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The Effects of Counseling-based Teaching Method on Physics Learning Achievements of Upper Secondary School Students: An Area Focus on Momentum

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Abstract
The study investigated the effects of the counseling-based teaching method on physics learning achievements of upper secondary school students. Four counseling techniques were selected to constitute a counseling-based teaching method for four constructed lesson-plan modules, i.e., (1) writing down a self-note, (2) questioning and active listening, (3) summarizing, and (4) group counseling. These selected techniques were meant to provide support in learning the topic of *momentum*. The subjects were thirty upper secondary school students participating in the study on a voluntary basis. There were three types of research instruments: (1) the platform and exit tests assessing physics learning achievements before and after learning each module, (2) four lesson-plan modules, each containing three counseling-based lesson plans and (3) twelve summative tests assessing physics learning achievements after using each lesson plan. Data analysis was in two parts: quantitative data in arithmetic mean, standard deviation, and dependent sample t-test; qualitative data by content analysis with two criteria: (1) varied understanding of physics concepts shown by the students' learning activities, and (2) complete understanding of physics concepts shown by the students' completed tasks. The findings of the study revealed the effects of the counseling-based teaching method on the subjects' physics learning achievements in three folds: (1) there was statistically significant difference of physics learning achievement scores of the subjects before and after using the counseling-based lesson plans at the .05 level; (2) all subjects increased their physics learning achievements at the level of 50% when guided with the techniques of *writing down a self-note, summarizing and group counseling*; 94% were noted as obtaining scores higher than the level of 50% when guided with the technique of *questioning and active listening;* (3) the subjects varied in degree of understanding the learned physics concepts, and were able to reach complete understanding with one to three attempts of repeated learning activities in four modules. The obtained findings point to positive pedagogical implications of four selected counseling-based techniques for upper secondary school students in learning physics.

Keywords: *physics learning, physics learning achievements, physics teaching, counseling-based teaching method, counseling techniques*

1. Introduction

The core curriculum of Thailand's Basic Education has its focus on the learning process in Science, particularly in the subject strand of physics (Ministry of Education, Thailand, 2008). The science curriculum prescribes process-based teaching and learning standards at all levels in secondary education. Physics at the secondary level covers major topics in (1) the law of energy conservation, (2) energy transfer, (3) heat equilibrium, (4) electrical quantities, (5) principles of electrical domestic circuits, (6) relationships between quantities involving various types of energy and motion, (7) combination of work, power, momentum and collision, (8) properties of mechanical waves, (9) quantities of sound and hearing, (10) combination of properties, benefits and harms of electromagnetic waves, and (11) radioactivity and nuclear energy (Ministry of Education, 2008). These physics topics are compulsory for students in the science track in all secondary schools in the country.

As for methods in teaching physics, the Institute for Promotion of Teaching Science and Technology (IPST) has suggested the use of hands-on mind-on activities and group activities based on the inquiry process or the scientific method for physics teachers (IPST, 2011). The principle of such a method is to reinforce in students multiple skills and build confidence in searching and accessing information as needed in learning and guided by curiosity. Inquiry-based activities to engage students in problem-solving process are devised in four stages: (1) ask questions, (2) explore by observing and investigating, (3) analyze and describe findings, and (4) communicate in discussion. Although the prescribed activities have their own merits for students' learning, they seem to exert insufficient effects on students' achievements in learning physics as shown in unsatisfactory scores on the National Test or O-Net and the well-known international test on science competency like PISA. The first researcher as a physics teacher at the secondary school level has an impression that science achievement limitations as shown in the O-Net or PISA scores can perhaps stem from abstraction of physics contents, the use of mathematics symbols and complexity of equations for solving problems. As a result, those students who are weak in mathematics and with insufficient practice in visualizing symbols for physics problems tend to find the subject somewhat too difficult to understand.

It is a challenge for physics teachers to help students to cope with physics learning by lowering their anxiety in the first place. Psychological barriers need to be overcome and some researchers suggested a counselling process to be used to support and facilitate learning. A recent example is Devi et al (2013) who explored the relationship and effect of counseling on the academic performance of college students with the use of individual intake interview. The study showed an increase in the average marks by about 15%-25% among 43% of the students and by about 10%-15% among 13% of the students. Two earlier studies are Lee et al (2009) and William (2011). Lee et al (2009) examined the effect of using counseling techniques on academic performance of American students. It was found that students seeking both individual and group counseling got better academic performance than those who did not. William (2011) studied the effects of group counseling activity on academic performance of 670 full-time freshmen entering the Southwest Texas State College. The result pointed to high grades earned by these students. The research findings in

the three studies appear to be in favor of positive effects of the counseling process and techniques on students' learning and academic performance.

2. Background of the Study

This section describes five counseling techniques to be used by the researcher in this study. Their psychological aspects are used by counselors in therapy for clients. These techniques can be applied to teaching subjects perceived as difficult to certain learners.

2.1 Note-taking or Writing down a Self-note

In a psychological context, writing down a self-note or note taking or journaling is a practice in writing a piece of information. The benefits of note-taking lie in its provision of opportunity for a person to review specific information. Clients often report that taking notes helps them be attentive, structure the materials and recall the content; notes are self-generated memory cues that remind a client of textual information that no longer exists. Lo (2013) asserted that the act of note-taking alone may improve recall and understanding over conditions and there are many ways for clients to write their notes. Kathleen (2016) explained that the techniques of writing down a self-note are used in counseling process to help clients open their mind and reflect their thought. There are five steps of this counseling method as follows:

W – What do you want to write about?
R – Review or reflect on it. Close your eyes. Take three deep breaths. You can start with "I feel…" or "I want…" or "I think…".
I – Investigate your thoughts and feelings.
T –Write the start time and the projected end time at the top of the page.
E – Exit smart by re-reading what you've written.

2.2 Questioning

Questions are used to encourage clients to think or recall information. It is cautioned for a counselor not to ask too many questions because too much asking signals control on the counselor's side as well as a set-up a situation in which the client may feel the counsellor has all the answers. The Australian Institute of Professional Counsellors (2009) lists two types of questions used in counselling as *Open* and *Closed*. Open questions are those that cannot be answered in a few words; a client is encouraged to speak at length so that the counsellor can gather information about the client's concerns. Closed questions can be answered with a minimal response--often as little as "yes" or "no." They can help the counsellor to focus on the client and secure very specific information as needed.

2.3 Active Listening

Active listening is used to reduce emotion that may arise in a situation. Once the emotional level has been reduced on purpose, a client can function with reasoning abilities more effectively. Poletto (2009) described the use of active listening in three patterns as follows:

Information-- getting a clear picture. This means asking questions to find out about needs, instructions and context of a client. Counsellors should recheck to ensure they've heard and understood the relevant details, and the client finally agrees on the concluded facts.

Affirmation--affirming, acknowledging, and exploring the problem. Counsellors reflect on the client's feelings toward the problem with a single statement of acknowledgement.

Inflammation-- responding to a complaint. When clients tell the counsellor they are unhappy with certain things or people, criticizing them, complaining about them, or getting them off their chest, the best thing the counsellor can do is to attentively listen.

2.4 Summarizing

Summarizing in counseling is the process in which the counselor combines two or more of the client's thoughts, feelings or behaviors into a general theme. Schaik and Hamerlinck (2008) explained that summarizing is frequently used when the client's presentation of a topic is somewhat confusing. The technique creates a brief synopsis of the client's story. An identified complication might come from someone else, and summarizing makes it clear to the client at what point he/ she is at the present moment and/or how far he/she has been with the problem. Grant (2009) further elaborated that summarizing may help clients to crystallize in a more coherent and integrated manner what they have been talking about, as well as put facts and feelings together.

2.5 Group Counseling

Group counseling is problem oriented by nature, and the members largely determine their content and aims. They may be facing situational crises or struggling with personal or interpersonal problems of living, experiencing difficulties with life transitions, or trying to change self-defeating behaviors. The group in turn provides empathy and support necessary to create the atmosphere of trust that leads to sharing and exploring specific concerns. Corey (2012: 31-34) explained the group counseling process in three parts: opening during and closing a group session as follows:

Opening a group session--members can be asked to briefly state what they want to get from the session. A counselor ought to use a quick "go-around" method in order to identify issues or concerns that could be explored during the session.

During a group session--the counselor's roles in this session are monitoring the behavior and progress of the members, supporting groups, and using the group therapy activity to help the clients.

Closing a group session--the counselor can add summary comments, especially pertaining to the group process; however, it would be better to teach the clients how to integrate what they have learned for themselves.

It can be seen that the counseling techniques described above aim at decreasing the clients' level of anxiety and suggestively explicating personal/ social problems for their self-

understanding. Such functional attributes, in the researcher's viewpoint, should have good potential for providing assistance or support in learning. In this paper, the researcher attempted at applying these counseling techniques to teaching physics, particularly in the complex topic on *momentum*. Such complexity of the topic has been identified by physics teachers at the secondary school level (personal communication with peers in physics teaching). The first researcher with a good experience in both teaching and tutoring in physics has observed the significance of support in learning, especially for students who might be weak in conceptualization at a certain stage that prevents further progress in learning specific topics. This is due to the fact that anxiety could prevent conceptualization to the extent of creating an emotional barrier that students may not be able to overcome it in the classroom context. However, from the first researcher's observation, once the students have received tutorial or additional explanation off class time, they often overcome the barrier with support from the tutor or a coaching teacher. For this reason, the researchers would like to put the selected counseling methods on trial in teaching the topic of *momentum* to students at the secondary level. The purpose was to observe empirically the effects of the counseling-based teaching techniques on physics learning achievements.

3. Objectives

The objectives of this study were (1) to integrate four counseling techniques as teaching methods into physics lesson plans on Momentum at the upper secondary school level: writing down a self-note, questioning and active listening, summarizing, and group counseling, and (2) to use the constructed lessons on *momentum* in the upper secondary school physics classes in order to assess the effects of the counseling-based teaching method on physics learning achievements of the upper secondary school students participating in the study.

4. Materials and methods

4.1 The Subjects

The population was 238 upper secondary school students in a government secondary school in Bangkok Metropolis. The subjects in the study were thirty science and math majors' students in Grade Ten. Their participation was on a voluntary basis; their demographic variables included grade, gender, age, years of physics study and physics grade point average in the previous semester. They were grouped at three performance levels by GPA and physics GPA in the semester prior to the study as low, moderate and high, with ten members per group, as shown in Table 1 below.

Table 1: The Subjects' Demographic Variables

Group Performance	Gender	Age Average	GPA Average	Physics GPA Previous Semester	Years of Physics Study
High (n=10)	male	15.6	3.76	3.80	3
Moderate (n=10)	male	15.7	2.85	2.33	3
Low (n=10)	male	15.7	2.32	1.25	3

4.2 Research Instruments

There were three types of research instruments in the study: (1) the platform and exit tests assessing physics learning achievements before and after learning each module, (2) four lesson-plan modules, each containing three counseling-based lesson plans and (3) twelve summative tests assessing physics learning achievements after using each lesson plan. The details are given below.

4.2.1 The Platform Test and Exit Test

Four platform tests and four exit tests were to assess physics learning achievements in sub-contents on *momentum* before and after the counseling-based lesson plans were used. The components of science learning assessment were after Kolpfer (2006): (1) knowledge, (2) comprehension, (3) science process, and (4) application. The tests were created by the researcher and validated by three physics specialists for content validity in terms of overall congruence (commonly known as IOC). Then, the tests was tried out for difficulty (p), discrimination (r), and reliability by Kuder–Richardson Formula 20 (or KR-20). The try-out was administered to thirty Grade 11 students who were not the subjects in this research. The results of the try-outs for the platform tests were (1) IOC was more than 0.5 in all items; (2) the range of difficulty and discrimination was 0.34-0.74, and 0.28-0.62, respectively; and (3) reliability was 0.72. As for the exit tests, their try-outs revealed (1) IOC was more than 0.5, (2) the range of difficulty and discrimination was 0.31-0.72, and 0.32-0.67, respectively; and (3) reliability was 0.73.

4.2.2 Four Lesson-Plan Modules

The researchers constructed four lesson-plan modules, each containing three counseling-based lesson plans. All twelve lesson plans were on four sub-topics of *momentum* and serve as individual themes of four modules: (1) momentum and impulse, (2) elastic collision, (3) inelastic collision, and (4) momentum of light. These lesson plans were constructed by the researcher and validated by three physics specialists for content validity. The counseling-based learning activities in twelve lesson plans were based on the principle of counseling and the person-centered counseling theory as shown in Table 2.

Table 2: Components of Four Lesson-plan Modules

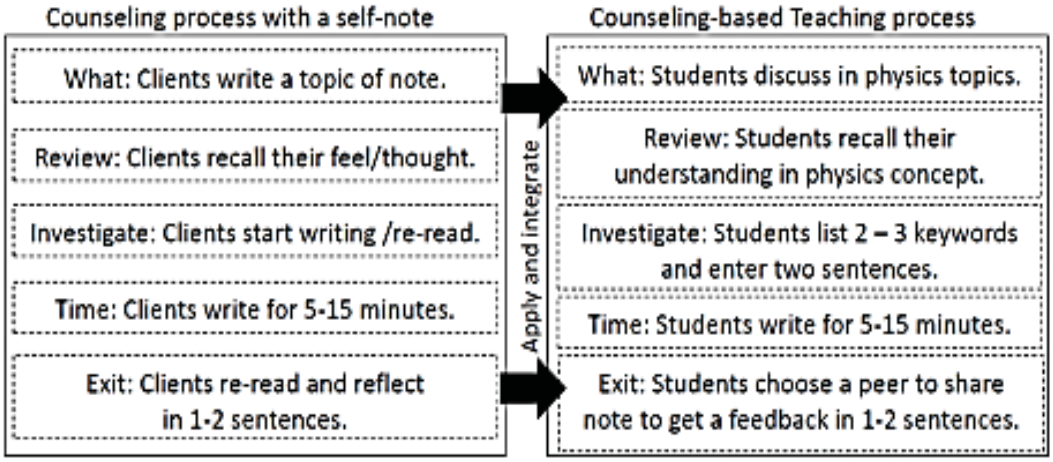
Module	Contents and Sub-contents	Counseling Technique
1	Momentum and impulse force 1.1 Impulse and impulse force 1.2 Conservation of linear momentum 1.3 Conservation of angular momentum	Writing down a self-note
2	Elastic Collision 2.1 Energy changing in elastic collision 2.2 Elastic collision in 1-D 2.3 Elastic collision in 2-D Momentum and Impulse force	Questioning and Active listening
3	Inelastic Collision 3.1 Energy changing in inelastic collision 3.2 Stricken collision 3.3 Explosion Momentum and impulse force	Summarizing
4	Momentum of light 4.1 Photoelectric effect 4.2 Light pressure 4.3 Black hole collision Momentum and Impulse force	Group counseling

The teaching procedures of each module are shown below:

4.2.3.1 Module 1: Momentum and Impulse Force

The counseling technique used in lesson plans in Module 1 was *writing down a self-note.* Figure 1 shows the counseling process using writing down a self-note technique being integrated into the counseling-based lesson plans.

Figure 1: The Counseling Process Using Writing down a Self-note Technique in the Counseling-based Lesson Plans



As shown in Figure 1, the teacher demonstrates *Momentum and Impulse Force* in daily life, asks some questions, introduces some new terms, and proves the related momentum and impulse force equations. Then, a note is used by students and the teacher gives instructions to the students how to write and use their self-note. The students are to hand in their note to the teacher who will photocopy all submitted notes for analysis and then return the original to each student. The analysis is for the teacher to check understanding of the target points.

4.2.3.2 Module 2: Elastic Collision

Module 2 uses a combination of questioning and active listening. Figure 2 shows the counseling process using both techniques as integrated into the counseling-based lesson plans.

Figure 2: The Counseling Process Using Questioning in the Counseling-based Lesson Plans

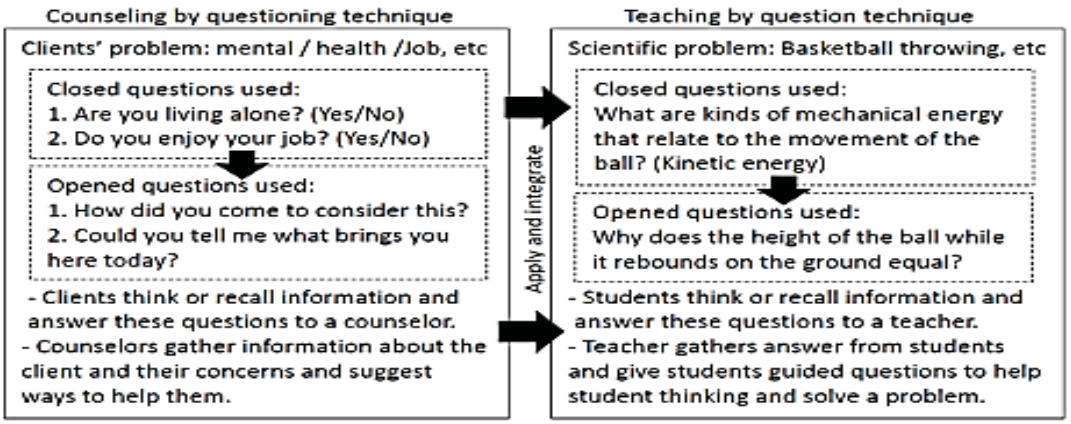
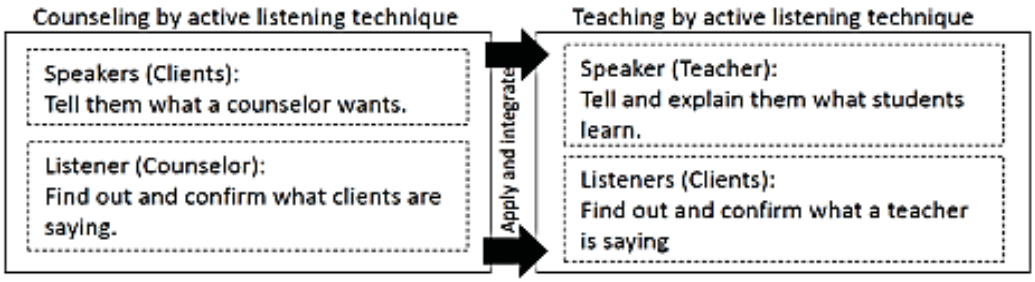


Figure 3: The Counseling Process Using Active Listening in the Counseling-based Lesson Plans

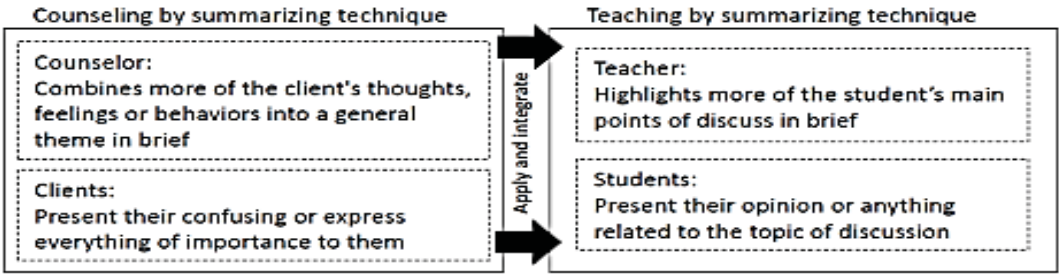


Figures 2 and 3 show the use of questioning and active listening in the counseling-based lesson plans. The teacher has to get scientific problems ready for questioning and active listening activities, such as pictures, clip videos, or demonstration materials. In the questioning part, the teacher presents scientific problems in elastic collision by demonstration and the use of pictures. Then, the teacher asks the students with closed questions, followed by open questions to prompt the students to solve the given scientific problems. The students are to think, and answer the teacher's questions for possible solutions. As for active listening, the teacher uses video clips to present scientific problems in elastic collision. The students are to listen to the explanation in the presented videos for target concepts and then write them on the provided worksheet. The teacher will collect all worksheets for an analysis to check the students' understanding of the teaching points.

4.2.3.3 Module 3: Inelastic Collision

Figure 4 shows summarizing as integrated into the counseling-based lesson plans.

Figure 4: The Counseling Process Using Summarizing in the Counseling-based Lesson Plans

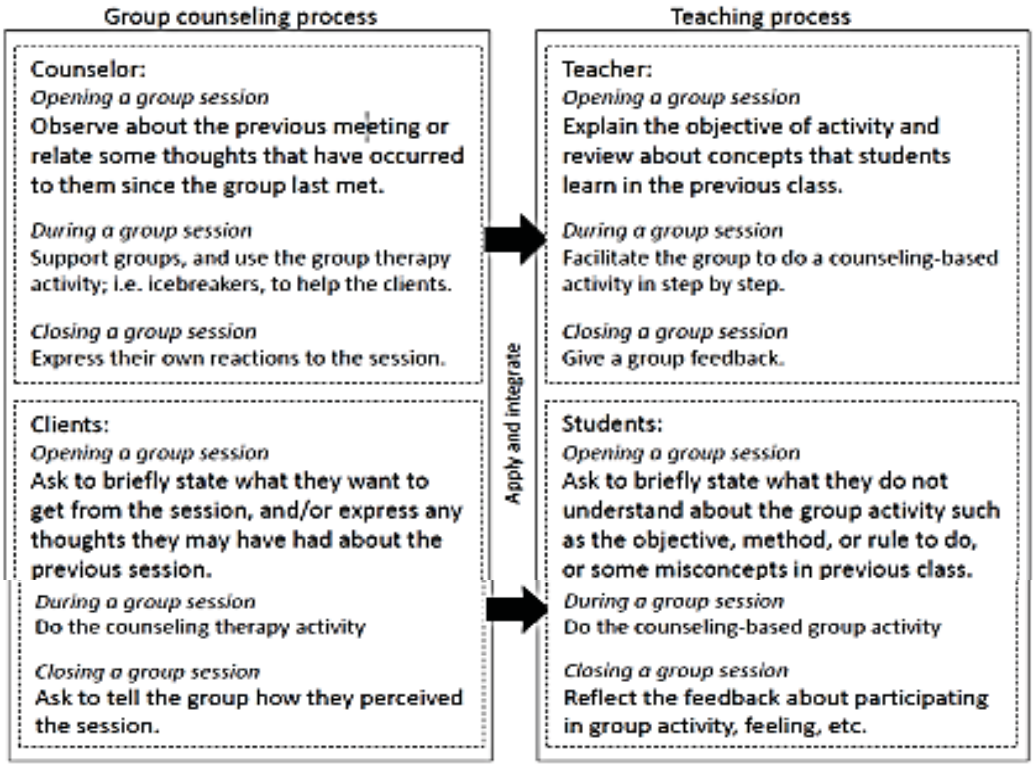


As shown in Figure 4, the teacher uses video clips about inelastic collision and discusses the topic with the students. The students are to gather information needed for discussion. The teacher encourages the students to discuss the topic among themselves and the teacher writes down on the board those main points each student conveys in their group discussion. After discussion, the teacher highlights the same and/or different points expressed in their discussion. Then the teacher summarizes the gist in 2-5 sentences for the students.

4.2.3.4 Module 4: Inelastic Collision? Momentum of Light

Figure 5 shows the group counseling technique in the counseling-based lesson plans.

Figure 5: The Counseling Process Using Group Counseling in the Counseling-based Lesson Plans



As shown, three groups of students are arranged by the teacher who explicates the roles and duties of all group members: (1) *A collector* to find data on the Internet or textbooks to answer given questions, (2) *An analyzer* to analyze collected data and hints, (3) *A presenter* to present a possible solution in class. The teacher uses a video clip showing the photoelectric effect experiment, gives an explanation and hands in questions to the groups. Each group has to find answers to the given questions and present them to their peers in class. The teacher also gives three hints in keyword, picture, URL (website for data search) every five minutes to the groups to help them find a possible solution. When the time is over, all groups present their solution to their peers in class.

All twelve lesson plans in four modules were carefully constructed using the specifications shown in Figures 1-5. Then the researchers asked three physics teachers with over ten years' teaching experience to validate the contents before piloting the lesson plans with three Grade 11 students who were not the subjects in the study. After getting feedback from the students in the pilot, the researchers adjusted the time length for the lessons and edited questions for clarity. The final versions of twelve lesson plans were used in data collection with the real subjects.

4.2.4 Twelve Summative Tests

Twelve summative tests were constructed by the researchers to assess physics learning achievements in twelve sub-contents of *momentum*. The items were in a multiple-choice format and assessed the specific teaching points in each lesson plan. The test items were validated by three physics specialists for content validity in terms on congruence or IOC and then tried out for difficulty (p), discrimination (r), and reliability. The results were: (1) IOC was higher than 0.5 in all items; (2) the range of difficulty and discrimination was 0.24-0.63, and 0.23-0.59, respectively; and (3) the range of reliability of twelve summative tests was 0.7-0.78.

4.3 Data Collection

Data were collected in the first semester of Academic Year 2016. The procedure of data collection was in the following steps:

(1) The first researcher asked the school director for permission to collect data for the study and the school gave one week for the pilot study and eight weeks for teaching four modules or twelve lesson plans.

(2) The first researcher explained before class an overview of course, objectives, conditions, and the assessments to the students participating in the study.

(3) The first platform test was used before the three lesson plans in Module 1 on momentum and impulse force.

(4) Three summative tests were used after completion of three counseling-based lesson plans in Module 1.

(5) The first exit test was used after completion of the third lesson plan in Module 1.

(6) Steps 3-5 were repeated in Module 2 on Elastic Collision, Module 3 on Inelastic Collision, and Module 4 on Momentum of Light, respectively.

4.4 Data Analysis

The obtained data were quantitative and qualitative in nature. They were analyzed as follows:

4.4.1 Quantitative Data

The students' scores before and after using counseling-based lesson plans in each module were also analyzed for differences by t-test for dependent samples. The scores of each student after using twelve lesson plans were analyzed by arithmetic mean and standard deviation to be presented in line graphs, followed by bar graphs for the students' learning achievements using counseling-based techniques characteristic of the four modules.

4.4.2 Qualitative Data

The students' writing tasks in each module were analyzed by content analysis to detect their understanding and limitations. The criteria of content analysis were (1) the right understanding and misunderstanding in physics concepts shown by the students, and (2) the full understanding of physics concepts shown in the students' completed tasks.

5. Results of the Study

The results showed the students' improved physics learning achievements in the scores obtained before and after using twelve counseling-based lesson plans. Details of improved performance were reported quantitatively and qualitatively by module in this section.

5.1 The Platform Test Scores and Exit Test Scores in Four Modules

The platform test scores and exit test scores in Modules 1-4 revealed improved physics learning achievements performed by the students after using the four-counseling based techniques: writing a self-note, questioning and active learning, summarizing and group counseling as shown in Table 3. It was noted that the scores in the platform tests show less variation in differences among individual students than those scores obtained in the exit tests. The results evidently pointed to difference in learning pace and attained achievements in individual students.

Table 3: The Platform Test Scores and Exit Test Scores in Four Modules

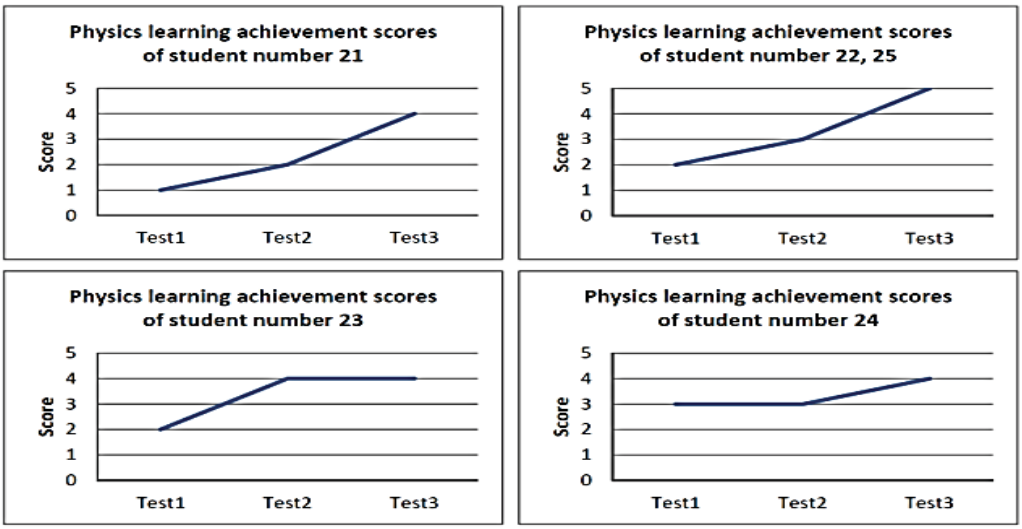
Module	Test	n	Mean	S.D.	T-test
1	Platform	30	2.20	0.99	18.73*
	Exit	30	7.37	2.79	
2	Platform	30	2.00	0.55	20.13*
	Exit	30	7.76	1.98	
3	Platform	30	2.40	0.80	22.67*
	Exit	30	8.90	3.13	
4	Platform	30	1.80	0.65	28.38
	Exit	30	9.93	1.44	

*p<.05, df =29

5.2.1 Results of Module 1: Writing Down a Self-Note

The summative test scores in Module 1 showed that all students were able to increase their physics learning achievement scores in varied percentages. Sixty percent of high performance students reached a peak or a full understanding after using three counseling-based lesson plans with emphasis on writing a self-note, whereas forty percent of moderate performance students were able to increase their scores but not reaching a peak. As for the low performance students, a half of them increased their scores and were even able to reach a peak. Four examples of line graphs in Figure 6 show the students' increased scores.

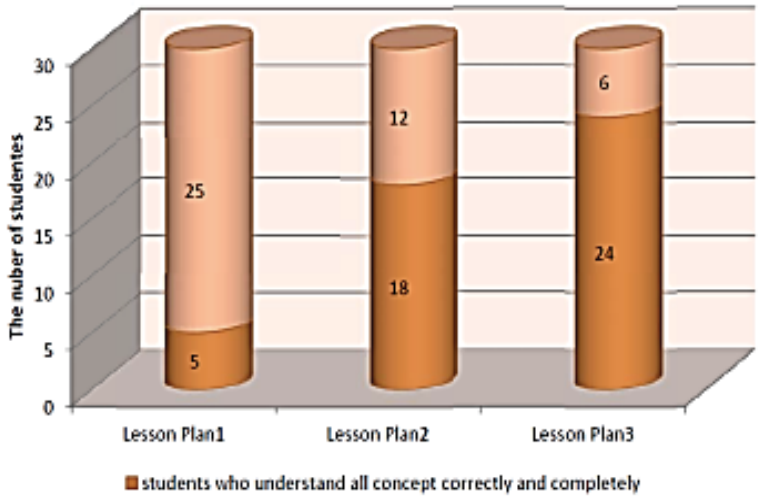
Figure 6: Four Examples of Line Graphs on Students' Increased Scores in Physics Learning Achievements in Module 1



5.2.2 Results Analyzed from Qualitative Data

From the analysis of the students' writings in Module 1, most students got a clear understanding of physics concepts in module 1: momentum and impulse force. After using the first plan, five students understood all physics concepts correctly and completely whereas twenty students misunderstood in some concepts, especially, the definition of *impulse and impulse force*. After using the first lesson plan, the students managed to understand better. The number of students who increased their understanding from the second to the third lesson plan was from eighteen to twenty-four. This evidence in Figure 7 pointed to a positive effect of writing down a self-note on the students' physics learning achievements.

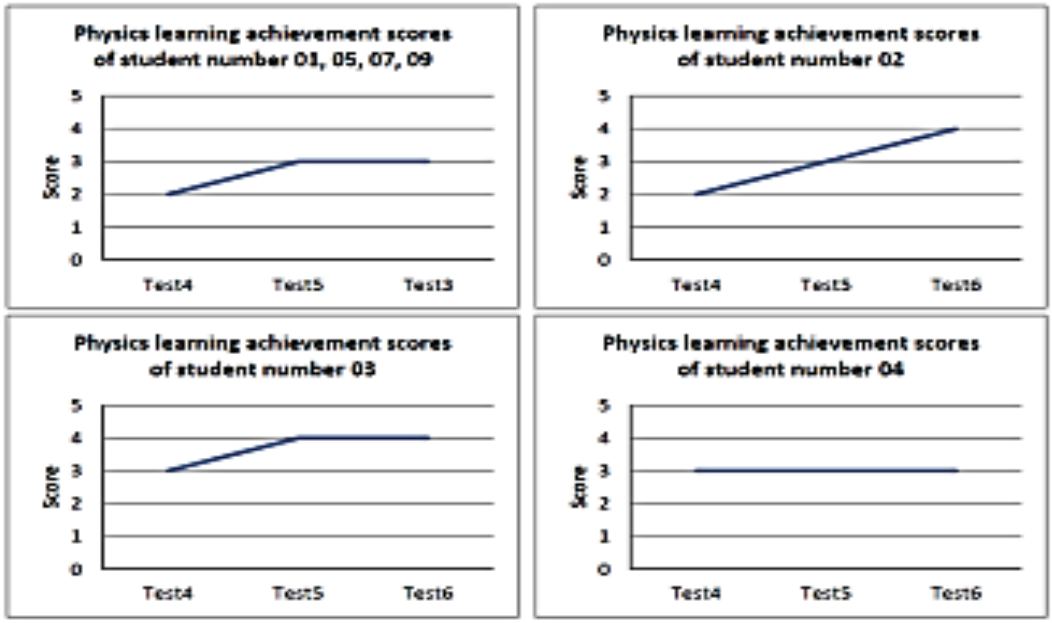
Figure 7: Students' Increased Understanding of Physics Concepts in Three Lesson Plans in Module 1



5.3.1 Results of Module 2: Questioning and Active Listening

The summative test scores revealed that most students were able to increase their physics learning achievement scores in varied percentages. Sixty percent of high performance students increased their scores slowly at first and were able to understand the learned concepts after three counseling-based lesson plans with the use of *questioning and active listening.* As for moderate performance students, forty percent was not able to increase their scores in the first lesson, but later on attained a full understanding of the learned concepts after the third counseling-based lesson plan. Similarly, those low performance students in half were not be able to increase their scores at the first attempt, but later on attained a full understanding of the learned concept after completing the third lesson. Four examples of line graphs in Figure 8 illustrate such a pattern of learning achievements.

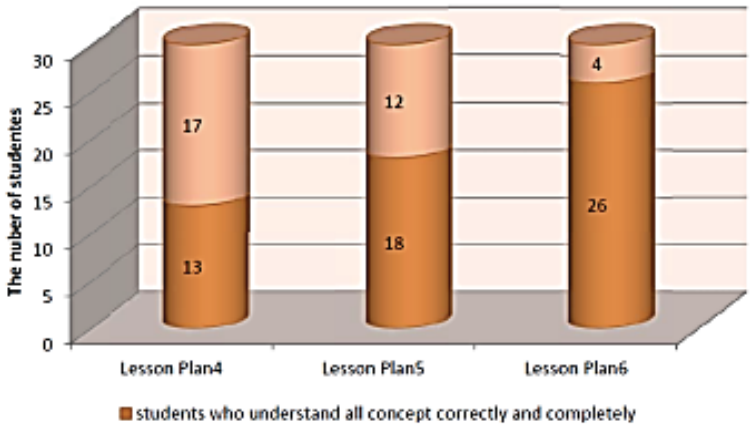
Figure 8: Four Examples of line Graphs on Students' Increased Scores in Physics Learning Achievements in Module 2



5.3.2 Results Analyzed from Qualitative Data

The content analysis of the students' writing revealed that thirteen students understood all physics concepts correctly and completely after the first lesson. The second lesson plan showed an upward understanding of students from 13 to 18 in the second lesson plan and reached 26 for a full understanding after the third lesson plan. Such evidence pointed to learning achievement supported by two counseling-based techniques *questioning and active listening* as shown in Figure 9.

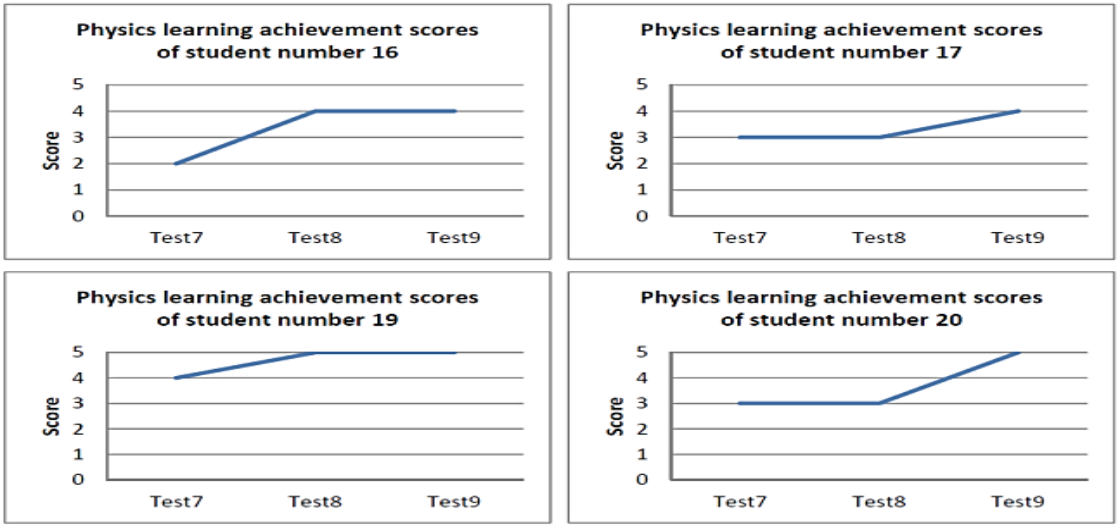
Figure 9: Students' Increased Understanding of Physics Concepts in Three Lesson Plans in Module 2



5.4.1 Results of Module 3: Summarizing

The results in Module 3 showed most students being able to increase their physics learning achievement scores in varied percentages. Sixty percent of high performance students increased their scores and reached a peak or full understanding after three counseling-based lesson plans using the summarizing technique. Both moderate performance students and low performance students in forty percent each, were also able to graph a full understanding of the learned concepts. It should be noted that there were four students who were able to attained only 50% achievement after the third lesson. Figure 10 illustrates line graphs of some students' attained scores.

Figure 10: Four Examples of Line Graphs on Students' Increased Scores in Physics Learning Achievements in Module 3



5.4.2 Results Analyzed from Qualitative Data

The content analysis of the students' writing revealed twenty-four students' full understanding of *inelastic collision* after the first lesson plan in Module 3. The rest appeared to misunderstand the concepts of *velocity and kinetic energy*. After the second lesson, a few students were not able to grasp the concept of *vector component*. Then, the third lesson plan provided an opportunity for low performance students to consult the teacher for their full understanding. Table 4 illustrates right/ full understanding and misunderstanding examples taken from the content analysis of students' writing.

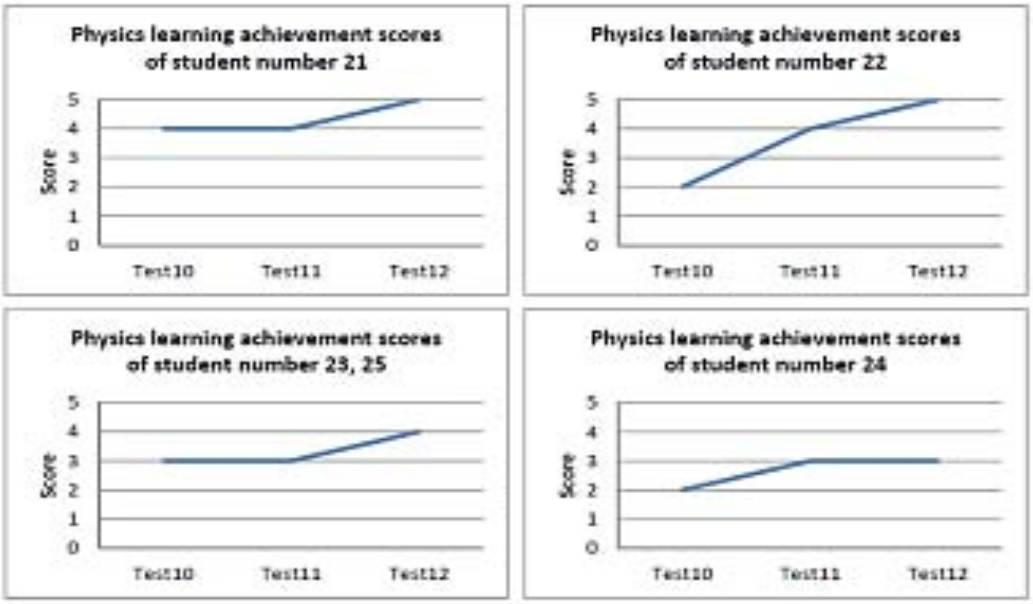
Table 4: Examples of the Students' Understanding in Module 3

Topic / Issue	Right Understanding	Misunderstanding
How to calculate the energy lost and velocity after crashing? (one dimension)	1. Energy lost while the object crashes. 2. The velocity needs to be identified at first before using collision formula. 3. After colliding, the velocity of two objects are equal 4. The initial total momentum is equal to the final one.	1. The momentum lost after colliding. (student 12) 2. Velocity is calculated by v = s/t. (student 14) 3. The velocity of one object is zero before colliding (student 26) 4. The $u_1+v_1 = u_2+v_2$ can be used in this case (students 26, 28, 30)
How to calculate the energy lost and velocity of bullet?	1. The initial momentum and final momentum are equal. 2. The velocity of two objects is zero.	1. The initial momentum is zero only. (student 26)

5.5.1 Results of Module 4: Group Counseling

The results in Module 4 showed that most students were able to increase their physics learning achievement scores in varied percentages. Eighty percent of high performance students increased their scores and reached a peak or full understanding after three counseling-based lesson plans using the group counseling technique. It was interesting to find that 40% of the low performance group reached a peak or full understanding after the third lesson plan. In contrast, 40% of the moderate group increased their scores in the second lesson plan and then managed to attain more than half of the full score after the third lesson. Figure 11 illustrates line graphs on examples of some students' attained scores.

Figure 11: Four Examples of Line Graphs on Students' Increased Scores in Physics Learning Achievements in Module 1



These evidences were in support of the use of the group counseling technique for the students' physics learning achievement in all groups.

5.5.2 Results Analyzed from Qualitative Data

The content analysis of the students' tasks showed that they understood the learned physics concepts of *momentum of light* in Module 4. The group counseling technique appeared to help the students to improve their understanding of the learned concepts. Those who still did not understand the target physics concept after the third lesson were able to graph a full understanding after class discussion at the end of the module. Table 5 illustrates some examples of the students' understanding taken from their tasks in Module 4.

Table 5: Examples of the Students' Understanding in Module 4

Topic / Issue	Right understanding	Misunderstanding
Photo electric effect	1. Electron can leave off the atom when it gets the light energy. 2. The light color affects on electron scattering. 3. The light energy is transferred to electron.	1. Electron absorbs the energy and always leaves off the atom. (Group 4) 2. Proton scatters after the light shine (Groups 3, 7)
Light pressure	1. Light makes the impulse force on the object. 2. Light pressure depends on surface area and intensity.	1. When surface area increases, the blade rotates fast. (Groups 1, 5)
Black hole collision	1. The black holes decrease their body gradually. 2. The black hole collision is like a stick collision.	1. The two black holes explode after collision (Group 8)

As seen in the results of the study reported so far, the researcher observed the students' learning physics concepts in terms of increasing aspects, remaining constant and reaching the peak or full attainment. As shown in Table 6, three techniques—*writing a self-note, summarizing and group counseling* appear to support the students well in percentages at 47, 40, and 47, respectively. Evidently, techniques of *writing a self-note, questioning and active listening, and summarizing* assisted the students to increase their learning constantly or slowly and later constantly at the percentages ranging from 10 to 36. Particularly, the combined technique of questioning and active listening seemed to work well with the students at the percentage of 36. It should be noted that the four techniques appeared to support constant learning at the percentages ranging from 10-30. The overall pictures of the four counseling-based techniques revealed learning support for the students in the study.

Table 6: Observed Learning in Percentage by Four Counseling-based Techniques

Observed Learning Aspects	Writing a Self-note	Questioning and Active Listening	Summarizing	Group Counseling
Increased constantly	17	10	10	--
Increased slowly and later constantly	10	36	17	--
Increased slowly	10	10	--	17
Became constant and increased slowly	7	30	17	10
Reached the peak	47	--	40	47

6. Discussion of Major Findings

The major findings of this study were taken from the results of physics learning achievements performed by the students in the study. These four counseling-based techniques were (1) writing down a self-note, (2) questioning and active listening, (3) summarizing, and (4) group counseling. These techniques served to support physics learning for students and were integrated into four modules under the topic of *momentum*, to make twelve lesson plans with three for each module. These findings were discussed in light of psychological counseling theories and previous studies in four parts.

6.1 Writing down a Self-Note

The results in *Writing down a Self-Note* pointed to learning abilities of all students to grasp a good understanding of the learned physics concept and got scores more than 50% after three lesson plans using thus particular counseling technique. The technique enabled the students to have the opportunity to review and recall the contents in the lessons as well and dependently presented the learned points through writing their self-note (Kathleen, 2016). They felt free to think and write, and was not nervous to reflect their idea (Thompson, 2011). As pointed out by Lo (2013), the note can help the clients review and mindfully and elaborate on information from self-generated memory cues. Therefore, the students in the study were allowed to concentrate on their thinking and such concentration facilitated their understanding for good learning achievement. Such psychological support was significant in providing conditions for understanding and recall via the use of self-note. Lo (2013) emphasized that the act of note-taking can help improve recall and understanding in conditions without note-taking.

6.2 Questioning and Active Listening

As shown in the results of the study, the use of *Questioning and Active Listening* turned out very promising as seen in 90% of the students being able to increase their physics learning achievement scores and 94% getting scores more than 50% after three lesson plans. From the researcher's observation, there seemed to be two reasons for their good learning performance. First, the use of closed questions consistently stimulated students' learning via responses to the teacher. Closed questions directed students to think relevantly and find the answers by themselves. Such a technique particularly supported weak students to focus on the target physics concept in each lesson and gained confidence when being able to give correct answers. It should be noted that correct answers followed by compliments from the teacher obviously boosted the students' confidence in learning physics concept. As for the use of open questions, those high performance students found them challenging for the fact that they were encouraged to express themselves in their own words and reflect on their own learning independently. Active listening activated by these two types of questions led the students to respond well by absorbing and memorizing all concepts perceptively. Such a processing aspect was explained by Poletto (2009) that the counselors can utilize active listening to build rapport via listening with clients. This finding was also in accordance with the point made by the Australian Institute of Professional Counsellors (2009) in that the use of questions and listening are vitally important in inviting clients to think or recall information effectively.

6.3 Summarizing

The summarizing technique helped all students to increase their physics learning achievement scores and got scores more than 50% after three lesson plans. The researchers noted the advantage of the students' role as speakers or writers whereas the teacher's role was an analyzer. The teacher helped students listen, summarize the main points in discussion activity, and write on the provided board. In using a writing board, the students did not have to record discussed points and were able to express their opinion independently and continuously. It was in fact a cooperative task between the students and the teacher. Such a task was important in the counseling procedure in that roles be explicated by the counselor to the client for effective communication, as pointed out by Grant (2009). The counselor had a role as person who connected between two or more topics of the client's problem and helped identify which topic should deserve most attention from the client. The summarizing technique as used in the study therefore helped crystalize the learned point agreed between the students and the teacher to support and facilitate the former's learning of the target physics concepts.

6.4 Group Counseling

The group counseling technique proved beneficial to the students who were able to increase their physics learning achievement scores and got scores more than 50% after using three lesson plans. In particular, those low performance students were able to improve their scores as well. This finding was in accordance with the study by Lee et al (2009) and Devi et al (2013) who asserted that group counseling can improve learners' academic performance. In this study, the researcher noted three advantages of group counseling for the students

under study. Firstly, the students were able to choose freely a group and roles in the chosen group as a collector, analyzer or presenter as preferred. Free choice as such created a friendly, harmonious, and trusting atmosphere for the students to do their group work voluntarily (Chauhan, 2009; William, 2011). In addition, the group members supported and learned from each other, particularly those weaker ones were assisted by the stronger ones when the former produced errors in their work. Secondly, students socially and cognitively learned from various symbolic models such as pictures, posters or videos and built self-efficacy through the assigned task. In this study, the clip videos were used to demonstrate the laboratory work: the light pressure experiment, the photoelectric experiment and the black hole experiment. These models helped the student learn and understand the complex concepts rapidly. Thirdly, the internet websites were used in the class activity. Using the Internet helped the students to access needed data quickly. The group members, for instance, used their smart phone to find data about the black hole to explain its collision in the last lesson plan in Module 4. The groups therefore gained sufficient information and analyzed newly obtained data for a good presentation in class. The second and third advantages were in fact based on the theoretical aspects of social-cognitive psychology for applications in the area of counseling (Corey, 2012).

7. Conclusion

All counseling techniques used in this study were meant to support and improve the students' understanding of physics concepts under the topic of *momentum.* The researchers investigated possible effects of these techniques on *the students' performance after* the use of twelve counseling-based lesson plans. It was found that the high performance students worked well with the *writing down a self-note* technique, whereas the low performance students proved *summarizing* and *group counseling* beneficial to their understanding of target physics concepts. It was noted that the high performance students were in favor of individual tasks, whereas those moderate and low performance students appeared to prefer group tasks. Moreover, *positive feedback* provided by the teacher helped facilitate their physics understanding and in turn remedy their limitations. What the researchers found in observation was that *the caring atmosphere* generated by the four counseling-based methods apparently served as a key to the students' success in conceptualizing the target physics topic of *momentum* and its related subtopics. When the students were cheered up in class by their peers and the teacher, they tried their best efforts in upgrading their learning achievements in physics.

The researchers expected that this study could shed more light on how physics teachers in Thailand can assist their students to overcome difficulty in learning complex physics concepts. As shown in this study, the social-cognitive aspects of counseling can be applied to learners at varied academic levels of performance, from high to low. The constructed lesson plans can serve as guiding examples for those teachers who may wish to explore the counseling-based techniques for their students as seen appropriate to their teaching and learning context.

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