The Research on Science and Technology Area Incorporated with the Local Education of the Cooperative Learning

Fang, Rong-Jyue[1], Cheng, Tsung-Wen[2], Li, I-Wen[3], Tsai Hua-Lin [4], Chen, Hsiu-Chuan[5]

***Abstract*—**This research discusses cooperative learning incorporated with local education to design a lesson plan of science and technology area with implemented in traditional teaching is mainly aimed at the impact. The target group is the two classes of the Grade Nine students in a junior high school. The conclusions of the research can be: 1) the students have a positive and affirmative attitude in this cooperative learning; 2) cognitively speaking, the learning effectiveness of the cooperative learning is better than that of lectures; and 3) the students are equipped with positive local recognition and they have better attitudes towards the environmental identity among the three dimensions of local recognition. This research expects that the experiences and results of the cooperative learning incorporated with local education in the area of the science and technology will offer any reference for the researchers to come, in the future, the teacher and student meet the example of studying trend.

Key-Words: **science and technology. local education. cooperative learning.**

I. Introduction

A. Background

This research attempts to adopt the cooperative learning incorporated into the concept of local education to design a lesson plan for science and technology area based on the materials of the grade nine of the year 2008. Due to the rapid development of technology, the resources of land have been tremendously exploited. The modern technology, however, brings us the side effect which makes people confront with many kinds of unpredictable social risks.[1]. The teaching of "science and technology" area expects the students not only to understand the formation and feature of the nature, but also to establish the affective concepts of the sustainable development by understanding the nature and environment. Thus this study attempts to incorporate the curriculum of science and technology into local education.

The fundamental spirit of local education is to "learn by doing" [2]. As the Curriculum Guidance of the Compulsory Education indicates, the curriculum of the elementary school and high school should focus on life, emphasizing the relationship between people and social and natural environments. One shall develop to be equipped with the competency of expression, communication, sharing, the respect to the others, the attentiveness to the social affairs, team work. Literatures indicate that cooperative learning can develop the students' ability and spirit of team work[3][4]. Thus cooperative learning is applied in this study.

As the two points mentioned above, this research attempts to adopt the cooperative learning incorporated into the concept of local education to design a lesson plan for science and technology area based on the materials of the grade-nine of the year 2008. Students are expected to have a better understanding about the learning materials offered from the curriculum on the one hand, and to experience the beauty of one's hometown, to reinforce his/her recognition towards it on the other. Only when the students understand the importance of the land and ocean can the economy, society or culture be able to develop.

B. Research purpose and questions

The purposes of study are as below:

1) Explore the students' feedback when the local education of cooperative learning is incorporated in the science and technology curriculum.
2) Explore the effect of local education of cooperative learning is incorporated in the science and technology curriculum.

The questions to be answered are as follows:

1) What is the students' feedback from their cooperative learning?
2) How is the students' cognitive effect after receiving cooperative learning?
3) How is the students' identity recognition after receiving cooperative learning?
4) How is the students' cultural identity after receiving cooperative learning?
5) How is the students' environmental identity after receiving cooperative learning?

II. Development History of Literature

A. The idea and strategy of cooperative learning

The cooperative learning is an effective teaching strategy

Rong-Jyue Fang is a professor with the Department of Information Management, Southern Taiwan University of Technology, Tainan County, Taiwan (e-mail: rxf26@mail.stut.edu.tw).

Cheng, Tsung-Wen is a doctoral student with the Department of Industrial Technology Education, National Kaohsiung Normal University, Taiwan. (e-mail: ptwen2466@gmail.com).

Li, I-Wen is a student with the Graduate Institute of Education Administration, National Pingtung University of Education, Taiwan. (e-mail: wenwen569@gmail.com).

Tsai Hua-Lin is a doctoral student with the Department of Industrial Technology Education, National Kaohsiung Normal University, Taiwan. (e-mail: kittyhl@gmail.com).

Chen, Hsiu-Chuan is a teacher with FangLiao Senior High School, PingTung County, Taiwan. (e-mail: 5588chen@yahoo.com.tw).

which focuses on the importance of team-work. It allows the students to learn in the beginning of cooperative behavior; it encourages the teams to help, critique, and share with each other. This will create an easy and interesting environment which allows mistakes, encouraging the learners to think deeply and develop higher level of thinking. This is, no doubt, a high-order-thinking [3][4][5][6]. Most of the students have positive attitudes towards cooperative learning, positing that the cooperative learning will make the classroom climate more interesting [7]. Many literatures indicate that the cooperative learning will be more effective than the lectures. The cooperative learning will make the learning climate better and make the students mutually learn a lot of knowledge and skills [8][9].

The cooperative learning is a general term of a kind of learning strategy, encompassing diverse ways of cooperative learning with its characteristics and functions [4][10]. It is most commonly used in Student's Team Achievement Division (abbreviated as STAD) which is most suitable for the novice teachers. It is proved to be able to motivate a student's learning achievement, if compared with individual learning and competitive learning. STAD can be mainly divided into four activities: 1) the whole class instruction, 2) team learning, 3) test, and 4) team rewards[11]. The students are heterogeneously grouped. For example, the high and low achievers are grouped together. In instruction, students are grouped as a team and expected to learn the materials instructed. One must ensure that all the members understand the materials in the learning process. Finally, the teacher will give an individual test to know how much they have acquired. In terms of assessment, the students' scores of the test are used to compare with their former scores. If there is any progress, the scores will be exchanged to individual progressive scores. The scores of each team is the sum from each team-member's progressive scores. The team or the students will be rewarded when the progressive scores reach to some extent [4][11]. This research adopts modified STAD which adds group report[22][24].

Photo 1. Process 1 of STAD: The teacher's instruction toward the whole class.

Photo 2. Process 2 of STAD: The team learning after teacher's instruction.

Photo 3. Process 3 of STAD: Individual tests are given to know students' learning achievement

Photo 4. Process 4 of STAD: The team which gets the highest progressive scores is rewarded.

B. The local education incorporated in the science and technology curriculum

The Grade 1-9 curriculum emphasizes on the ten basic abilities. The learners' activity is the subject of the science and technology curriculum by exploration and practice, emphasizing the uses of both hand and brain, activities, concerns on design and manufacture, concerns on cognition and behavior, and the worldview of culture and ecology[13].

Local land is the environment where people feel most familiar and intimate. The goal of local education is to develop the citizen's curiosity and observation on the nature and culture since childhood, to equip them with the concerns on the social affairs, and to inspire their curiosity and interests of knowing the sciences, society, and the world [14]. If the people feel ignorant towards their history and hometown, they do not have any love to their local land. If without love, they will not identify themselves to this land [15] [23]. The local education is to make the students know and understand the place where they live, and furthermore, the students will identify themselves with their local land and then love it positively and actively. They will work hard for the protection of and development of local environment, inherit and create the essence of local culture [16]. The teaching materials of the local education come from the students' living environment which is much easier for them to understand [17]. The teaching of local education is the foundation of actualizing education localization and building the identity conscious. This will help the teachers and students to know their surroundings better, and experience the hometown's truth, good and beauty. This can also develop a student's capacity of recognition, affection, and skills.

The implement of local education should be incorporated in the general courses [18][19][20]. Huang et al. discover that the series of fieldwork and analysis with the computerized explanation will help the students improve their knowledge, affective performance, data collection, creativity and so on[21].

The goal of the science and technology expects the students to protect the environment, cherish the natural resources, respect life, love local environment and have technology spirit, apply what they learn at present to the future, and explore the mutual relationship between humans and technology. This concept just corresponds to that of local education. The five topics of the learning content of the science and technology area are: 1) the formation and feature of nature; 2) the function of nature; 3) evolution and continuation; 4) life and environment; and 5) sustainability—which can be incorporated in the experience of local culture [13].

As mentioned above, it is applicable if the local education is incorporated in the science and technology area to reflect the local colors. This will develop a student's cognition, affection, and skills.

III. Methodology And Tool

A. Research design

The researcher plans to design a study plan about the geomorphic balance incorporated with the Fang-liao environment based on the Kang Hsuan version of the third grade of junior high school in the year of 2008. The cooperative learning is conducted for five classes of a week with post-test experimental group and control group. After the experimental teaching, the researcher will conduct achievement test on the experimental group and control group. The experimental group will be conducted with cooperative learning questionnaire to explore the achievement of the curriculum as well as the students' feedbacks and opinions. The experimental research design is as Table 1:

Table 1. Model of the research design

Group	Treatment experiment	Post-test
Experimental Group	X1	Y1
Control Group	X2	Y2

X1 suggests the curriculum of water resources and geomorphic balance on the experimental group.

X2 suggests the curriculum conducted by lecture on the control group.

Y1 and Y2 suggest the students' scores after receiving achievement test after the experiment.

B. Research target

The target group of this research is the students led by the researcher; the control group is the students led by another teacher. The arrangement of the two classes is conducted by normal class grouping and coeducation. The two classes are thus selected because their scores of the science and technology subject are almost the same.

C. Research Tool

Three methods are conducted in this research: (1) the achievement test edited by the researcher, (2) cooperative learning questionnaire, and (3) local education questionnaire. These three methods will be further explained as below:

1) Achievement test

The curriculum selected to conduct the edition of pretest from test data of the Kang Hsuan version as well as the Han-Lin version. The total number of questions are 71, which are selected to conduct the test of one class of the Grade nine of Fang-liao High School (, who are non-experimental group and control group). After the pretest of the SPSS statistic software, the achievement test with 45 questions is based on the difficulty, discrimination, and point-biserial correlation, between the "proper" questions and "improper" ones in which its difficulty ranges between 0.2~0.8, and its discrimination is more than 0.3. The content includes water cycle and freshwater application; the formation of groundwater; the relations between groundwater and rain; the relations between lake water and river water; the damage of groundwater; weathering, erosion, movement, and sedimentation; the erosion of river, movement, and sedimentation; wind, seawater, and glacier; riverbed base level; river base and so on.

2) Questionnaire of cooperative learning

The researcher attempts to understand the comment and feedback of the students of the control group based on the self-edited questionnaire of cooperative learning. The questions are divided into close questions and semi-open questions: seven close questions and two semi-open questions.

3) Questionnaire of local education

In order to understand their feedback on the local identity from students of the experimental group, the researcher designs the questionnaire of local education in accordance with my research goal. This questionnaire is divided into three sections: 1) identity recognition, 2) cultural identity, and 3) environmental identity, which are separately question 4, question 5, and question 6.

D. Data analysis

(1)The achievement test examines the experimental group and control group, and then tests the difference of the scores between the two groups by independent sample T test.

(2)Each question in the cooperative learning questionnaires is analyzed by its numbers, percentage statistical analysis. The semi-open questions are analyzed by induction.

(3)Each question in the local education questionnaires is analyzed by its numbers, percentage statistical analysis.

IV. Result and Conclusion

This research indicates that the research purpose and questions are respectively to explore the students' reflection and feedback to the science and technology curriculum incorporated with the cooperative learning on the local education, and then, analyze the effectiveness of the science and technology curriculum.

A. Student's reflection of cooperative learning

Questionnaire of students' reflection to the cooperative learning, as illustrated in Table 2:

Table 2. Questionnaire of students' reflection to the cooperative learning

QUESTION	AGREE	DISAGREE
I. I think I can learn more by team-learning rather than the teacher's lecture.	85%	15%
II. I think I am supposed to do my best for my team.	94%	6%
III. I will help my classmates of the same team except my duty task.	91%	9%
IV. Team-learning helps me learn how to communicate with my classmates.	75%	24%
V. Team-learning allows the classmates of the same team to learn from one another.	85%	15%
VI. Team-learning will promote the friendship among the classmates.	82%	18%
VII. I feel that there are still some students fail to do their duty, and this will influence the performance of their team.	30%	70%

This diagram above demonstrates that most students think that cooperative learning has learning function and benefits their communication and friendship. This indicates that most students agree with the cooperative learning, but there are still 30% of the students who think that some of their team members fail to do their duty.

Most students think that the strengths of team-learning are: mutual learning, friendship building, and mutual discussion, which are respectively ranged as 75%, 72%, and 58%. Other students think that the strengths of team-learning are: convenient communication, different opinions, more hard-working, learning how to communicate with classmates, creativity, fun of learning, building the habit of discussion, developing one's talent, and not easy to forget. They think that the weaknesses are: someone fails to work as a team; it takes too much time; some conflicts will occur when the opinions differ; they are respectively ranged as 58%, 36%, and 30%. Other weaknesses, as they claim, are: poor done in report, unprepared for the discussion, failure of searching for the information, failure of helping each other, some students who play by themselves, disagreement, discords, doing only his/her duty, inappropriate attitude, and conflicts.

B. The implementation effects of student's curriculum

The achievement test is illustrated in the Table 3.

Table 3 Achievement Test t-Test

	Experimental group (N=31)	**Control group (N=34)**
Highest scores	42	43
Lowest scores	10	8
Means	34.9	30.8
Correct ratio	77.6%	68.4%
Standard deviation	5.45	6.26
T-value	-2.06*	

1) There are 31 participants in the experimental group who participate from beginning to end in the curriculum implementation. Thus, the number of participants of this achievement test is 31; the total scores of it are 45; the average scores are 34.9. The correct ratio is 77.6%; the whole standard deviation is 5.45; the highest scores are 42; the lowest 10.
2) There are 34 participants in the control group. The average scores are 30.8 from the whole achievement test. The correct ratio is 68.4%; standard deviation 6.26; the highest scores are 43; the lowest 8. The t-value is -2.06*, which reaches the significant level .05 by independent sample T test. This indicates that the achievement test of the experimental group is better than that of the control group.
3) Discussion. In the whole context, the student's achievement test knowledge is good. It ranges above the middle level. The experimental group's scores are higher than the control group. This indicates that the implementation of cooperative learning on the local education incorporated with science and technology curriculum receive positive cognitive effects. The researcher posits that the student's positive learning interests and participation will make their learning effect much better.

C. The questionnaire of local identity

In this questionnaire of local identity, the *Agree* item that is checked will get one point, while the *Disagree* item that is checked will get zero point. This questionnaire is summarized as below with a discussion.

1) The average scores of the local recognition are 12.09; the highest are 15; the lowest are 6. The average scores are 0.81 from the whole 15 questions. This indicates that the students' local recognition is positive.
2) The students' scores, as the diagram indicates, range around 60.6-90.9. This indicates that most students check the Agree item. The Agree item of "belonging and recognition" in the diagram is 81.5%; the Agree item of "cultural identity" is 76.96%; the Agree item of "environmental identity" is 85.44%.
3) Of the whole questions, Question 9 ("I can clearly

introduce the local historical spots and relics.") in the section of Cultural Identity gets lowest scores; Question 12 ("I think my hometown has abundant creatures and life resources.") and Question 15 ("I can protect my hometown's beach from damage and pollution by myself") get highest scores.

4) Discussion. The section of Environment Recognition gets highest scores, due mainly to this subject's emphasis on the local education, and due mainly to the mass media's constant promotion in the daily life.

The result of analysis is illustrated as Table 4 below:

Table 4. Questionnaire of the identity of the local education

The dimension of the local identity	Number of Question	Percentage	Average percentage of each question
Identity and belonging	1	78.8%	81.05%
	2	69.7%	
	3	81.8%	
	4	84.8%	
Cultural identity	5	81.8%	76.96%
	6	69.7%	
	7	84.8%	
	8	75.8%	
	9	60.6%	
Environmental Recognition	10	81.8%	85.44%
	11	84.8%	
	12	90.9%	
	13	84.8%	
	14	87.9%	
	15	90.9%	

V. Conclusion

This research is conducted with cooperative learning incorporated with local education in the science and technology curriculum of Grade Nine in Fang-liao Senior High School in Pingtung County. The researcher explores the impact of the curriculum implemented on the students' recognition, environmental protection concept, local identity effect, as well as their reaction to this curriculum.

A. Student's feedback in the cooperative learning process

Some of the students in the cooperative learning may act immaturely. Some may have conflicts with each other. They, however, have positive attitude towards the methodology of cooperative learning, feel the importance of the cooperative learning skills, and get improved by constant learning.

B. The Cognitive effectiveness of the curriculum implements

The experiment indicates that the students in experimental group and control group have significant difference in the achievement test. That is, the local education of cooperative learning incorporated in the NSLT curriculum have better effects than the lecture. While in the experimental curriculum, most students in the experimental group feel as other do, change their attitude because of the environment, and have enormous interest in the curriculum.

C. The local recognition after the curriculum implementation

Students will be equipped with better recognition to their hometown in terms of the local recognition. For the dimension of local recognition, the section of "environmental identity" is the strongest. This resembles the concept of the science and technology area, suggesting that students are able to identify themselves with their environment by the formation and feature in Nature, and furthermore, they will be able to take care and protect the environment.

VI. Suggestion

This research proposes some suggestions concerning the experience and result from the science and technology area as follows:

1) The implement of the science and technology curriculum shall incorporate students' life experience cognitively, affectively, and skillfully.

The object of education is the students, and it should significantly take students' ability and interest into consideration. The curriculum implementation should make the students learn by doing and motivate them to learn. Then, the students will no longer consider the curriculum distant and unrelated to the life experience. The marine education should emphasize on the "curriculum 'activitilization', and activity 'curriculummization'." Students can empirically prove from what they see and what they know through the multicultural and playful learning activities. Thus, the researcher posits that the concept and goal of marine education curriculum should have a plan of students' learning experiences in advance. The students are able to feel the beauty from their environment; then, they can make our society beautiful, enrich one's spirit, and love his/her local place through the curriculum.

2) The cooperative learning should emphasize the cooperative skills so as to build the concept of mutual cooperation and interpersonal relationship, and makes learning more effective.

Cooperative learning allows the learners to freely learn by discussion, and they can practice what they have cognitively learned in their life so as to establish the ability of lifelong learning. Instead of the traditional education focusing on the passive learning, the learners are able to have a positive attitude to learning. The teacher can teach the students some cooperative skills before the class. This enables the students to listen to and communicate with others. The students can moderately express their own thoughts, ideas and emotions. This suggests not only the cooperative spirit of tolerating

different opinions but also the sense of respect towards life, society, environment, and nature. They are developed to have the sense of mutual dependence, mutual trust, and mutual help. If they do not have sufficient cooperative skills, they are likely to have partial duty, disbelief, poor learning, postponing, and attacking. Thus, the acquisition of cooperative skills in advance is essential.

3) By combining the multicultural learning with the resources from school, community and society, the education of science and technology education can be easily promoted.

The researcher discovers that it requires more strengths from other teachers in experimental teaching in terms of profession and time. By so doing, it will reduce a teacher's labor and meanwhile, benefits students' learning effectiveness. Students will get improved once if the school can combine the resources from the community institution to implement the science and technology curriculum.

4) The science and technology teaching can be conducted from different learning areas or topics.

The researcher discovers that it requires more strengths from other teachers in experimental teaching in terms of profession and time. By so doing, it will reduce a teacher's labor and meanwhile, benefits students' learning effectiveness. Students will get improved once if the school can combine the resources from the community institution to implement the science and technology curriculum.

REFERENCES:

[1] Wu, C. L., The ethics of technology and management of social risks, *Guangxi Social Sciences*, Vol.1, pp.23-27, 2009.

[2] Chang, Y. C., *Research of the 6th grade students' Indigenous Knowledge and Indigenous Identification in Chaozhou Town*, Unpublished M. A. thesis, National Hualien University, 2004.

[3] Lin, P. X., *An experimental study on the cooperative learning in the vocational high schools in Taiwanese County*, Unpublished M. A. thesis, National Taiwan Normal University, 1992.

[4] Slavin, R. E., *Cooperative learning: Theory, research, practice*. (2nd ed.), Boston: Allyn and Bacon, 1995.

[5] Haley, W. S., & Resnick, L. S., Collaborative vs. individual and the role of explanations, 1997. (ERIC Document Reproduction Service NO. ED 409339)

[6] Anderson, W. L., Mitchell, S. M., and Osgood, M. P., Comparison of student performance in cooperative learning and traditional lecture-based biochemistry classes, Biochem. Mol. Biol. Educ, Vol. 33(6), pp.387–393, 2005.

[7] Robbins, S. B., Allen, J., Casillas, A., Peterson, C. H., and Le, H. , Unraveling the differential effects of motivational and skills, social, and self-management measures from traditional predictors of college outcomes, J. Educ. Psychol, Vol.98(3), pp.598–616, 2006.

[8] Elsa Sánchez and Richard Craig., Strengthening Teaching Effectiveness Through Cooperative Learning Activities, HortTechnology, Vol.17, pp.254-257, 2007.

[9] Norris Armstrong, Shu-Mei Chang, and Marguerite Brickman, Cooperative Learning in Industrial-sized Biology Classes, *CBE Life Sci Educ*. Vol.2, pp.163-171, 2007.

[10] Johnson, D. W., Johnson, R.T., & Stanne, M. B. , Cooperative learning methods: A meta-analysis. [Online]. Retrieved Vol.17, 2000. Available: <http://www.clcrc.com/pages/cl-methods.html>

[11] Huang, C. C. & Wu, C. X. , *The development and practice of cooperative learning*, Taipei: Wu-Nan Cultural Publishers, 2006.

[12] Slavin, R. E., Student teams-achievement divisions, In S. Sharan (Ed.), *Handbook of cooperative learning methods*, Westport: Praeger Publishers, 1999, pp.3-19.

[13] Minister of Education, The curriculum guideline for the elementary and junior high schools, Retrieved 2008, December, 10,, Available: <http://www.edu.tw/eje/content.aspx?site_content_sn=15326. >

[14] Wen, J. W., The local education and global view. China Times, (1995, June 30), pp. A3.

[15] Yao, C. , From ideology to identity: on the construction of Taiwan local education. *The Curriculum and Instruction Quarterly*. 3(3). pp.1-16, 2000.

[16] Shih, S. M., The meaning of local education and the study plan of the local cultural heritage. *Nantou Education*, Vol.24, pp.39-42, 2006.

[17] Tsai, C. T. & Yun, D. W., A study on the decisive factors of the local education curriculum of the elementary school teachers. *Journal of Ping-Tung University of Education*, Vol.29, 2007.

[18] Yang, L. C., *The case study of the Ming Nan dialect curriculum implementation of the elementary school teachers*, Unpublished M. A. thesis, National Taipei University of Education, 2001.

[19] Lin, C. S., The strategies and practice for the local education. Ping-tung Education, Vol.9, pp.13-17, 2002.

[20] Hsieh, T. L., The meaning, difficulty, and future of the local education in elementary school, Taiwan. *The New Knowledge of National Education*, Vol.54, No.1, pp.1-8, 2007.

[21] Huang, K. C., The modals of activity design for the digital technology incorporated in the subject teaching: the digital archive of the local education in the elementary school. *Quarter of the Taiwan Library Management*. Vol.4, 2008.

[22] H. J. Yang, L. H. Kuo, C. C. Lin, and H. M. Wei, "Integrating Databases for Compiling Statistical Yearbook of Teacher Education," WSEAS Transactions on Engineering Education, vol. 3, 2006.

[23] Y. M. Chu, Y. J. Chen, H. J. Yang, H. H. Yang, and W. C. Hu, "A Study of the Intension of Using Computer as a Strategic Resource of Web Searching," WSEAS Transactions on Communications, vol. 5, 2006.

[24] H. H. Yang and H. J. Yang, "Investigating the Opinions of University Students on E-learning," WSEAS Transactions on Communications, vol. 5, 2006.

Appendix I:

The Lesson Plan of Water Resources and Landform Balance

I. Content of lesson plan

A. Designer: Mr. Zong-Wen Cheng, Fangliao Senior High School

B. Field: Nature and Life Technology

C. Topic: The Introduction of Rivers

D. Aim:

i. cognitive domain:

a). Understand the cycle and importance of water.

b). Understand the effects of the wind-erosion, erosion, transportation, and sedimentation.

c). Understand the origin and relationship between river and groundwater.

d). Understand the balance between the river course and coastline.

ii. affective domain:

a). Give all kinds of situations and question to the students and train them to be equipped with an accurate attitude and behavior to the environment.

b) Students will be equipped with the love, passion and accurate attitude towards their birthplace.

c) Students are expected to have the responsibility and duty of being an Earth member.

iii. psychomotor domain:

a). Students are equipped with the ability of searching, filtering, and incorporating the knowledge they acquired through the homework.

b). Students are equipped with the ability of cooperation, distribution and reporting through the homework.

c) Students are able to sort the different information and establish a holistic observation.

E. Target: the Grade Nine students

F. Time: five classes (approximately 200 minutes)

G. Process of teaching

TEACHING ACTIVITY			
Field	Nature and Life Technology	**Time**	200 min
Topic	Water Resources and Landscape Balance		

EXPLANATION	TIME	TEACHING AIDS	Evaluation
Section One	minutes		
I. Preparation			
Prepare a poster about the cycling of water.	10	Photos or posters concerning this topic	
II. Development			
2.1. Grouping and rules of cooperative learning:			
2.1.1. Divide the students into groups, and there are 5-7 students in each group.	5		
2.1.2. Explain the rules, assignment and evaluation of the cooperative learning.			Able to state the principles and meaning of evaporation, runoff and precipitation. Able to understand the importance of water.
2.2. Motivation	15		
2.2.1. Do you drink water every day? Where does the water come from? How many days can a person survive without water?			
2.2.2. Think & Discuss: Where does drinking water come from?	5		Able to state the cause and function of the ocean, glacier, and lakes.
2.3. Explanation	5		
2.3.1. The cycle of water:			
Water has different states in the ocean, land, and atmosphere with a cycle of evaporation, runoff and precipitation.	5		Able to state that the usable water mainly comes from lakes, rivers, and groundwater.
2.3.2. The scope of water: the water on Earth is in the ocean, glacier, lake, river, and groundwater. Describe how the ocean, glacier and lake form?	5	Worksheet I; Group's worksheet	
2.3.3. Leading discussion: Students are expected to guess the percentage of the water in the ocean, glacier, lake/river, and groundwater (freshwater).	5		Understand the importance of water and how to save water.
2.3.4. Explanation: People can only use less than 0.5% of water resources (fresh water), in which the form of rain may supply. Ask the students to cherish water.	5 10	The photos of the fish farm that uses the ground water in the Fangliao District.	Able to describe the function of groundwater.
3.Discussion and Ending: Discuss and encourage the students to save water.	5 5	The photos of the land subsidence in the Fangliao District.	
Section II.			
2.1. Preparation			
Prepare the photos of the groundwater and land subsidence.	5		
2.2. Development			
2.2.1. Review the content of the last class.			
2.2.2. Motivation			
2.2.2.1. *Do you know the water that we daily use come from? How did the people in the past get water without the water system? Is anyone still using the groundwater in Fangliao District? And what's its purpose?*	5 5		
2.2.2.2. **Think and Discuss:** What is groundwater?	5	Photos	
2.3. Explanation	5		
2.3.1. Groundwater is restored in the groundwater. It is the water when it runs to the impervious surfaces, and then it stops in the mud, sand, gravels or rocks.	10 5	Worksheet II, and Group worksheet	Able to state how the groundwater is thus formed. Able to stat which is impervious surface.
2.3.2. Leading discussion: Is it really horizontal on the surface of the groundwater? Will the water surface constantly keep the same height?	12 3		
2.3.3. Explanation: The water surface of			Able to know how the well

the underground will be influenced by weather and terrain, and balanced between the rivers and lakes.			water, spring, and artesian wells are formed.
2.3.4. **Leading discussion (Motivation)**: What will happen if the groundwater was over-pumped? Will this cause any disaster to the districts such as Fangliao and Gadang?	5 5 5		Able to know how the weather or landform influences the levels of the groundwater. Able to state the relationship among the groundwater surface, lake surface, and river surface, and well surface.
2.3.5. Explanation: land subsidence will cause the function of flood control system, and inwelling, and make the groundwater salt. The districts of Fangliao and Gadang are examples.	10 5 5		
3. Ending: Encourage student to protect the groundwater from the pollution, and not to pump the groundwater.	12 3		Able to state the damages that the groundwater is over-pumped.
Section Three **3.1. Preparation** Prepare the pictures of the upper, middle, and lower streams of the Lu-mang River.	5	Worksheet II Group worksheet	Know the importance of groundwater and avoid the pollution.
3.2. Development 3.2.1. Review the content of last class.	35		
3.2.2. Motivation. a) *What are the rivers in the Pingtung County? The river can supply the groundwater, and what else can the river do?* b) **Think and Discuss:** What are the differences of the upper, middle, and lower streams?	10		
3.2.3. Explanation a) Explain the main rivers and other rivers in Pingtung County. Introduce the location of the rivers and the Lu-mang River by the map. b) Explain what are *wind erosion*, *erosion*, *transportation*, and *sedimentation*? The photos will demonstrate these terms and the Lu-mang River can be an example. c) Explain what will the erosion, transportation, and sedimentation influence the upper, middle, and lower streams. **d) Leading discussion (motivation)**: What will the other natural phenomenon affect the erosion, transportation and sedimentation. e) Explain that the sandstorm, glacier, ocean water, and waves will cause the phenomenon of erosion, transportation, and sedimentation. The air, water, and creatures will cause the phenomenon of wind erosion.			Able to state the main rivers, such as Kao-Ping River, and Tang-Kang River. Able to state what *erosion*, *transportation*, and *sedimentation* are. Able to state the influences that the downward erosion, side erosion, origin erosion, and cursive course cause. Able to state the difference of the size and shape between the upper stream rocks and the lower stream rocks. Able to what natural phenomenon that the sand-storm, glacier, ocean water, and waves will cause.
3.3. Ending: Encourage students to think and find any actual examples of wind erosion, erosion, transportation, and sedimentation.			Students are expected to find out the actual examples of how the gravel-storm, glacier, ocean water, and waves cause the wind erosion, erosion, transportation, and sedimentation.
Section IV **4.1. Preparation** Prepare the pictures of the balance of river course and the bridges destroyed by the flood.			
4.2. Development 4.2.1. Review the content of the last class.			
4.2.2. Motivation a) Will the flows of the river be influenced by the erosion and			Able to state

sedimentation? Will the erosion and sedimentation be different when the river runs to the lake or ocean? b) Think and Discuss: What are the differences caused by the erosion and sedimentation? 4.2.3. Explanation a) Elucidate the changes of the river course and make the students understand what temporary erosion surface and final erosion surface. b). Elucidate: The protruding part of the river bed will make it level; the indentation part will be added by sedimentation. Then the riverbed will be balanced. c).Leading discussion (motivation): Will the balance of the river course be permanent? Will the artificial intervention make the river course change? d) Elucidate: Make students understood that the river course be changed and cause enormous damage to the bridges if the mine gravels of the upper river are tremendously taken away. The coastline will be reduced or expanded by the accumulation of the sands of the river. **4.3. Ending:** Encourage the students to think the tremendous exploitation of the mine gravels of the rivers will seriously damage the environment. **Section V** **5.1. Preparation**			Able to state what is temporary erosion surface and final erosion surface. Able to state the function of river course balance from the erosion and sedimentation. Able to state what damage that the stealing of mine gravels cause on the bridges and the coastlines. Able to find the real examples of the stealing of mine gravels.

Evaluation sheet, and questionnaire 5.2. Development 5.2.1. Explain the process and rules of today's class, including the report of each group, group evaluation sheet, and the final questionnaire. 5.2.2. Group report a) Each group is expected to do a report according to the worksheet. b) Each group evaluates one another. 5.3. Filling in the questionnaire.			