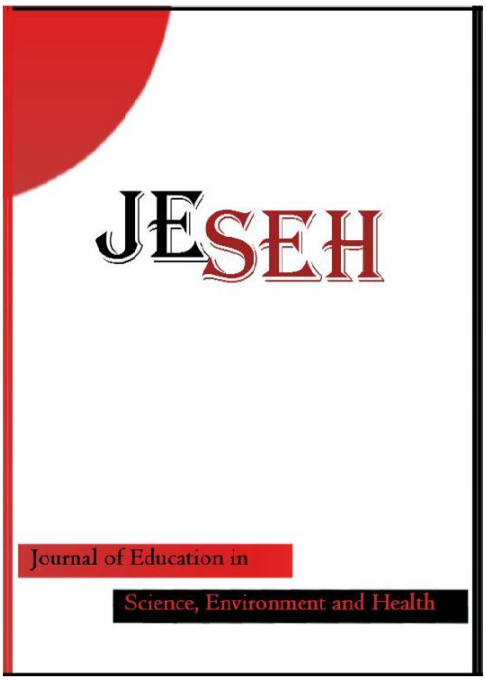

ISSN: 2149-214X

Journal of Education in Science, Environment and Health

www.jeseh.net

Effect of Cooperative Learning Strategy on Students' Acquisition and Practice of Scientific Skills in Biology

Hanadi Chatila, Fatima Al Husseiny
Lebanese University

To cite this article:

Chatila, H. & Husseiny, F. (2017). Effect of cooperative learning strategy on students' acquisition and practice of scientific skills in Biology. *Journal of Education in Science, Environment and Health (JESEH), 3*(1), 88-99.

JESEH
Journal of Education in Science, Environment and Health
Volume 3, Issue 1, 2017 ISSN: 2149-214X

Effect of Cooperative Learning Strategy on Students' Acquisition and Practice of Scientific Skills in Biology

Hanadi Chatila, Fatima Al Husseiny

Article Info

Article History

Received:
21 September 2016

Accepted:
18 December 2016

Keywords

Scientific skills
Cooperative learning
Biology education

Abstract

Recent research findings have shown that cooperative learning improves students' thinking skills as it allows them to communicate actively with each other (Johnson, Johnson and Smith, 2014). Therefore, cooperative learning has been proposed by many educators to be implemented in classrooms to produce lifelong learners and critical thinkers (Lunenburg, 2011). The current study investigates the effect of cooperative learning in Biology classroom, on students' learning and achievement of scientific skills. A convenient sample of 120 students from two grade levels, seven and ten, participated in the study in a private school in Beirut, where biology was taught to each class of the two different grades using two different teaching methods: cooperative learning (experimental group) and individualistic-direct learning (control group). Pre- and post- tests were administrated to both groups of each grade to compare students' achievement particularly in scientific skills items before and after intervention. Results of the study show that cooperative learning has a significant effect on students' achievement in learning and practicing scientific skills in grade ten, however no significant effect was shown in the acquisition of new scientific skills for grade seven students.

Introduction

Many studies around the world have documented students' difficulties in learning biology that may affect their motivation and achievement (Agboghoroma and Oyovwi, 2015; Bahar et al., 1999; Çimer, 2012). Those difficulties encountered by students may be attributed to two main factors: the difficulty of grasping biology concepts and "working scientifically" skills, and the overloaded curriculum.Studies have reported that students face difficulties in many abstracts concepts or topics in biology, at both high schools and university levels, including the concepts of hormones, cells, genes and chromosomes, mitosis and meiosis, and the nervous system (Agboghoroma and Oyovwi, 2015, Agorram et al, 2010, Chattopadhyay, 2005 and Tekkaya et al., 2001), in addition to other topics like water and gas transport in plants, protein synthesis, photosynthesis and respiration, gaseous exchange, energy, organs, physiological processes and oxygen transport (Çimers, 2012). Adding to the abstract content, the nature of science itself, which requires learning and applying "working scientifically skills" throughout the course of study, is a major problem for students. Another cause of difficulties is the overloaded curriculum (Tekkaya et al., 2001), which indirectly affects both teachers and students. Due to the massive and abstract content in curriculum, teachers usually take care of delivering the content regardless students' interest and motivation, which unfortunately prevents meaningful learning and results in learning materials by memorization, and therefore causes several learning problems (Zeidan, 2010).

Science education research, including biology education, conducted in the past few decades has focused on the integration of knowledge, skills and attitudes to develop a better understanding of scientific concepts (Zeidan and Jayosi, 2015.) In other words, the emphasis has been on how students learn, and how they built their personal understandings of scientific concepts. Lunenburg (2011) considered that the use of student-centered teaching strategies in classrooms within an overall inquiry-based pedagogy is an effective way to enhance students' academic performance, critical thinking, and problem solving skills. So, through inquiry, students may learn both skills and concepts, and develop positive attitudes towards science.

Chiappetta & Koballa (2010) considered that the learning and application of "science process skills" are always associated with scientific inquiry. Many factors have an impact on students' achievement such as classroom environment, attitude and motivation, and above all teaching methods and strategies. Educators around the world have been investigating various teaching strategies in science classes to improve students' outcomes. One of the most favored investigated teaching strategies among science educators is cooperative learning; it is

considered as one of the most efficient instructional methods that enable students to work together in solving scientific problems, as it improves students' thinking skills and abilities, and has the potential to promote academic achievement, enhance social skills, and improve self-esteem by engaging students in an active learning environment (Vijayratnam, 2009).

Cooperative Learning and Academic Achievement

Research around the word has highlighted the effectiveness of cooperative learning in promoting deep learning and higher achievement in the classroom, especially science classroom at all levels (Johnson & Johnson, 1989; Johnson et al., 2014; Lord, 2001; Lin, 2006; Vijayratnam, 2009 and Wolfensberger and Canella, 2015). Knowing that cooperative learning encourages student involvement and engagement in their own learning, it provides all students with opportunities to make their thoughts visible to others, allows them to talk about their own ideas, and permits them to consider the ideas of others, which enhances their higher order thinking skills (Johnson et al., 2014). In the light of this, Chang and Mao (1999) noted that effective cooperative learning leads to active learning that enables students to move beyond the text, memorization of basic facts, and consequently promotes learning and practicing higher-level skills. This would lead, apart from academic benefits, to enhance learners' self-esteem, and interpersonal relationship and attitudes toward school and peers (Bilgin and Geban ,2006).

For an effective cooperative learning experience, Richards and Rodgers (2001) and Johnson et al. (2013) suggested five major premises :(1) Positive interdependence when learners work together to attain the group objective. (2) Individual accountability, when each team member is considered responsible for his or her own understanding of the work, which in turn contributes to the objective of the team. (3) Interpersonal skills (communication, trust, leadership, decision-making and conflict resolution), where team members argue, solve problems, and work together. (4) Face to face interaction and (5) Processing where learners assess and reflect on their team work ability and skills.

Therefore, it is assumed that cooperative learning has a positive effect on students' cognitive, emotional and social skills, such as promoting higher achievement, greater use of higher level critical reasoning competencies and strategies, higher self-esteem, and greater collaborative skills and attitudes necessary for working effectively with others. However, literature includes some studies reporting no significant effect on learning.

For example, Chang and Lederman (1994) applied cooperative learning to investigate students' physical science achievement and found that cooperative learning had no significant difference on students' achievement. Similar findings were reported by Seymour (1994) and Tingle & Good (1990) as cited in Chang and Mao (1999). Sadler (2002) investigated the effect of cooperative learning on college students' biology academic achievement and reported no significant difference in academic achievement and cooperative learning verses direct lecture methods.

Biology in Lebanese schooling system

In Lebanon, the Science curriculum is rich in content, details and concepts that students must learn through exploring, investigating and describing their experiences to achieve meaningful learning. There is a great emphasis on knowledge and skills in the Lebanese science curriculum, disfavoring the affective domain in education. Table 1 shows the general objectives of the Lebanese "science curriculum" (CRPD, 1997).

In the Lebanese schooling system, Biology is delivered separately from other sciences (chemistry and physics) at the intermediate level starting from grade seven up to grade nine under the name of Earth and Life Science. The table below show the distribution of periods per week, knowing that the duration of each periods is 50 minutes .

Noting that the number of periods in grade nine was two per week, until recently in 2015 it was increased to three periods per week following the request of teachers to meet the requirement of the official exam at the end of grade nine. As for the secondary level, Biology is delivered differently between grades, under the names of "life Science" and "scientific literacy". The table below show the distribution of periods at the secondary level.

Table 1: General Objectives of the Lebanese "Science Curriculum" (CRPD, 1997)

General Objectives of the Lebanese "Science Curriculum" (CRPD, 1997)	
Introduction	"Science plays an important role in our everyday life. It manifests itself in all aspects of human activity. Consequently, it is important that students become lifelong learners of science, starting with science at school, but extending science learning beyond the school years"
General objectives	• Develop the learners' intellectual and practical scientific skills • Deepen the learner's awareness in the ability of humans to understand, invent, and create • Understand the nature of science and technology, their development across history, and their impact on human thought • Ensure that learners have acquired the facts, concepts, and principles necessary to understand natural phenomena • Motivate students to apply basic scientific principles in all sciences. • Explain the scientific concepts and principles behind commonly used machines and devices • Acquire knowledge about health, environment, and safety practices and behave accordingly • Realize that some natural resources can be depleted, and make the learner aware of the role of science in sustaining these resources • Encourage learners to use scientific knowledge and skills in novel situations, especially in everyday life • Emphasize the role of scientists in the advancement of human kind. • Encourage learners to be open to the ideas of scientists from different cultures, and to their contributions in the advancement of science • Encourage learners to abide by such scientific values as honesty and objectivity • Develop the learners' scientific curiosity and orientation toward scientific research • Encourage learners to work independently and cooperatively in solving scientific problems • Make the learners aware of career possibilities in different science related areas

Table 2: Distribution of Biology Periods in the Lebanese Schooling System.

Grade	Number of periods/week
Seven	3
Eight	2
Nine	3

Table 3: Distribution of Biology Periods at the secondary level.

Grade	Number of periods/week/sections		
Secondary first	2		
Secondary second	Sciences Sections 2		Humanities Sections 1
Secondary third	Life Science 6	sociology and Economics 2	Humanities 1

In the Lebanese system, there are two official exams, the first one at the end of the intermediate level (grade nine) and the second one at the end of the secondary level (grade twelve). Biology teachers (Earth and Life Science, and Life Science teachers) in most schools are concerned in delivering the content required by the curriculum. This was supported by research studies, so teachers focus mainly on the content, regardless students' needs, interest and motivation, and attributing their decision to do so to time limitation and the need to prepare students for official exams (Boghtchalian Karadaghlian, 2014). Therefore, it is well noticeable that lecturing is the main mode of instruction in Lebanese schools, and thus deeper learning is neglected (Al

Husseiny, 2014; Zeidan 2014). Biology concepts are explained by text readings using textbook documents, with minor usage of animations and video presentations, which results in passive learning.

Research Problem

Being Science /Biology Educators at the Lebanese University, faculty of education, the researchers of this study have noticed that both teachers and students are complaining from difficulties in Biology classes. We interviewed ten "Life and Earth" and "life Science" qualified secondary teachers about those difficulties faced by their students in all grades, from grade seven to grade twelve. All teachers agreed that the main issue in their teaching is the teaching and learning of scientific skills. Students have little problem with the content, and the department of education has removed many topics from the curriculum in order to make it lighter and to allow extra time for the abstract content to be grasped. However, according to "Life and Earth" and "Life Science" teachers, students are always struggling with the learning and application of "scientific skills". Researchers have different views about the categorization of scientific skills (Phang and Tahir, 2012).

Table 4: The Lebanese framework for competences and skills in Biology (CERD, 1998).

Domain	Skills
A- Acquiring Knowledge	A1- Recall Knowledge - Recall the acquired knowledge related to specific facts, terminology, law, theories, model… A2- Apply knowledge - Select the knowledge and use it in a new situation - Apply knowledge in a new context
B- Practicing Scientific Process	B1- Collect Information - Select information related to a real situation or to its representation in a table, text, graph, media… B2- Interrelate information to define a problem and/or formulate a hypothesis - Organize data in order to prove a relation - Compare new data to previous data - Identify a cause and effect relation - Define a problem - Formulate a hypothesis B3- Test a hypothesis - Identify the consequences implied by a hypothesis that could be verified - Design an experiment - Use data to test a hypothesis B4- Synthesize B5- Demonstrate critical thinking - Criticize experimental results, an argument, design an experiment
C- Mastering of Techniques	C1- Use laboratory or field materials and apply laboratory techniques C2- Perform an experiment following a given design C3- Carry out measurements, construct a model or make drawing based on observation…
D- Communicating	D1- Utilize proper scientific terminology - Use appropriate specific terminology to express information, observation, tabulated data, drawing, graph, or flow chart, in verbal or written form D2- Use various modes of scientific representation - Represent data by a table, a graph, a drawing, a chart, a symbol, or a formula.

The classification includes two levels: basic skills and integrated skills. Chiappetta and Koballa (2010) classified basic scientific skills as follows: observing, classifying, space/time relation, using numbers, measuring, inferring and predicting. As for integrated skills, they include: defining operationally, formulating models, controlling variables, interpreting data, hypothesizing, and Experimenting. In the Lebanese system, the

Centre of Educational Research and Development has set a framework for teachers to follow in the educational guide (1998). The framework includes four domains of competences: Domain A "Acquiring Knowledge", Domain B "Practicing Scientific Process", Domain C "Mastering of Techniques", and Domain D "Communicating". The table below represents the Lebanese framework for competences and skills in Biology. The current study investigates the effect of cooperative learning in Biology classroom, on students' learning and achievement of scientific skills, namely measured by the achievement of "Practicing Scientific Process" Domain B of the Lebanese framework. Three skills were the focus of the study: "analyze a document (text, graph or table)", deduce", and "draw out a conclusion". The Centre of Educational Research and Development (2012) has defined the requirement of these action verbs used in biology classes, as follows:

"Analyze: Decompose a whole into its constituent elements to make evident to variation.
Deduce: Draw using logical reasoning new information from given or existing information.
Draw out: Draw from a set of given and without reasoning a relation, a role, a law…" (CRDP, 2012. P 1)
The main research question addressed in the study: Does cooperative learning enhance students' acquisition and practice of scientific skills in Biology classroom?

Consequently, the following sub-questions are investigated:
Does cooperative learning strategy enhance:

- the practice of scientific skills, namely for grade ten students?
- the acquisition of new scientific skills, namely for grade seven students?

It is assumed that cooperative learning enhances the performance of students, regardless of their class grade level, and improves their achievement in domain B representing the acquisition of "Practicing Scientific Process" skills.

Method

This study employed a quasi- experimental design in which two intact sections of each grade were assigned to control and experimental conditions, and an independent variable, the teaching method, was manipulated.
The researcher used the pre-test/post-test control group design. This design greatly minimizes threats to the internal validity of the experiment. In addition, self-assessment of the student's and teamwork in the experimental groups were measured using two self- assessment grids with a five-point scale. The teachers observed the teams in the experimental groups, and filled out an observation grid to ensure that cooperative teamwork was conducted correctly.

Participants

School

A private high school in Beirut was selected based on its convenience in terms of location and time, and the willingness of the biology teachers to participate in the study. In addition, the school is a high school, thus contains all the grades which are of the sample of this study. Also, the school is well equipped with tools that facilitate cooperative learning in terms of wide classes.

Students

A total of 120 students (N=120) enrolled in two different grades (grade seven and grade ten participated in this study.) Grade seven represents the first class in the third cycle of the Lebanese educational system, while grade ten is the first class in fourth cycle. The table below represents the distribution of students among grades.

Table 5 shows the distribution of students among the groups.

Grade	Control Group	Experimental Group	Total Number of Students
7	30	30	60
10	30	30	60
Total	60	60	120

All participants were native speakers of Arabic and learning English as a first foreign language. English is the language of instruction in Biology.

Teachers

Two qualified biology teachers participated in the study; an Earth and life Science grade seven teacher, who taught both experimental and control groups, and a Life Science grade ten teacher who also taught both experimental and control groups.

Procedure

The duration of the study was a total of nine weeks. Students in both grades had two fifty minutes Biology sessions per week, which made a total of 18 sessions throughout the study. The study included two parts:
The first part was a training period for both the teachers and the students. It extended for two weeks. During this period, students practiced how to work cooperatively and distribute the roles among the team members. Moreover, the researchers followed up on the work of the teachers by making observations in both sections of each grade, to check if the teachers are planning their teaching periods according to the assigned and if the students are mastering how to work cooperatively. This part of the study aimed to help both students and teachers to master the learning strategy used in this study so that the results of the second part can be reliable.
The second part was the implementation period of the study, which was seven weeks long. This phase used the same process as described in the first phase, except that data was collected during this part. Both groups, experimental and control were given an equal amount of time and worked on the same hands-on activities but in different strategies (individually or cooperatively). They had the same assignments and were given equal opportunities to practice their learning objectives. For the control groups, the lessons were explained using the traditional individual learning (teacher demonstration approach). This method includes asking open-ended questions, oral reading of textbook, classroom discussion, and oral reviews. The teachers used the textbook and other materials including worksheets to help students construct their conceptual knowledge. Those sheets included hands-on activities that students must solve. Students in both experimental groups were teamed up in six groups of fives by the stratified random method in order to form heterogeneous groups. It is believed that when the size of team members increases, the range of abilities, expertise, skills, and number of minds available for acquiring and processing information increase (Johnson and Johnson, 1989). The experimental groups were taught using Johnson and Johnson Model of cooperative learning, where the same hands-on activities were used, but students worked on them cooperatively rather than individually. Students in those sections discussed open-ended questions in groups, read the content knowledge in cooperative groups, in addition to doing the hands-on activities cooperatively. When the groups completed their work and reached a consensus, the teachers asked the readers of the groups to explain their answers and discuss them with other members of the class. Assessment grids were used in the study, they were prepared, piloted and validated by the researcher based on group interaction in the cooperative learning teams (appendix):

A student self-assessment grid was given to each student to measure self-assessment of their learning; it included nine items (e.g. I accomplished my task; I organized my thought before and while speaking) in which each member of the team was to respond to a five-point Likert scale. A mark of 1-5 was applied on a scale that goes from a very positive assessment of their ability to a very negative assessment. The grid was administered twice during the study: once in the first session and once in the last session. The sum of the marks on each item were calculated for each student and named: "student self-assessment 1" referring to the first administration and "student self-assessment 2" for the second one. Moreover, each team was required to fill a team self -assessment grid and submit it before the end of the cooperative learning session. This included nine items (e.g. All of the team members contributed ideas; everyone in the team responded kindly to disagreements) assessing the teamwork and was filled according to a five-point scale. The aim of this grid was to ensure that students were practicing the cooperative skills to help teachers in team processing and providing feedback about the work. The sum of the marks on each item were calculated for each team and named: "team's self-assessment". In parallel to team self-assessment grids, an observation grid was designed to be used by the teacher and named "Teacher's team-assessment grid"; it was filled by the teachers during the cooperative work sessions for the experimental groups, where they chose randomly two teams each session for observation. The grid included nine five-point Likert scale items. Throughout the whole study, teachers had assessed all teams in each class, and then the marks of each item were calculated for each team and compared with the team's self-assessment to ensure the reliability of the teamwork. Means of the teams' and teacher's assessment scores were calculated for each experimental group in each grade, and were then compared to ensure the reliability of the teams' work. The

results of teams' self-assessment and teachers' assessment of all the teams of both grades seven and ten show high values of self-assessment among the teams, an average of 18.2 and 18.8 respcetively. While teachers' assessment mean scores are 17 and 18.2 respectively. Those results show close scores between the teams' self-assessment and teachers' assessment of the teams, which indicates that cooperative learning was effectively implemented and reflected the honesty of students in assessing their work. In addition, students were comfortable in assessing themselves especially since these scores don't count in their task assessment. Thus, the results assure the reliability of the cooperative learning strategy used in the study.

Data Collection and Analysis

Students' achievement was measured by tests prepared by the researchers with the collaboration of other science educators. The tests included a variety of questions covering the three domains of evaluation in the Lebanese curriculum: Domain A (knowledge), B (cognitive), D (communication). For both grade seven and ten, three main "action verbs" were presented in the pre and post-tests and repeated twice, representing the higher order skills: "analyze", "deduce" and "draw out". The tests were piloted and based on the piloting results; minor modifications were made. Descriptive statistics for the domain B questions items of pre and post-tests were computed for each control and experimental group in each grade (seven and ten). To check whether the dependent variable (teaching method used) had an effect or not on student achievement in domain B questions, t-tests were conducted to determine whether there were significant differences between means on domain B selected items on pre and post-tests of the control and experimental groups in each grade.

Results and Discussion

The results show that grade seven students in the experimental and control groups have very close means in the pre-test domain B items (10.37/20 and 10.5/20 respectively). In the post-test, both groups show an increase in the scores (15.5/20 and 14.12/20 respectively). However, the increase in the means of experimental group is greater than that of the control group. Table 6 shows the mean scores and standard deviations for the domain B scores in pre- and post-tests of both experimental and control groups in grade seven.

Table 6: Mean and Standard Deviation of Domain B scores of pre-and post-test for grade seven groups

	Group	N	Mean	SD
Pretest	G7 E.	30	10.375	3.2250
	G7 C	30	10.500	3.2088
Posttest	G7 E	30	15.504	2.8728
	G7 C	30	14.118	3.4436

Similarly, concerning grade ten, table 7 shows the mean scores and standard deviations for the domain B scores in pre- and post-tests of both experimental and control groups. Students in both groups have very close means in the pre-test (9.67/20 and 8.69/20 respectively). In the post-test, both groups show a significant increase in the domain B scores (13.93/20 and 11.15/20 respectively). However, the increase in the means of experimental group is greater than that of the control group. Table 7 shows the mean scores and standard deviations for the domain B scores in pre- and post-tests of both experimental and control groups in grade ten.

Table 7: Mean and Standard Deviation of Domain B scores of pre-and post-test for grade ten experimental and control groups.

	Group	N	Mean	SD
Pretest	G10 E.	30	9.671	4.4861
	G10 C.	30	8.686	4.1851
Posttest	G10 E.	30	13.929	3.8909
	G10 C.	30	11.153	5.8610

A two-tailed t-test at the level 0.05 of significance shows no significant difference between cooperative learning and individualistic learning in grade seven on domain B of pre-or post-tests (t-value of 0.89 and 0.1 respectively). Table 8 shows the the results of T-test for pre-test and post-test domain B items for grade seven experimental and control groups.

Table 8: T-test for pre-test and post-test domain B items for grade seven experimental and control groups.

	Group	N	Mean	SD	Sig (2-tailed)	Mean difference
Pretest	G7 E.	30	10.375	3.2250	0.885	- 0.1250
	G7 C.	30	10.500	3.2088		
Posttest	G7 E.	30	15.504	2.8728	0.108	1.3866
	G7 C.	30	14.118	3.4436		

On the other hand, a two-tailed t-test at the level 0.05 of significance shows no significant difference between cooperative learning and individualistic learning in grade ten on domain B of pretest (t-value of 0.399 > 0.05). However, there is a significant difference on domain B of post-test (t-value of 0.042 < 0.05). Table 9 shows the results of T-test for pre-test and post-test domain B items for grade ten experimental and control groups.

Table 9: T-test for pre-test and post-test domain B items of grade ten experimental and control groups.

	Group	N	Mean	SD	Sig (2-tailed)	Mean difference
Pretest	G10 E.	30	9.671	4.4861	0.399	0.9857
	G10 C.	30	8.686	4.1851		
Posttest	G10 E.	30	13.929	3.8909	0.042	2.7760
	G10 C.	30	11.153	5.8610		

As mentioned earlier, cooperative learning has no effect on students' domain B scores in grade seven experimental group. This result shows that cooperative learning has neither a positive nor a negative effect on students' achievement. The findings of this study are in line with the results of other studies carried out about the effect of cooperative learning on students' academic achievement in science. This result is not consistent with the literature concerning the effect of cooperative learning on academic achievement for primary and secondary school students, with few exceptions, such as Sherman (1989) and Chang and Lederman (1994) who applied different types of cooperative learning models on middle school students and came up with the same results: cooperative learning had no effect on students' academic achievement in science, but had an effect on other aspects like confidence and attitudes.This lack of significant differences between the control and the experimental groups in grade seven in this study may be due to the fact that Domain B skills are newly introduced to grade seven students, since it is their first year of learning biology as a separate discipline, and in this grade they are introduced to skills such as "analyze", "deduce" and "draw out". Students might need more time to show a significant acquisition of the concept. Therefore, it is recommended that more research is needed to investigate this finding. However, results of grade ten students are different. They show significant difference in post-test for domain B items. The findings are in parallel with the literature review, namely the reported studies that confirm a significant correlation between cooperative learning and achievement and that cooperative learning engages students in the learning process and improves critical thinking, reasoning, and problem-solving skills of the learner (Chang, & Mao, 1999; Bilgin and Geban ,2006; Nezami , Asgari and Dinarvand, 2013).

Conclusion

The main purpose of the study is to investigate the effect of cooperative learning strategy on teaching and learning scientific skills in grades seven and ten. The results show a significant improvement in students' achievement of scientific skills in grade ten; however, grade seven students show improvement but not significant. Therefore, we may conclude that students' grade level and the complexity of concept introduced have impacts on students' outcomes. It is well clear that cooperative learning has a positive effect on teaching and learning scientific process skills, even though it is not always significant, but it does improve the learning

and practice process of the acquired skills and help the learning of new skills. The results of this study are in line with findings reported in the literature.

Recommendations

Changes are needed in biology teaching. Teachers should pay more attention to teaching and learning scientific skills, and incorporate a variety of teaching strategies to overcome the major problems faced by students in the acquisition and practice of scientific process skills. Cooperative learning is proved by research to be an effective strategy to enhance the learning and practice of those skills. It is recommended to investigate in a larger scale the effectiveness of cooperative learning on teaching and learning skills, by including a larger sample for both grades for a longer period of time.

Notes

Data used in this study were taken from a Master Research study conducted by Fatima Al Husseiny under the supervision of Dr. Hanadi Chatila at the Lebanese University, entitled *Enhancing Critical Thinking through Cooperative Learning in Biology.*

References

Agboghoroma, T E., & Oyovwi, E.O (2015). Evaluating Effect of Students' Academic Achievement on Identified Difficult Concepts in Senior Secondary School Biology in Delta State. *Journal of Education and Practice, 6 (30), 117-125.*

Agorram, B; Clement, P; Selmaoui, S; Khzami,S.E., & Chafik, J (2010). University students' conceptions about the concept of gene: Interest of historical approach. *US-China Education Review. 7 (2), 9 - 15*.

Al Husseiny, F. I. (2014). *Enhancing Critical Thinking through Cooperative Learning in Biology. Research* Master Dissertation, Lebanese University.

Aydin, S. (2011). Effect of cooperative learning and traditional methods on students' achievements and identifications of laboratory equipments in science-technology laboratory course. *Educational Research and Reviews*,*6*(9), 636-644

Bahar M, Johnstone A.H., & Hansell M.H. (1999). *Revisiting learning difficulties in biology. Journal of Biological Education., 33(2), 84-86.*

Bilgin, I., & Geban, O. (2006). The effect of cooperative learning approach based on conceptual change condition on students' understanding of chemical equilibrium concepts. *Journal of Science Education and Technology, 15(1)*, 31-46.

Boghtchalian Karadaghlian, S (2014). The Effect of Computer Based Games on the Academic Achievement and Motivation towards Biology of Grade 8 Students. Unpublished thesis. Lebanese University, Beirut, Lebanon.

Center for Educational Research and Development CERD (1997). Lebanese national curriculum. Beirut, Lebanon.

Center for Educational Research and Development CERD (1998). Life Science Pedagogical Guide, Teacher's guide, Secondary Education, First Year.

Center for Educational Research and Development CERD (2012). Verbes d'action : Physique, chimie et Sciences de la Vie. Définitions et exemples.

Chang, C. Y., & Mao, S. L. (1999). The effects on students' cognitive achievement when using the cooperative learning method in earth science classrooms. *School Science and Mathematics, 99*(7), 374-379.

Chang, H. P., & Lederman, N. G. (1994). The effect of levels of cooperation within physical science laboratory groups on physical science achievement. *Journal of Research in Science Teaching, 31*(2), 167-181.

Chattopadhyay, A. (2005). Understanding of genetic information in higher secondary students in northeast India and the implications for genetics education. *Cell Biology Education, 4*(1), 97-104.

Chiappetta, E. L., & Koballa, T. R. (2010). Science instruction in the middle and secondary schools: Developing fundamental knowledge and skills for teaching (6 th ed.). NJ: Pearson Prentice-Hall.

Çimer, A, (2012).What makes biology learning difficult and effective: Students' views. *Educational Research and Review, 7(3), 61-71.*

Iyer, R. B. (2013). Relation between cooperative learning and student achievement. *International Journal of Education and Information Studies*,*3*(1), 21-25.

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research*. Interaction Book Company.

Johnson, D., W.; Johnson, R., T., & Smith, K., A. (2014). Cooperative Learning: Improving University Instruction By Basing Practice On Validated Theory. *Journal on Excellence in College Teaching, 25 (4),*1-26.

Lin E (2006). Learning in the science classroom. Sci. Teach., 73(5): 35- 39.

Lord, T. R. (2001). 101 reasons for using cooperative learning in biology teaching. *The American Biology Teacher, 63*(1), 30-38.

Lunenburg, F. C. (2011). Critical thinking and constructivism techniques for improving student achievement. *National Forum of Teacher Education Journal, 21 (3),* 1-9.

Nezami, N. R., Asgari, M., & Dinarvand, H. (2013). The effect of cooperative learning on the critical thinking of High School students. *Technical Journal of Engineering and Applied Sciences*, *3(19)*, 2508-2514.

Phang, F. A., & Tahir, N. A. (2012). Scientific skills among pre-service science teachers at universiti teknologi malaysia. *Procedia-Social and Behavioral Sciences*, *56*, 307-313.

Richards, J., & Rodgers, T. (2001). Approaches and methods in language teaching. Cambridge: Cambridge University Press.

Sadler, K. C. (2002). The Effectiveness of Cooperative Learning as an Instructional Strategy To Increase Biological Literacy and Academic Achievement in a Large, Non-Majors College Biology Class. Retrieved from the ERIC database. (ED 471 548).

Sherman, L. W. (1989). A comparative study of cooperation and competitive achievement in two secondary biology classrooms: The group investigation model versus an individually competitive goal structure. *Journal of Research in Science Teaching, 26* (1), 55-64.

Tekkaya C, Özkan Ö., & Sungur S (2001). Biology concepts perceived as difficult by Turkish high school students. Hacettepe Univ. J. Educ., 21, 145-150.

Tran, V. D. (2014). The effects of cooperative learning on the academic achievement and knowledge retention. *International Journal of Higher Education*, *3*(2), 131-140.

Vijayaratnam, P. (2009, November). Cooperative learning as a means to developing students' critical and creative thinking skills. *Proceedings of the 2nd International Conference of Teaching and Learning, Nilai, Negri Sembilan*, 16-18.

Wolfensberger, B., & Canella, C. (2015). Cooperative Learning about Nature of Science with a Case from the History of Science. *International Journal of Environmental and Science Education*, *10*(6), 865-889.

Zeidan, A. (2010). The relationship between grade 11 Palestinian attitudes toward biology and their perceptions of the biology learning environment. *International Journal of Science and Mathematics Education, 8(5),* 783 – 800.

Zeidan, A., & Jayosi,M., R. (2015). Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students *World Journal of Education. 5 (1),* 13-24.

Zeidan, M (2014). *The Effect of Self-Regulation (Checklist as a Tool of Learning) on Students' Motivation and Achievement in Biology.* Unpublished thesis. Lebanese University, Beirut, Lebanon.

Author Information

Hanadi Chatila
Lebanese University, Faculty of Education.
Beirut, Lebanon.

Fatima Al Husseiny
Lebanese University, Faculty of Education.
Beirut, Lebanon.

Appendix

STUDENT SELF-ASSESSMENT GRID

Name:……
Date……
Grade…… / Section: ……
The Title of the activity: ……..……

- *The objective of this grid is to self -assess the student's learning skills during team work.*

Using "5" as the highest point and "1" as the lowest, decide to what degree you were successful in each of the following areas. Circle one number.

Student's Self-assessment of Learning Skills					
1-I accomplished my tasks.	1	2	3	4	5
2-I shared ideas and opinions.	1	2	3	4	5
3-I organized my thoughts before and while speaking.	1	2	3	4	5
4-I used appropriate terms when stating ideas.	1	2	3	4	5
5-I asked for facts and reasoning.	1	2	3	4	5
6-I offered to explain and clarify statements.	1	2	3	4	5
7-I clarified statements using examples.	1	2	3	4	5
8-I can summarize what have been said without referring to notes.	1	2	3	4	5
9-I can relate the material to previous information or experience.	1	2	3	4	5

TEAM'S SELF-ASSESSMENT GRID

Date……
Grade…… / Section: ……
The Title of the activity: ……..……

- *The objective of this grid is to self-assess our team's work.*

A. Using "5" as the highest point and "1" as the lowest, decide to what degree your team was successful in each of the following areas. Circle one number.

Team Self- Assessment					
1- All of the team's members contributed ideas.	1	2	3	4	5
2- All of the team's members listened carefully to the ideas of other team members.	1	2	3	4	5
3- All of the team's members encouraged other members to contribute their thoughts and opinions.	1	2	3	4	5
4- Everyone in the team shared ideas/information.	1	2	3	4	5
5- Everyone in the team helped others.	1	2	3	4	5
6-Everyone in the team accepted help.	1	2	3	4	5
7-Everyone in the team responded kindly to disagreements.	1	2	3	4	5
8- Everyone in the team understood the activity.	1	2	3	4	5
9- We finished the task on time.	1	2	3	4	5

Team Members' Names

……
……
……
……
……

TEACHER'S TEAM-ASSESSMENT GRID

Date……
Grade…… / Section: ……
The Title of the activity: ……..……

- *The objective of this grid is to assess the team's work by the teacher during her observation.*

Team Members' Names

……..……
……..……
……..……
……
……..……

Team Work Assessment					
1- All of the team's members contributed ideas.	1	2	3	4	5
2- All of the team's members listened carefully to the ideas of other team members.	1	2	3	4	5
3- All of the team's members encouraged other members to contribute their thoughts and opinions.	1	2	3	4	5
4- Everyone in the team shared ideas/information.	1	2	3	4	5
5- Everyone in the team helped others.	1	2	3	4	5
6-Everyone in the team accepted help.	1	2	3	4	5
7-Everyone in the team responded kindly to disagreements.	1	2	3	4	5
8- Everyone in the team understood the activity.	1	2	3	4	5
9- The team finished the task on time.	1	2	3	4	5