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The Effect of Metacognitive Learning Strategy in Physics Achievement

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Abstract:
The study aimed to find out the effect of the metacognitive learning strategy in the Physics achievement of fourth year high school students in David Moises Memorial High School for school year 2011 – 2012. This experimental study was conducted among 120 randomly selected fourth year high school students. The independent variables were the traditional methods and the metacognitive learning strategy, on the other hand, the dependent variable was the physics achievement. The findings of the study revealed that the physics achievement of students in the pretest and posttest of the control group design showed that it is average in the pretest. On the other hand, the post-test showed that the experimental group is very good while the control group is good in physics. The physics achievement on the post-test of the post-test-only control group design showed that the experimental group with non-pretest has good achievement, while in the control group with non-pretest has an average achievement. There is no significant difference in the posttest scores on the physics achievement in favor of the experimental group. The pretest has an effect on the post-test of the experimental group and on the post-test of the control group. There is a significant difference in the physics achievement between the experimental group with non-pretest and the control group with non-pretest respectively. There is a significant difference in the post-test of the control group and a control group with non-pretest correspondingly. There is a statistically significant difference in the posttest scores of the experimental groups and control groups.

Keywords: *Physics achievement, Traditional Methods, Metacognitive Learning Strategy*

1. Introduction

Nowadays, countries all over the world, especially the developing are striving hard to develop technologically and scientifically, since the world is turning scientific and all proper functioning of lives depend greatly on Science.

According to [xx], science is a dynamic human activity concerned with understanding the workings of our world. Science comprises the basic disciplines such a Physics, Chemistry, Mathematics and Biology. Many investigations have shown that secondary school students are exhibiting dwindling interest in Science [vii]. Besides, Physics as one of the science subjects remains one of the most difficult subjects in the school curriculum [xiii]. Studies have revealed that the achievement in Physics was generally and consistently poor over the years. In the different science subject areas, achievements in physics of Filipino students appeared below the international standards. The Philippines ranked third and fourth to the last in the list of nations in the 1999 and 2003 TIMSS respectively (US Department of Education National Center for Education Statistics 2000, International Association for the Evaluation of Educational Achievement 2004).

The poor academic achievement in Physics could be attributed to many factors among which teacher's strategy itself was considered as an important factor [ix]. It is observed that in the application and selection of teaching methods, the majority of teachers still rely heavily on classroom lectures and blackboard demonstrations; most of them lack either the ability or the will to develop and utilize diversified, innovative ways of teaching.

At present, many educators are prodding the teachers to expose students to use metacognitive learning strategy. This strategy introduces learners' automatic awareness of their own knowledge and their ability to understand, control, and manipulate their own cognitive processes. Students typically learn metacognitive skills while they are involved in learning something else. If they are to do this successfully, it is extremely important that the learners have learned the prerequisite content knowledge for the subject matter topic being studied. If that prerequisite knowledge has not been mastered to a sufficient level of automaticity, then the working memory of the learner will be overwhelmed by the subject matter; and the result will be no time for metacognitive reflection [xvi]. The observation and usefulness of this strategy to students prompted the researcher to use the metacognitive learning strategy in teaching physics lesson. As a physics teacher in high school, the researcher would like to find out if this strategy of teaching is effective in improving the physics achievement of students.

This study was anchored on the Metacognitive Theory of [xvi]. Based on this theory, the key aspect of metacognitive learning is a person's beliefs about themselves, particularly their views about their ability to learn. At the extreme, if a person does not believe that they can learn they won't. Learning requires conscious attention, effort and "time on task". These activities are a waste of time to someone who does not believe that they have the ability to learn. More fundamentally, for many, their learning ability is stifled by a "fixed" self-concept whereby they tell themselves that they can't learn. Following "the learning way" begins with embracing the idea that "I am a learner" and continues with the development of sophisticated strategies for intentional learning based on their unique talents and the different learning challenges they face. In metacognition, there were four general metacognitive strategies to be followed: (1) organize/plan your own learning, (2) manage your own learning, (3) monitor your own learning, and (4) evaluate your own learning. This metacognitive learning strategy follows the sequential order of the process a learner generally goes through in accomplishing any task. What do I do before I start? (Organize/Plan) What do I do while I am working on the task? (Manage) How do I make sure I am doing the task correctly? (Monitor) What do I do after I have finished the task? (Evaluate).

This is also supported by the constructivist learning theory. A subset of the trend of developing skills in metacognition is the relationship between metacognition and constructivist learning theory. Constructivist teaching and learning theory is an approach to learning that locates cognition and understanding within the individuals [v]. This theory states that learning is an active process of creating meaning from different experiences. In other words, students will learn best by trying to make sense of something on their own with the teacher as a guide to help them along the way.

2. Statement of the Problem

Generally, this study was designed to investigate the effect of metacognitive learning strategy in the Physics achievement of fourth year high school students in David Moises Memorial High School for the school year 2011-2012.

Specifically, the study sought to answer the following questions:

1. What is the Physics achievement in the pretest and posttest of the experimental group and the control group?
2. What is the Physics achievement in the post-test of the experimental group and control groups with non-pretest?
3. What are the mean gains in the pretest and posttest of the experimental group and the control group in Physics achievement?
4. What are the mean gains in the post-test of the experimental group and control groups with non-pretest?
5. Are there significant differences in the pretest scores of the experimental and control groups?
6. Are there significant differences in the posttest scores of the experimental and control group?
7. Are there significant differences in the Physics achievement in the pretest and posttest of the experimental group and the control group?
8. Are there significant differences in the Physics achievement in the post-test of the experimental group and control groups with non-pretest?
9. Are there significant differences in the post-test for both experimental groups?
10. Are there significant differences in the post-test for both control groups?
11. Are there significant differences in the post-test of experimental groups and control groups?

3. Literature Review

3.1. Metacognitive Learning Strategy

The central role of experience in learning is on the concept of metacognition which introduced consciousness to the study of human learning. Although related, cognition and metacognition differ: cognitive skills are those needed to perform a task whereas metacognitive skills are necessary to understand how it was performed [xxvii]. Metacognitive skills are generally divided into two types: self-assessment (the ability to assess one's own cognition) and self-management (the ability to manage one's further cognitive development) [xxvii]. Successful learners employ a range of metacognitive skills and effective teachers attend to the development of these skills.

Trends in the literature on metacognition can be grouped around the two types of metacognitive skills. Literature on self-assessment deals with the importance of learners being able to assess their knowledge and abilities. Research indicates that learners who are skilled in metacognitive self-assessment and, therefore, aware of their abilities are more strategic and perform better than those who are unaware [xxvii]. Examples of instrumentsfor assessing metacognitive skills can be found in [xix]. The use of such instruments can help learners to incorporate strategies that will improve metacognition [xix].

Most of the literature on metacognitive learning strategies is related tothe area of self-management skills. Metacognitive learning strategy refers to the ability of learners to be aware of and monitor their learning processes [xxiii]. According to [xvi], the four general metacognitive strategies to be followed are: organize/plan your own learning, manage your own learning, monitor your own learning, and evaluate your own learning. These metacognitive strategies follow the sequential order of the process a learner generally goes through in accomplishing any task. What do I do before I start? (Organize/Plan) What do I do while I am working on the task? (Manage) How do I make sure I am doing the task correctly? (Monitor) What do I do after I have finished the task? (Evaluate).

The role of instructors in enhancing learner cognition is stressed in much of the material on self-management. Teachers who are aware of their own metacognitive functioning tend to play a more significant role in helping learners develop skills in metacognition [xxx]. Suggestions for instructors can be found in several sources including [iv] and [xxviii]. Helping learners improve their self-management skills through the use of specific techniques is the subject of some articles. [v], for example, describes how she used concept mapping to help learners become more aware of and understand their learning processes. [xvii] used self-regulated learning strategies to help nurses improve their metacognition so that they could function more effectively in practice.

Metacognition is essential to successful learning because it enables individuals to better manage their cognitive skills and to determine weaknesses that can be corrected by constructing new cognitive skills. Almost anyone who can perform a skill is capable of metacognition – that is, thinking about how they perform that skill. Promoting metacognition begins with building an awareness among learners that metacognition exists, differs from cognition, and increases academic success. The next step is to teach strategies, and more importantly, to help students construct explicit knowledge about when and where to use strategies. A flexible strategy repertoire can be used next to make careful regulatory decisions that enable individuals to plan, monitor, and evaluate their learning. Recent research indicates that metacognitively aware learners are more strategic and perform better than unaware learners, allowing individuals to plan, sequence, and monitor their learning in a way that directly improves performance. Metacognition is separate from other cognitive constraints on learning such as aptitude and domain knowledge. There is strong support for the two-component model of metacognition which includes knowledge and regulation of cognition [xii].

Metacognitive skills are important not only in school, but throughout the life because: 1. Teaching specific strategies, such as the order in which to perform a particular task, will not give students the skills they need in the long run. Students must learn general principles such as planning, monitoring and how to apply them over a wide variety of tasks and domains. 2. Both the long-term benefits of training in cognitive skills and the ability to apply cognitive skills to new tasks appear to depend on training at the metacognitive level as well as the cognitive one. Metacognitive skills are needed for effective cognitive performance. 3. Usually students have an experience of blindly following instructions. They have not acquired the habit of questioning themselves to lead to effective performance on intellectual tasks. 4. Students with the biggest metacognitive skills deficiencies seem to have no idea what they are doing when performing a task. 5. Students have the metacognitive performance of: a) determining the difficulty of the task; b) monitoring their comprehension effectively; c) planning ahead; d) monitoring the success of their performance or determining when they have studied enough to master the material to be learned;
e) using all relevant information; f)using a systematic step-by-step approach; g) jumping to conclusions; h) using inadequate or incorrect representations.6. Metacognitive skills and knowledge, as important as they are, are not often taught in most areas of the curriculum.

Metacognitive skills positively impact students because they provide these students an efficient way to acquire, store, and express information and skills [xxxi]. For many students who have learning problems, their inability to efficiently retrieve information previously stored in memory negatively impacts their ability to accurately express what they know. Well developed metacognitive skills aid such information retrieval for these students. The key to the success of metacognitive skills is that when they are taught appropriately, they assist learners who are dependent on high levels of teacher support to become self-directed learners. When students have been directly taught a strategy, the strategy's purpose, how to use the strategy, and are provided the opportunities to practice using the strategy, these students' posses a powerful learning tool that builds learning independence.

Confronted with a problem-solving situation, these students can implement the appropriate metacognitive strategy when they have difficulty remembering how to solve a particular problem. Metacognition is not a linear process that moves from preparing and planning to evaluating. More than one metacognitive process may be occurring at a time during a learning task. This highlights once again that the orchestration of various strategies is a significant component of learning. Students with developed metacognitive skills are able to monitor and direct their own learning processes. When learning a metacognitive skill, learners typically go through the following steps [xxxi] :1. They establish a motivation to learn a metacognitive process. This occurs when either they themselves or someone else points them reason to believe that there would be some benefit to knowing how to apply the process. 2. They focus their attention on what it is that they or someone else does that is metacognitively useful. This proper focusing of attention puts the necessary information into working memory. Sometimes this focusing of attention can occur through modeling and sometimes it occurs during personal experience. 3. They talk to themselves about the metacognitive process. This talk can arise during their interactions with others, but it is their talk to themselves which is essential. This self talk serves several purposes: a. It enables them to understand and encode the process; b. It enables them to practice the process; c. It enables them to obtain feedback and to make adjustments regarding their effective use of the process; and d. It enables them to transfer the process to new situations beyond those in which it has already been used. 4. Eventually, they begin to use the process without even being aware that they are doing so which means that they became autonomous.

3.2. Physics Achievement

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 [xxiv]. 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 also present the same conclusion of low student achievement in physics [iii].

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. In most of the reports, research findings confirmed that teacher quality appears to be the most important factor influencing student performance [ix]. Research confirmed that among other school-related factors, teacher quality has the greatest impact on students. Teacher academic preparation, certification type, and years of teaching experience, among others, are often taken as indicators of teacher quality [ix]. 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 [vi].

Licensed teachers are also considered to be effective because licensing typically requires prospective teachers hold a college degree in pedagogy and in the subject they wish to teach [ix]. Veteran teachers, on the other hand, can better handle students and colleagues, and are more familiar with classroom practices [xxxii].

Experts also affirm that quality professional development involvement is an important factor in building teachers' capacity to teach effectively [xviii]. Studies revealed that student achievement is correlated to teachers' continued learning activities. Teacher confidence, too, has been regarded by the International Association for the Evaluation of Educational Achievement 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, workbook/worktext, learning modules, models, audio-visual materials, computer-assisted instructional programs, and digital technologies such as computer hardware, software, and internet [i] are proven to be effective in modifying learners' behavior and in facilitating effective acquisition of knowledge and skills.

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 [xxiv]. 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.

The 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.

3.3. 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 [xxiv]. 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.

3.4. 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, 42.3students. 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.

3.5. 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 schoolteachers 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. 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%.

3.6. 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.

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%).

An inventory of instructional materials confirms 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. 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.

3.7. Teacher- Related Factors

To [ix], 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. 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 cannot be attributed to existing facts for no distinct difference can be seen as to economic and educational situation in both regions.

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.

3.8. 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.

3.9. Academic Preparations

All participating teachers have baccalaureate degrees. The majority, 68.0%, earned a Bachelor in Secondary Education (BSE)1 degree, a 4-yearcourse 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%.

3.10. 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.

3.11. 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, 9.6years 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 turnover 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.

3.12. 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 exist 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 schoolteachers 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.

3.13. 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, where5 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.

4. Methodology

This study employed the quasi-experimental method involving the Solomon's four equivalent control group design. This design was appropriate because there was non-random selection of students to the groups.

Secondary school classes exist as intact groups and teachers do not normally allow the classes to be dismantled and reconstituted for research purposes. This design has advantage over others since it controls the major threats to internal validity except those associated with interaction and instrumentation [viii]. In this study, no major event was observed in the students to introduce the threat of interaction. The conditions under which the instruments were administered were kept as similar as possible across the groupings in order to control instrumentation and selection. The students were randomly assigned to the control and treatment groups to control for selection and interaction.

5. Results and Discussion

5.1. Physics Achievement in the Pretest and Posttest of the Experimental Group and the Control Group

Table 1 presented the pretest and posttest achievement of students in physics using the metacognitive learning strategy in the experimental group and the traditional methods in the control group.

The students' pretest achievement either in the use metacognitive learning strategy *(experimental group)* or in the use of traditional methods *(control group)* in teaching physics is average with means of 11.30 and 13.27; and standard deviations of 4.5 and 3.4 respectively. However, the students assign in the traditional methods *(control group)* have higher mean score than those in the metacognitive learning strategy *(experimental group).*

In the posttest, students had very good and good achievements when taught using metacognitive learning strategies *(M = 21.40; SD = 3.6)* and traditional methods *(M = 16.73; SD = 1.5)* in that order. The posttest comparison of students' achievement in physics showed that there is an increase in the mean score of the metacognitive learning strategy than those in the traditional methods.

The results indicated that there were greater improvements in the physics achievement when the students asses and manage the metacognitive learning strategy rather than the traditional methods. The result conforms to the findings of [xxvii] that learners who are skilled in metacognitive self-assessment and, therefore, aware of their abilities are more strategic and perform better than those who are unaware.

	Physics Achievement							
	Pretest				**Posttest**			
Group	Mean	Description	SD	N	Mean	Description	SD	N
Experimental	11.30	Average	4.5	30	21.40	Very Good	3.6	30
Control	13.27	Average	3.4	30	16.73	Good	1.5	30

Table 1: Pretest and Posttest Means and Standard Deviations of the Experimental and the Control Groups

5.2. Physics Achievement in the Posttest of the Experimental Group and the Control Group with Non-Pretest

The physics achievement in the posttest of the experimental group and the control group with non-pretest is shown in Table 2.

The comparison of posttest achievement in physics showed that those students who learn the lesson using the metacognitive learning strategy *(M = 19.17; SD = 2.13)* have good achievement, while for those students who use the traditional methods *(M = 14.60; SD = 4.48)* have average achievement. The results implied that the students who are more exposed to the metacognitive learning strategy perform better than the traditional methods. The increase in the physics achievement maybe attributed to the metacognitive skills acquired and developed in the learning experiences of the students. The result of the study supports the idea of [xxxi] that metacognitive skills positively impact students because they provide these students an efficient way to acquire, store, and express information and skills. When students have been directly taught the learning strategies, the students' posses a powerful learning tool that builds learning independence.

	Physics Achievement			
	Posttest			
Group	**Mean**	**Description**	**SD**	**N**
Experimental with Non-Pretest	19.17	Good	2.13	30
Control with Non-Pretest	14.60	Average	4.48	30

Table 2: Posttest Means and Standard Deviations of the Experimental Group and the Control Group with Non-Pretest

Scale	Description
20.01 – 25.00	Very Good
15.01 – 20.00	Good
10.01 – 15.00	Average
5.01 – 10.00	Poor
0.00 – 5.00	Very Poor

5.3. Mean Gains in the Pretest and Posttest of the Experimental Group and the Control Group in Physics Achievement

The mean gain in physics achievement of the experimental group and control group in the pretest and posttest is presented in Table 3.

The results showed that there is a greater mean gain in the experimental group *(M = 10.10)* as contrasted to the control group *(M = 3.46).* This means that the experimental group performed better than the control group. The results implied that the students learn better when they used the metacognitive learning strategy compared to the traditional methods. The result of the study conforms to the findings of [xxvi] that the role of metacognition in learning is fundamental to achieve deeper and fruitful understanding of the lesson.

	Physics Achievement		
Group	Pretest Mean	Posttest Mean	Mean Gain
Experimental	11.30	21.40	10.10
Control	13.27	16.73	3.46

Table 3: Results of Mean Gain of the Experimental and Control Groups in Physics Achievement in the Pretest and Posttest

5.4. Mean Gains in the Posttest of the Experimental and Control Groups with Non-Pretest in Physics Achievement

In Table 4, the mean gain in the posttest of the experimental and control groups with non-pretest is presented.

The results showed that there is a greater mean gain in the experimental group with non-pretest as match up to the control group with non-pretest *($M = 4.57$)*. This means that the experimental group with non-pretest learned better than the control group with non-pretest. The results implied that the students perform better when they applied the metacognitive learning strategy compared to the traditional methods. The outcome of the study supports the findings of [xxix]that the regulation of metacognition is the executive component that comprises the repertoire of activities used by individuals to control and improve their cognition.

	Physics Achievement			
Group	**Posttest Mean**	**Group**	**Posttest Mean**	**Mean Gain**
Experimental with Non-Pretest	19.17	Control with Non-Pretest	14.60	4.57

Table 4: Results of Mean Gain of the Experimental and Control Groups with Non-Pretest in Physics Achievement in the Posttest

5.5. Inferential Data Analyses

5.5.1. Differences in the Pretest Scores of the Experimental and Control Groups

The results of the pretest scores on the physics achievement for experimental and control groups are shown in Table 5.

Data showed that, statistically there is no significant difference *$t(-1.906) = .062$, $p > 0.05$* in the pretest scores on the physics achievement for experimental and control groups. Therefore, the hypothesis which states no significant difference in the pretest scores on the physics achievement is accepted. This means that the p value was large, and therefore the obtained difference between the sample means is regarded as not significant. This indicated that the groups used in the study exhibited comparable characteristics. The groups were therefore suitable for the study when comparing the effects of metacognitive learning strategy with the traditional methods on achievement in physics.

	Pretest Scores				
Group	**Mean**	**SD**	**t-value**	**Df**	**Sig.(2-tailed)**
Experimental	11.30	4.5			
Control	13.27	3.4	-1.906	58	.062

Table 5: t-test Result for the Difference in the Pretest Scores of the Experimental and Control Groups

$^{ns}\ p > .05$ – significant at 5% level

5.5.2. Differences in the Posttest Scores of the Experimental and Control Groups

The results of the posttest scores on the physics achievement for experimental and control groups are shown in Table 6.

Data showed that there is a significant difference *$t(6.614) = .000$, $p < 0.05$* in the posttest scores on the physics achievement in favor of the experimental group *($M = 21.40$; $SD = 3.6$*. Therefore, the hypothesis which states no significant difference in the posttest scores on the physics achievement is rejected. This indicated that the metacognitive learning strategy has an effect on the physics achievement of students as compared to the traditional methods.

	Posttest Scores				
Group	**Mean**	**SD**	**t-value**	**Df**	**Sig.(2-tailed)**
Experimental	21.40	3.6			
Control	16.73	1.5	6.614*	58	.000

Table 6: t-test Result for the Difference in the Posttest Scores of the Experimental and Control Groups

$^{*}\ p < .05$ – significant at 5% level

5.5.3. Differences in the Physics Achievement between the Pretests and Posttests of the Experimental Group and Control Group

The data in Table 7 showed the difference in the pretest and posttest of the experimental group and control group.

The result of the t-test for dependent samples revealed a significant difference *$t(29) = -11.751$* and *$p = .000$* between pre-posttest achievement of students in physics *($M = 11.30$, $SD = 4.5$; $M = 21.40$, $SD = 3.6$)* in the experimental group respectively with a mean difference of 10.10. The result indicated that the students had obtained higher score in their posttest in physics which contributed to a significant increase in their posttest mean achievement as compared to their pretest scores in the same test. This means that metacognitive learning strategy had an effect in the students' achievement in physics. The result of the study supports the findings of [xxv] that the students' acquisition of the metacognitive strategy, skills, and knowledge can improve their learning performance.

The result also showed that the t-test for dependent samples revealed a significant difference *$t(29) = -5.616$*and *$p = .000$* between pre-posttest achievement of students in physics *($M = 13.27$, $SD = 3.5$; $M = 16.73$, $SD = 1.5$)* in the control group with a mean difference of 3.46. This means that likewise the traditional methods have an effect in the physics achievement.

Therefore, the hypothesis which states no significant differences in the physics achievement in the pretest and posttest of the experimental group and the control group is rejected. This implied that the application of metacognitive learning strategy and traditional methods contribute to improve the achievement of the students in physics. However, analysis of the paired difference further revealed that there is a significant increase in the mean achievement of students in physics using the metacognitive learning strategy as compared to the traditional methods.

	Physics Achievement					
Group	Mean	SD	Paired Difference	t-value	Df	Sig.(2-tailed)
Experimental Pretest Posttest	 11.30 21.40	 4.5 3.6	 10.10	 -11.751*	 29	 .000
Control Pretest Posttest	 13.27 16.73	 3.5 1.5	 3.46	 -5.616*	 29	 .000

Table 7: t-test Result for Pretest & Posttest Achievement in Physics between the Experimental and Control Groups
**p < .05 – significant at 5% level*

5.5.4. Differences in the Physics Achievement in the Posttests of the Experimental and Control Groups with Non-Pretest

The data on the differences between the experimental group and the control group with non-pretest is presented in Table 8.

The result of the t-test for independent samples revealed a significant difference *t (58) = 5.036* and *p = .000* in the physics achievement between the experimental with non-pretest and the control group with non-pretest respectively with a mean difference of 4.57. Thus, the hypothesis which states no significant differences in the posttest of the experimental and control groups with non-pretest is rejected. This means that the use of the metacognitive learning strategy in the experimental group with non-pretest contributed a significant increase in the physics achievement of students.

	Physics Achievement					
Group	Mean	SD	Paired Difference	t-value	Df	Sig.(2-tailed)
Experimental with non-pretest	19.17	2.1				
Control with non-pretest	14.60	4.5	4.57	5.036*	58	.000

Table 8: t-test Result for Posttest Achievement in Physics between the Experimental and Control Groups with Non-Pretest
**p < .05 – significant at 5% level*

5.5.5. Differences in the Posttest for both Experimental Groups

In Table 9, the data showed that there is a significant difference *t (58) = 2.936* and *p = .005* in the posttest of the experimental group and experimental group with non-pretest respectively. Hence, the hypothesis which states no significant differences in the posttest of the experimental groups was rejected. Therefore, there was a significant difference in the acquisition of knowledge and skills using the metacognitive learning strategy particularly by those students who are exposed to the pretest.

Furthermore, the mean revealed that there was a difference of about 2.23 after the application of the metacognitive learning strategy which shows the effect of the metacognitive learning strategy to students learning.

	Physics Achievement					
Group	Mean	SD	Paired Difference	t-value	Df	Sig.(2-tailed)
Experimental (Group 1)	21.40	3.6				
Experimental (Group 3)	19.17	2.1	2.23	2.936*	58	.005

Table 9: t-test Result in the Posttest for both Experimental Groups
**p < .05 – significant at 5% level*

5.5.6. Differences in the Posttest for both Control Groups

The data in Table 10 showed the difference in the posttest for both control groups.

The result revealed that there is a significant difference *t (58) = 2.478* and *p = .016* in the posttest of the control group and control group with non-pretest respectively. Hence, the hypothesis which states no significant differences in the posttest of the control groups was rejected. Therefore, there was a significant difference in the learning of the students using the traditional methods specifically to those students who are exposed to the pretest.

Furthermore, the mean revealed that there was a difference of about 2.13 after the traditional methods were employed. This means that the traditional methods have an effect also to students learning.

	Physics Achievement					
Group	**Mean**	**SD**	**Paired Difference**	**t-value**	**Df**	**Sig.(2-tailed)**
Control (Group 2)	16.73	1.46				
Control with Non-Pretest (Group 4)	14.60	1.48	2.13	2.478*	58	.016

Table 10: t-test Result in the Posttest for both ControlGroups
**p < .05 – significant at 5% level*

5.6.1. Differences in the Posttest Scores of Experimental

5.6.1.1. Groups and Control Groups

Table 11 showed the results of the ANOVA post-test scores on the physics achievement. The table shows that there is a statistically significant difference between the means *F = 23.346* p <0.05*. This means that the F factor is significant at p <0.05 level and between means square is statistically significantly greater than within means square. This shows that there is a highly significant overall treatment effect. Hence, the null hypothesis is rejected. This means that there is probably at least one significant difference among possible comparisons of two means in the four groups. There was therefore, a need to find out where this experimental effect was located.

Category	Sum of Squares	df	Mean Square	F	Sig
Between Groups	782.492 3		260.831		
Within Groups	1148.433116		9.900		
Total	1930.925 119				

Table 11: ANOVA Results on the Differences in the Posttest Scores of Experimental Groups and Control Groups
$^{*}p < .05$ – significant at 5% level

This made it necessary to carry out Scheffe's test of significance for a difference between any two means. Table 12 showed the results of Scheffe's test of significance for a difference between any two means.
The results in Table 12 show that the pairs of physics achievement mean of groups 1 and 2, groups 1 and 4, groups 2 and 3 and groups 3and 4 are statistically significant different at the 0.05 level. However there are no statistically significant differences in the mean between Groups 1and 3 and Groups 2 and 4. This means that the metacognitive learning strategy was effective in helping the students to learn the physics lesson.

(I) GROUP4	(J) GROUP4	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
pst exp 1	post control 2	4.66667*	.81242	.000	2.3619	6.9715
	post exp 3	2.23333	.81242	.061	-.0715	4.5381
	post control 4	6.80000*	.81242	.000	4.4952	9.1048
post control 2	pst exp 1	-4.66667*	.81242	.000	-6.9715	-2.3619
	post exp 3	-2.43333*	.81242	.034	-4.7381	-.1285
	post control 4	2.13333	.81242	.081	-.1715	4.4381
post exp 3	pst exp 1	-2.23333	.81242	.061	-4.5381	.0715
	post control 2	2.43333*	.81242	.034	.1285	4.7381
	post control 4	4.56667*	.81242	.000	2.2619	6.8715
post control 4	pst exp 1	-6.80000*	.81242	.000	-9.1048	-4.4952
	post control 2	-2.13333	.81242	.081	-4.4381	.1715
	post exp 3	-4.56667*	.81242	.000	-6.8715	-2.2619

Table 12: Results of Scheffe's Test of Significance for a Difference Between any Two Means

6. Conclusions

Based on the foregoing findings, the following conclusions are formulated:

1. The students are able to improve their achievement in physics using the metacognitive learning strategy over the traditional methods. The students successfully maximize their learning through enhanced, systematic and direct learning experiences using the metacognitive learning strategy. This may be the reason why the students gain adequate knowledge and confidence in managing and improving their own learning. The students learn better when they used the metacognitive learning strategycompared to the traditional methods. This maybe because the students are exposed to the hands-on experiences which promote positive perceptions, affect, and motivation among students.
2. The students who are exposed in the metacognitive learning strategy perform better than the traditional methods. Hence, the increase in the physics achievement maybe attributed to the metacognitive skills, awareness, and manipulation of cognition acquired and developed by the students. In this manner, the metacognitive learning experiences of the students provide them personal insights into their own thinking and foster independent learning. There is greater mean difference in the experimental group with non-pretest as compared to the control group with non-pretest. This is due perhaps in their desire to learn and to accomplish a variety of tasks in the lesson.
3. Since there is no significant difference in the pretest scores of the experimental and control groups, therefore, the students are considered comparable prior to the treatment because they are not exposed to metacognitive learning strategy and maybe adaptive in the traditional methods.
4. The posttest scores in the experimental group are significantly different. Therefore, the metacognitive learning strategy has an effect on the physics achievement of students. This maybe because the students find the metacognitive learning more active and challenging rather than the usual steps or routines they were doing in the classroom,
5. The pretest and posttest results of the experimental group and control group are significantly different. Therefore, the strategy and/or methods are effective. Perhaps, the students are comfortable in learning physics lessons using the traditional methods, and after exploring the lesson employing the metacognitive learning strategy, the students in the experimental group improve further their achievement.
6. The physics achievement of students in the experimental group with non-pretest and the control group with non-pretest is significantly different. This is an indication that students can learn independently. They can process their learning through planning, assessing, monitoring, and evaluating their own thinking. This is possible maybe because the students are interested to learn in whatever methods or styles in teaching the teachers apply in the classroom.

7. The posttest of the experimental group and the experimental group with non-pretest is significantly different. Therefore, the active use and regulation of the metacognitive learning strategy particularly by those students who are exposed to the pretest assisted them to learn the physics lessons effectively.
8. The posttest of the control group and control group with non-pretest is significantly different. Therefore, the traditional methods are also effective in learning physics lessons maybe because of the long application of this method in the classroom where the students find it easy and less of mental challenges.
9. The metacognitive learning strategy introduced by the teacher has a significant effect in learning the physics lessons. This is possible maybe because the students find this strategy new to their experiences which challenge their skills, abilities, and knowledge in learning the lesson.
   This brings the students in focus which allows them to explore if there is really a possibility for them to learn a lesson by simply making them aware how they learned.

7. Recommendations

Considering the findings and conclusions in the study, the following recommendations are advised:

1. It is important for the teachers to use various teaching strategies preferably the metacognitive learning strategy as an alternative and innovative method in the traditional teaching to improve the achievement of students in physics. The teachers need to restructure the learning environment that can equalize interaction and accommodate experiential learning with students enabling greater learner participation, satisfaction and further academic motivation.
2. Since the results showed that the experimental group had higher mean gain over the control group, it is suggested that the metacognitive learning strategy should be used by the teachers to address the average achievement of the students and improve it better.
3. Meanwhile, the teachers should not abandon the use of the traditional methods. Since there was a significant difference in the pre-post test in the control group, this method may still be used; however, the teachers may improve their presentation and use the metacognitive learning strategy if possible during the work activities of the students.
4. The students' interest in metacognitive learning strategy embolden the teachers to utilize and apply it from time to time so as not to diminish self-regulation in learning and enhanced further students' ability to understand, control, and manipulate their own cognitive process to make best use of learning. Since the posttest of the experimental groups was significantly different, the students are encouraged to follow the steps of the metacognitive learning strategy whenever possible to improve their achievement. In the light of this, the learners learn how to learn by consciously following a recursive cycle of experiencing, reflecting, thinking and acting to increase their learning power.
5. Since the posttest of the experimental group and the experimental group with non-pretest was significantly different, the principals should play their part to create conducive school environment which will promote the use of the metacognitive learning strategy. They may provide instructional materials that students should use to learn effectively, and ensure available school facilities like laboratories for the students to perform the metacognitive processes. It is certain that the physics achievement of students can improve if the metacognitive learning strategy will be utilized due to its undeniable effect.
6. Since the achievement of the students in the pretest is average both in the experimental and control groups, the parents should endeavor to meet regularly with teachers to discuss problems faced by their children in schools with a view to finding solutions to these problems jointly with the teachers.
7. Since there is significant difference in the posttest scores of the experimental groups and control groups, the science supervisors should identify this as an effective learning method that would e suitable, to provide favorable learning conditions for all students rather than just using the traditional methods in teaching. They may identify topics and design appropriate instructional strategies involving metacognitive learning strategy, which would enhance the learning of physics.
8. It is recommended that related studies may be conducted not only to strengthen the effectiveness of metacognitive learning strategy but also to disseminate to the researchers the usefulness of this strategy in any learning areas to improve the achievement of the students.

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