A minority of the teachers in the regions, except NCR and ARMM (67% and 62%, respectively), enjoys professional mentoring in their schools.

In the library access parameter, 91% of teachers indicated that they have access to library materials. A high percentage (above 80%) of teachers in the four groups has access to libraries as shown in Table 1. The majority of teachers in the regions also reported high library access, ranging from 85% to 98%. Region II (Cagayan Valley) teachers top the group.

Access to the internet is also substantial. The majority of teachers, 70%, reported having internet access. A significantly greater percentage is noted for teachers in private schools, 80%, and in urban schools, 89%, than their counterparts in public schools, 68%, and in rural schools, 55%. Further, a substantial variation exists among the regions. While NCR teachers reported a 98% access rate, teachers from Region XII (Central Mindanao) registered a low percentage of 39%.

Availability of Instructional Materials and Technologies Philippine secondary schools seem to have limited instructional devices, in general. The majority of teachers rated their school's collection of print materials "Limited". They reported "Adequate" only for the textbooks component. For transparencies, they even reported "None". Private school teachers conveyed "Adequate" print instructional materials, while public school teachers indicated "Limited" availability. "Limited" availability was also reported by urban school teachers. Private urban schools tend to possess "Adequate" collection of print materials, while public rural schools have a "Limited" collection. In regional settings, five teacher groups indicated that their schools have "Adequate" number of textbooks, while the rest indicated "Limited", except for NCR where textbooks yielded "Very satisfactory" remarks. Similarly, only NCR teachers reported that their schools have "Adequate" collections of print educational materials. It must be noted that in this section, teachers were asked to rate the number of instructional materials present in their schools in terms of four scales: "Very satisfactory", "Adequate", "Limited", and "None". No operational differences were given to teachers on this particular categorization; hence, teachers' ratings were based on their personal distinction of the categories. Items in Tables 2 and Table 3 are the majority responses.

Print Materials	Availability
Charts	Limited
Journals	Limited
Lab. Guides	Limited
Modules	Limited
Textbooks	Adequate
Transparencies	None
Workbooks	Limited

Table 2: Availability of Print Materials

Non-Print Materials	Availability
CAIs	Limited
Instructions on Audio Format	Limited
Instructions on Video Format	Limited
Models	Limited
Documentary Films/Movies	None
Lab. Equipment	Limited
Power Point Presentations	None

Table 3: Availability of Non-Print Materials

Philippine schools also seem to lack non-print instructional devices. When asked to rate the availability of non-print instructional materials in their schools, teachers reported "Limited" for almost all devices. Documentary films and Power Point presentations are rated "None". A similar trend, as in print materials, is also observed when schools are grouped by school classification and school setting. Moreover, it appears that NCR schools have the greatest pool of these materials but still, teachers reported "Limited" in number. The use of technology in physics teaching in the Philippines does not appear prevalent. Thirty-one percent (31%) reported non-usage of any educational technology equipment considered in this study. Data showed that television sets are the most widely used teaching device. Teachers in private schools and urban schools reported a higher percentage of television use than their counterparts in public and rural schools. Interestingly, NCR teachers reported the highest percentage of use of at least one technological device considered (93%), while that in Region XII reported the lowest (15%).

Technology	Percentage
Audiocassette Player/Recorder	21%
CD Player	23%
Overhead Projector	32%
Personal Computer	21%
Slide Projector	10%
Television Set	53%
Video Player	38%

Table 4: Percentage of Teachers using Technologies in Teaching Physics

Summary and Implications School-related indices have some unfavorable implications for effective physics teaching in the Philippine secondary schools. The number of relatively large physics classes, at 7.1 classes per school, implies that there must be at least two qualified physics teachers per high school, and that a considerably large collection of instructional materials is needed to effect meaningful student learning. However, results of the instructional material inventory reveal otherwise. Data on physics class size also disclose a dismal reality of about 54 students per class, unlike in developed countries such as Australia, Japan, and USA where the average class size is 26, 35, and 24, respectively (IEA 2004). This large number signifies that much burden is placed on the teacher to facilitate learning, and less teacher time is allotted to monitor student learning advancement. Despite this unfavorable condition, however, physics teachers do not receive necessary professional help from colleagues and science supervisors. The study reveals that only 44% of teachers enjoy professional help. This lack of mentoring could have been partly compensated for by teachers' access to a library and the internet, because data reflect high library use and sufficient internet access for many, though not all teachers. While sufficient internet access was reported, no online training relevant to Philippine school curricula was available. The presence of such online training could afford needed help that eventually can make future progress in physics teaching in the Philippines possible.

An inventory of instructional materials confirm that Philippine secondary school physics teaching is textbook-based. This scenario implies that students are neither exposed to varied modes of learning or classroom learning is not maximized. Classroom teaching is not supported by quality instructional materials because of their scarcity in the classrooms. Hence, learning effectiveness is dependent on teachers' knowledge proficiency and teaching skills.

This learning environment in the Philippines is probably similar to that of most developing nations. Unlike developed countries, students are provided with adequate, if not very sufficient and varied, instructional devices for classroom use to accommodate students with diverse learning styles. On books alone, the 2003 TIMSS report (IEA 2004) reveals that 31% of students in Australia, 17% in Japan, and 24% in USA, have more than 200 books at home in contrast with only 3% in the Philippines. Eighty-three percent (83%) of students in Australia, 55% in Japan, and 79% in USA also use computers at home and in school to reinforce classroom instruction, as against 11% in the Philippines which is below the international average of 39%. While developed nations can attract bright people to their teaching work force because of relatively higher compensations, Filipino teachers' salary can hardly compare to that in most developed countries (Mehrotra & Buckland 1998). To illustrate, the 1998 UNICEF data indicate that Philippine teachers receive only an annual income of $2,066, while their counterparts in Japan, $28,770, and in the US, $24,780. Partialing-out consideration of the standard of living in these countries, the average teacher's salary in the Philippines can hardly compare with that of leadership in developed nations.

With this argument, comparison of student achievement as a result of global assessments like the TIMMS must be taken with some degree of caution. Learning conditions in all countries are varied to a certain extent. If disparity in these conditions is equalized, it is possible for students from developed countries to achieve on a par with developing nations in any given assessment. There must be rhyme and reason for not using TIMSS results and those of similar international assessments to discriminate against low achieving nations. Rather, they should provide insights into curricular improvements, better yet, serve as calls for developed countries to extend assistance to those nations in dire need of help.

Teacher-Related Factors

To Goldhaber & Anthony (2003), teacher-related factors have the greatest impact on student achievement among other school-related factors. Experts claim that what comes out at the end of school is the result of what happened inside the classroom. Since teachers play an integral part as facilitators of learning, teacher quality reflects on student learning to a considerable extent. Evaluation of the teaching force, therefore, does not only define the quality of academic staff but also predicts future student scholastic outcomes.

Preliminary Information Besides the identified teacher-related indicators, preliminary data such as age and teaching assignment were gathered to present clearly the condition of physics education in the country. These variables were regarded as relevant to student achievement.

Filipino physics teachers are generally young with an average age of 36.9 years. While negligible difference exists among teachers grouped by school setting, school classification presents significant variation. Teachers in public schools have a significantly higher average age, 37.7 years, than those in private schools, 32.8 years. Occurrences such as this can be attributed to the transfer of teachers after teaching some time in private schools to public schools that provide better fringe benefits, such as allowances and other compensations over and above their monthly salary. Hence, the flow of private school teachers to public schools is commonly observed in Philippine schools. A substantial variation in age also exists among teachers in the various regional groups. Teachers in Region XII (Central Mindanao) registered the highest age average, 39.9 years; Caraga the lowest with 33.0 years. This observation can not be attributed to existing facts for no distinct difference can be seen as to economic and educational situation in both regions.

Category		Ave. Age (in years)
School Classification	*Public Schools*	37.7 (9.1)
	Private Schools	32.8 (10.8)
School Setting	*Urban Schools*	36.8 (9.8)
	Rural Schools	37.0 (9.5)
National		***36.9 (9.6)***

Table 5: Profile of Some Preliminary Data
Note: Standard deviations are enclosed in parenthesis.

Academic assignment per physics teacher in the Philippines appears low with an average of 4.1 classes. The teaching assignment is almost the same in public and private schools, as well as in urban and rural schools since the minimum and maximum teaching load per teacher is prescribed by the Philippine DepEd. Data also reveal that not all physics teachers handle physics subjects only. A majority teach other science classes (e.g. biology and chemistry), 53%, and non-science subjects, 14%. In the regions, the academic load per teacher varies significantly. For instance, teachers in Caraga have the highest, 4.7 classes, while those in ARMM the lowest, 3.5. Moreover, NCR teachers teach the highest number of physics classes, 3.3, while those in Region XII (Central Mindanao) and ARMM, the lowest, 1.7.

Category		Teaching Assignment by Subject Type			
		Physics	Science	Non-Science	Total
School Classification	*Public Schools*	2.7 (1.3)	1.2 (1.4)	0.3 (0.8)	4.1 (1.2)
	Private Schools	2.2 (0.8)	1.8 (1.6)	0.2 (0.8)	4.2 (1.6)
School Setting	*Urban Schools*	3.0 (1.2)	1.0 (1.4)	0.2 (0.6)	4.1 (1.2)
	Rural Schools	2.3 (1.2)	1.5 (1.5)	0.4 (0.9)	4.1 (1.4)
National		***2.6 (1.2)***	***1.3 (1.5)***	***0.3 (0.8)***	***4.1 (1.3)***

Table 6: Teaching Assignment of the Participants
Note: Standard deviations are enclosed in parenthesis.

Teacher Quality Numerous teacher quality indicators influence student achievement. In fact, not all that were identified can account for students' achievement in the classroom. Substantial research findings, however, suggest that parameters such as academic preparation, licensure status, teaching experience, involvement in professional development programs, and teaching confidence can capture teacher quality significantly. Hence, these indicators were used to assess the quality of physics teachers in this study.

Academic Preparations All participating teachers have baccalaureate degrees. The majority, 68.0%, earned a Bachelor in Secondary Education (BSE)[1] degree, a 4-year course for those intending to teach in high schools. In this course, students take liberal arts courses, education-related courses, and major courses in their preferred field(s) of specialization. Every graduate of this course has a major specialization and some have a minor specialization. For example, a physics major can sub-specialize in mathematics or in chemistry by taking additional credit units. The remaining teachers have degrees in pure sciences (12%), in engineering (11%), in industrial/ agricultural education (5%), in applied sciences (2%), and in non-science fields (2%). Of the surveyed teachers, a small percentage specialized in physics. Only 19% majored in physics, while 5% had minor specializations in the same subject. Those with a certificate in physics teaching (9% of the population) comprise 7% of the teacher population.

Interestingly, 14% of teachers have master's degrees and 41% have graduate units. Very few, 2%, have doctorates or are presently enrolled in a doctoral program. Of those with master's degree, 22% have a specialization in physics/physics education, and those pursuing a master's degree, 13%, are specializing in the same field. Those teachers who have a doctorate specialized in educational administration-related fields.
Considering their academic preparation, only 30% of teachers are considered qualified physics teachers, that is, those teachers who have earned a degree with specialization in physics. While public schools have 32% qualified physics teachers, the private schools have 21%. This edge of public schools over private schools can be accounted for by the effort of the government, particularly that of the Department of Science and Technology – Science Education Institute (DOST-SEI), to provide scholarships to outstanding students to pursue education degrees with a specialization in physics. Soon after graduation, scholar graduates are obliged to teach in public schools for a duration equivalent to the number of years they received the scholarship. On the other hand, urban schools have 39% qualified teachers, while rural schools have 24%. The relative abundance of opportunities to improve in urban places may explain this incidence. The majority of universities in the Philippines are situated in urban areas; hence, urban school teachers can take supplementary credit units easily in these universities. NCR posted the highest qualified teachers at 67%, followed by Region IX (Zamboanga), 57%.

Licensure Status The survey shows that 94% of physics teachers possess licensure certificates. From this figure, it appears that a majority of these teachers have the necessary skills to teach. The percentage of licensed physics teachers in public schools stands at 97%, while that in private schools 79%. The significant percentage difference can be explained by the fact that in order to be employed in the public schools, an applicant must be a licensed teacher. Urban schools have 96% licensed teachers and rural schools have 92%. Those without teaching license, 6%, have passed other licensure examinations (e.g. engineering board examinations), are new graduates or are teachers who failed to have licensure certification. No significant variation exists in this index among the regional groups.

Category		Qualified Teachers	Licensed Teachers	Years of Experience	Professional Activities Involvement	Teaching Confidence
School Classification	*Public Schools*	32%	97%	9.6 (7.4)	55%	3.4 (0.7)
	Private Schools	21%	79%	6.6 (6.8)	45%	3.6 (0.7)
School Setting	*Urban Schools*	39%	96%	9.6 (7.4)	57%	3.6 (0.7)
	Rural Schools	24%	92%	8.6 (7.4)	51%	3.3 (0.7)
National		**30%**	**94%**	**9.0 (7.4)**	**54%**	**3.5 (0.7)**

Table 7: Profile of Some Teacher-Related Factors Considered
Note: Standard deviations are enclosed in parenthesis.

Teaching Experience Physics teachers in the Philippines have taught high school physics for 9.0 years on average. Some of them have less than 5 years experience in physics teaching, 36%, others have 5 to 10 year experience, 32%, and very few, 2%, have taught physics for more than thirty (30) years. No significant difference appears in the average physics teaching experience of teachers in urban and rural schools, 9.6 years and 8.6 years, respectively. A considerable difference, however, exists in the physics teaching experience between teachers in public schools and private schools. Public school teachers have significantly longer experience than their counterparts in private schools. The fast turn over of teachers in private schools explains this occurrence. Teachers in public schools stay longer in their posts than those in private schools because of the better benefits they receive from the government. Among the regions, Region VI (Western Visayas) has the highest physics teaching experience, 11.9 years, while Region VII (Central Visayas), the lowest with 6.2 years.

Involvement in Professional Development Activities In the last five years (1999-2004), not all of the surveyed physics teachers were able to attend physics-related professional development activities. Only a small majority, 54%, has attended international, national and/or local trainings. Public school teachers registered a percentage attendance, 55%, which is significantly higher than that in private schools, 45%. Such differences exists because the Philippine DepEd sponsors trainings exclusively for public school teachers from time to time during the school year or during summer breaks. The DOST-SEI also sponsors training for public school teachers at least once every year. By contrast, private school teachers must use their financial resources to attend training organized by private professional organizations and universities. Moreover, the effort of these two government agencies to spread these training opportunities among urban and rural school teachers explains the statistical equivalence of the percentage attendance of these two groups of teachers. On regional grouping, Region X (Northern Mindanao) teachers reported the highest attendance, 74%, closely followed by those in Region XI (Davao), and Region IX (Zamboanga) with percentages of 73% and 71%, respectively. The lowest attendance is registered by CAR teachers, 29%. A significant variation in this parameter exists among these regional groups.

Further investigations sought to identify probable reasons for teachers' poor attendance in continuing professional activities. Presented with five preconceived barriers, teachers were asked to rate them according to their applicability using a scale of 0 to 3, the latter being the highest. Results indicate that "Insufficient funds" were given the highest rating, 2.4, followed by "Not enough seminars/conferences available", 1.6, and "Family matters", 0.7. These results indicate that, teachers' salaries in the Philippines can not support their professional development. A minority can afford to pay registration, travel, and accommodation expenses necessary when attending seminars, conferences and training - this is especially true when the activity venues are not held in the locality.

Confidence in Physics Teaching The teachers were also asked to rate their physics subject proficiency and their teaching competence using a scale of 1 to 5, where the latter is the highest. Results show that physics teachers have an average confidence of 3.5. Despite having a lower percentage of qualified and licensed physics teachers, private schools have significantly more confident teachers than public schools. Urban schools, on the other hand, employ more confident teachers than rural schools. This could be due to the fact that there are more qualified and licensed teachers in urban schools than in rural schools. Qualified teachers possess more confidence than unqualified teachers. In the regional grouping, NCR teachers posted the highest confidence, 3.9, while ARMM teachers reported the weakest confidence, 3.0. NCR has the highest percentage of physics-major teachers, which could explain the highest teacher confidence in the region.

Among physics areas, teachers consider themselves weak in Modern Physics and strong in Mechanics, when asked to rate their confidence in a scale of 1 to 5, where 5 is the highest. The strength in Mechanics is expected because this physics area involves basic physics concepts, and is part of most science-related curricula in the Philippines. The relative superiority of Electromagnetism, 3.5, over Waves and Optics, 3.4, can be accounted for by the inclusion of Electromagnetism in engineering curricula as a basic course. Waves and Optics, as is Modern Physics, are taken only by students in a physics program.

Physics Area	Rating
Mechanics	3.8 (0.9)
Heat & Thermodynamics	3.5 (0.9)
Waves & Optics	3.4 (0.9)
Electricity & Magnetism	3.5 (0.9)
Modern Physics	3.0 (0.9)

Table 8: Teaching Confidence of Teachers in the Different Physics Areas
Note: Standard deviations are enclosed in parenthesis.

Summary and Implications The above indices imply that the quality of physics teachers in Philippine secondary schools is low. Academic preparation index indicates that the majority of teachers have below minimum qualification in physics. In the Philippines, minimum qualification for a physics teacher is a master's or a baccalaureate degree in physics or a certificate in physics teaching. Results show that only 30% of teachers are qualified to teach high school physics. The survey conducted by the Philippine Department of Science and Technology (DOST) illustrates that the lowest percentage of qualified secondary school science teachers is in Physics (27%) followed by Chemistry (34%), General Science (42%), and Biology (44%). Likewise, the 2003 TIMSS report revealed that only 7% of students in the Philippines were taught by teachers who were physics majors, unlike Japan, 33% (IEA 2004).

On attendance at professional development activities, the index also suggests poor participation in relevant seminars, conferences, and training. Teachers were given limited opportunities to collaborate with seasoned physics educators and experts and acquire valuable insights for professional improvement. On the contrary, these poor indices are partly compensated for by the substantial physics teaching experience of teachers which probably lead to their considerable confidence in teaching physics. Global data, however, suggests that these teachers have less teaching experience when compared to their counterparts in other countries. For example, the average teaching experience of physics teachers in Australia, Japan, and USA is 15, 16, and 14 years, respectively. On confidence, 51% of teachers in the Philippines reported capability to teach physics, as compared with those in Australia, 98 %, Japan 92%, and USA, 90% (IEA 2004).

Implications of these findings suggest that the condition of physics education in the Philippines is unlikely to result in quality student outcomes. Teachers' academic deficiencies and poor collaboration with physics experts can not result in innovative instructional methods in the absence of instructional devices in the classroom. Consequently, ineffective teaching and learning processes take place resulting in poor transfer of knowledge and skills to students. Unsurprisingly, therefore, Filipino students perform poorly in educational assessments, national and international tests.

Remaining Challenges

Considering the indicators used in this study, it appears that there is much work to be done to bring forth significant improvement in the Philippine physics education. Challenges to advance teacher quality and upgrade classroom educational infrastructure must be addressed to strengthen physics teaching in the country. Training should focus more on content and less on methodologies, because licensure examination results imply that teachers have mastery of education principles and practices. Similarly, training should not put teachers merely into a listening mode, but must require them to actively participate in the sessions and perform hands-on activities for greater motivation and better challenges. Post-baccalaureate scholarships are also desirable although they may only cater to teachers with above average aptitude. Many scholarship requirements serve only the intellectually capable, but leave the majority unaided.

Another way to address this challenge is to enjoin non-major teachers to avail themselves of undergraduate programs in physics. The Philippine DepEd could establish links with higher education institutions in collaboration with the Philippine Commission on Higher Education (a government agency supervising universities and colleges in the country), so as to create relevant, responsive, and financially affordable programs in physics education for teachers. This link may also include a program that encourages state universities or colleges to adopt a school division to help its schools improve teacher competence and instructional materials and devices. Professional mentoring and sharing of new teaching methodologies and research in physics education by university or college professors should be encouraged in this program. Granting of incentives upon completion of any of these programs is highly recommended.

Digitizing of training materials can also improve the quality of physics teaching in the country. If training modules are digitized and stored in the Internet, they can be made available to physics teachers across the country, an undertaking that is highly practical and doable, considering the high percentage of internet access of physics teachers, as revealed in the previous assessment. Teacher access to the Internet is also expected to increase because the Philippine DepEd expressed optimism on the computerization of all public schools before 2008 (Philippine Department of Education 2005). To complement this project, intensive training of teachers in information technology must be done. It will be futile to pursue this project, if some teachers do not know how to maximize use of the infrastructure. Successful implementation of this project will undoubtedly benefit teachers especially those with little opportunity to attend relevant training because of monetary and geographical constrains.

The dearth of instructional materials and technologies in schools is another major challenge. State-of-the-art physics classrooms remain an elusive dream for Philippine schools due to the limited financial resources of the country. Equipping these schools with simple, but useful instructional devices is much more attainable, however. Teachers and school support staff have to be trained in producing improvised instructional devices using raw materials available in school localities. This type of community-based project will also make learning more meaningful to students because these classroom devices are more likely to originate from familiar sources. It is also highly recommended that the number of Mobile Information Technology Classrooms (MITC) - laboratory/activity classrooms in buses that move from school to school – be increased to provide students with opportunities to learn science using information technology facilities and standard laboratory equipment. This project was initiated by the Philippine DOST-SEI (Philippine DOST-SEI 2005).

Furthermore, the challenge remains of providing attractive compensation schemes for science teachers. Proposals to this effect have long been recommended by prominent science educators in the Philippines. Improved salaries will increase morale and directly address poor personal and professional advancement. Innovative compensation schemes will also attract individuals with better academic potential to pursue a career in science teaching, particularly in physics. It may also help solve the serious problem of 'brain drain' faced by the Philippine educational system. Seasoned science teachers leave the country to seek more financially rewarding teaching positions abroad. One placement firm in the Philippines with links to the American Board for Certification of Teacher Excellence, for instance, recently reported that they have already helped 280 Filipino teachers find teaching jobs in the United States between 2003 and 2005 (Contreras 2005). It plans to send another 500 skilled Filipinos this year, and the number of job placements could increase by 500 a year until 2010 to meet growing US demand for new teachers. The job placement agency reported that demand for teachers in the US alone will reach 200,000 a year over the next decade, prompting recruiters to consider non-teaching Filipino professionals to fill US teacher vacancies in some states.

On a smaller scale, school division superintendents should encourage physics-major school administrators to teach physics classes, in concurrent capacity with their supervisory responsibilities, to prevent depletion of qualified teachers in the classroom. It should also encourage sharing of resources among privileged schools and schools with poor collections of instructional materials and fewer qualified physics teachers. This approach is possible because survey data indicate that most urban schools have these capabilities. Also, to remedy the insufficiency of reading materials in schools, school administrators can solicit or campaign for books from people in the locality and from private and non-governmental organisations.

Equally, development of semi-detailed lesson plans in physics and provision of demonstration classes would be of benefit. Post-demonstration conferences should be held to identify strengths and flaws of classes observed. Echo seminars to fellow teachers in the school division should be required from those who attend physics-related training. All these moves would help address the lack of professional mentoring in schools.

Conclusion

The survey results from this study indicate that the challenge facing the Philippine government is to devise ways to substantially improve the quality of physics education in the country. If relevant efforts outlined here then substantive improvements are possible.

Notes

[1] In the case of the Philippine Normal University, the BSE in Physics program comprises of 71 units of general education courses, 48 units of professional education courses, and 68 units of specialisation courses. Specialisation courses includes physics (39 units), mathematics (21 units), and chemistry (8 units).

References

Amid, D. (1998) *Development and validation of a proposed work-text in analytic geometry,* Unpublished master's thesis, Centro Escolar University, Manila.

Ariota, R. (1997) *Proposed instructional materials in the teaching of mathematics at La Salette College of Engineering, Santiago City*, Unpublished master's thesis, Saint Paul University, Santiago City.

Avila, A. (1998) *Design and evaluation of a computer-assisted instruction material in heat and thermodynamics,* Unpublished master's thesis, De La Salle University, Manila.

Becta (2003) "Secondary Schools – ICT and Standards: An analysis of national data from Ofsted and QCA", Retrieved: June 8, 2004. <http://www.becta.org.uk/page_documents/research/secschoolfull.pdf>.

Brown, C. A., Smith, M. S., and Stein, M. K. (1995) Linking teacher support to enhanced classroom instruction. Paper presented at the annual meeting of the American Educational Research Association. New York.

Calacal, S. (1999) *An analysis of the physics competencies of Mariano Marcos State University students under the New Secondary Education Curriculum (NSEC)*, Unpublished doctoral dissertation, De La Salle University, Manila.

California Education Policy Seminar and California State University Institute for Educational Reform (1998) *Doing what matters most: Investing in quality teaching*, California State University Institute for Educational Reform, USA.

Capili, M. (1987) *Development of laboratory manual in physics for students enrolled in the double secondary curriculum with a thrust in the arts*, Unpublished master's thesis, De La Salle University, Manila.

Capistrano, N. (1999) *Students alternative conceptions in introductory college physics courses*, Unpublished master's thesis, De La Salle University, Manila.

Cohen, D. K. and Hill, H. (1997) Instructional policy and classroom performance: The mathematics reform in California. Paper presented at the annual meeting of the American Educational Research Association. Chicago, Illinois.

Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfeld, F., and York, R. (1996) *Equality of educational opportunity*, US Government Printing Office, Washington, DC.

Contreras, V. (2005) US needs 200,000 teachers yearly, say placement firm, *Philippine Daily Inquirer*, 16 November.

Corpuz, E. (1998) *Effects of a computer instruction program on college students' performance in solving simple problems in mechanics,* Unpublished master's thesis, De La Salle University, Manila.

Curammeng, G. (1993) *Development and Evaluation of a laboratory manual in College Physics I for engineering students using standard and improved apparatus*, Unpublished master's thesis, De La Salle University, Manila.

Darling-Hammond, L. (1998) Doing what matters most: Investing in quality teaching, in a discussion sponsored by the California Education Policy Seminar and California State University Institute for Educational Reform.

Darling-Hammond, L. (2000) "Teacher Quality and Student Achievement: A Review of State Policy Evidence", Educational Policy Analysis Archives, 8(1), viewed 9 June 2004 <http://epaa.asu.edu/epaa/v8n1/>.

Ferguson, R. (1998) Can schools narrow the black-white test score gap?, in C. Jencks and M. Philipps, eds., *The Black-White Test Score Gap*, The Brookings Institution, Washington, DC.

Figuerres, O. (1985) *An analysis of the physics achievement of engineering students from selected colleges and universities in Region I*, Unpublished master's thesis, De La Salle University, Manila.

Flores, A. (1989) *A proposed workbook in algebra for an agricultural school*, Unpublished master's thesis, De La Salle University, Manila.

Goldhaber, D. and Anthony, E. (2003) "Teacher quality and student achievement", ERIC Clearinghouse on Urban Education Urban Diversity Series, Retrieved: June 9, 2004.
<http://www.eric.ed.gov/ERICWebPortal/Home.portal?_nfpb=true&ERICExtSearch_SearchValue_0=Goldhaber+%26+Anthony&ERICExtSearch_SearchType_0=authors&_pageLabel=RecordDetails&objectId=0900000b8011f92e>.

Goldhaber, D. (2002) The mystery of good teaching: Surveying the evidence on student achievement and teachers' characteristics, *Education Next*, vol. 2, no. 1, pp. 50-55.

Goldhaber, D., Brewer, D. and Anderson, D. (1999) A three-way error components analysis of educational productivity, *Education Economics*, vol. 7, no. 3, pp. 199-208.

Hanushek, E., Kain, J. and Rivkin, S. (1999) "Do higher salaries buy better teachers?", Working Paper No. 7082, National Bureau of Economics Research, Cambridge.

Hawk, P., Coble, C.R. and Swanson, M. (1985) Certification: It does matter, *Journal of Teacher Education*, vol. 36, no. 3, pp. 13-15.

International Association for the Evaluation of Educational Achievement. (2004) *TIMSS 2003 International Science Report*, TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College, USA.

Jordan, H., Mendro, R. and Weeasinghe, D. (1997) Teacher effects on longitudinal student achievement. Paper presented at the National Evaluation Annual Meeting, Indianapolis.

Kington, A., Harris, S., Smith, P. and Hall, M. (2003) "Computers for Teachers. A qualitative evaluation of Phase 1", Report to the DfES, ICT in Schools Research and Evaluation Series No. 14, Retrieved: June 8, 2004.
<http://www.becta.org.uk/page_documents/research/cft_qual_eval_phase1.pdf>.

Logmao, D. (1997) *Effectiveness of programmed instruction using audio-visual technique in teaching physics*, Unpublished master's thesis, Philippine Normal University, Manila.

Lontayao, R. (1999) *Effectiveness of video instruction in teaching concepts on aquatic ecosystem to second year high school students of selected public high schools school year 1998-1999*, Unpublished master's thesis, Mindanao State University – Iligan Institute of Technology, Iligan City.

Mayer, D., Mullens, J. and Moore, M. (2001) "Monitoring school quality: A indicators report", Education Statistics Quarterly, 3(1), viewed 9 June 2004 <http://nces.ed.gov/programs/quarterly/vol_3/3_1/q4_4.asp#top >.

Mehrotra, S. and Buckland P. (1998) "Managing teacher costs for access and quality", UNICEF Staff Working Papers, No. EPP-EVL-98-004, Retrieved: 23 May 2006.
<http://www.unicef.org/evaldatabase/files/Global_1998_Managing_Teacher.pdf>.

Orleans, A. (1994) *The relative effectiveness of calculus-based college physics instructions on student achievement*, Unpublished mater's thesis, De La Salle University, Manila.

Philippine Department of Education, Culture, and Sports, Department of Science and Technology Science Education Institute, and University of the Philippines National Institute for Science and Mathematics Education Development (2000) TIMSS-R Philippine Report, *Volume 1: Science.*

Philippine Department of Education (2005) "DepEd targets computerization of all public schools by 2008", Retrieved: April 4, 2005. <http://www.gov.ph/cat_education/newscontent.asp?newsid=7743>.

Philippine Department of Science and Technology Science Education Institute (2005) "Programs and Projects", Retrieved: April 4, 2005. <http://www.sei.dost.gov.ph/programs.html>.

Philippine National Statistics Office (2005) "Index of demographic statistics", Retrieved: May 30, 2006. <http://www.census.gov.ph/data/sectordata/datapop.html>.

Philippine National Statistics Office (2003) "Philippines: Urban population was registered at 48.05 percent", Retrieved: May 30, 2006. <http://www.census.gov.ph/data/pressrelease/2003/pr0382tx.html>.

Plaza, L. (1996) *Development and validation of issue-oriented supplementary materials in ecology,* Unpublished master's thesis, Philippine Normal University, Manila.

Sanders, W. and Horn, S. (1998) Research findings from the Tennessee Value-Added Assessment System (TVAAS) database: Implications for educational evaluation and research, *Journal of Personal Evaluation in Education*, vol. 12, no. 3.

Sanders, W. L. and Rivers, J. C. (1996) Cumulative and residual effects of teachers on future academic achievement, University of Tennessee Value-Added Research and Assessment Center.

Schmidt, W. & Cogan, L. (1996) Development of the TIMSS Context Questionnaires, in M. Martin and D. Kelly, eds., *Third International Mathematics and Science Study (TIMSS) Technical Report, Volume 1: Design and Development,* Boston College, Chestnut Hill, MA.

Tribiana, E. (1991) *Development of molecular models for use in teaching selected topics in organic chemistry*. Unpublished master's thesis, De La Salle University, Manila.

UK Department of Education and Skills (2003) "The big pICTure: The impact of ICT on attainment, motivation and learning", by V. Pittard, P. Bannister, and J. Dunn, Retrieved: June 9, 2004. <http://www.ioe.ac.uk/schools/clc/ma-tesol/technology/files/ICT_research/The_big_picture.pdf>.

Undag, M. C. (1996) *Television programs as instructional media resource: Effects on achievement and attitude in science,* Unpublished master's thesis, University of the Philippines, Quezon City.

US Department of Education (1999) *Defining effective professional development: Lessons from the Eisenhower program*, Washington, DC.

US Department of Education, National Center for Education Statistics (1998) "Towards better teaching: Professional development in 1993-94", NCES 98-230, by Susan Choy and Xianglei Chen, Project Officer: Micheal Ross, Retrieved: June 8, 2004. < http://nces.ed.gov/pubs98/98230.pdf >.

US Department of Education, National Center for Education Statistics (2000) "School-level correlates of academic achievement: Student assessment scores in SASS public schools", NCES 2000-303, by Donald McLaughlin and Gili Drori, Project Officer: Ross, M., Retrieved: June 8, 2004. <http://nces.ed.gov/pubs2000/2000303.pdf >.

Wiley, D. and Yoon, B. (1995) Teacher reports of opportunity to learn: Analyses of the 1993 California Learning Assessment System, *Educational Evaluation and Policy Analysis*, vol. 17, no. 3, pp. 355-370.

Wright, P., Horn, S. and Sanders, W. (1997) Teacher and classroom context effects on student achievement: Implications for teacher evaluation, *Journal of Personnel Evaluation in Education*, Kluwer Academic Publishers, Boston, no. 11, pp. 57-67.