

## **Cooperative learning and teamwork effectiveness: impacts of education period on cadets**

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### **Abstract**

The maritime industry is a multinational industry where participants of several languages and cultures operate in a global teamwork environment. Seafarers' operating procedures are totally based on a teamwork infrastructure and climate. By the introduction of Safety Management Systems, shore-based human resources are also included in the wider system of the maritime teamwork of the company where information and communication technologies have accelerated this integration. Goals and tasks for the team, team composition, team-player styles, phases of team development, communication and interpersonal skills, decision making, leadership, and evaluation of team performance are the key elements in developing the structure of the teamwork based systems.

Training and development is the main instrument in preparing the human resources for the teamwork climate of modern organizations. Education methodologies that support the characteristics, which encourage teamwork and cooperation, are widely applied in maritime education. Cooperative learning and problem-based learning are among those approaches.

This study analyzes the effects of cooperative learning dimensions among the cadets in a maritime higher education institute with regard to teamwork effectiveness. An empirical study has been realized to measure the effects of cooperative learning dimensions on 1) individual performance in groups and 2) effective team members. To comment on the impacts of the education period on these dimensions, the study aims to realize a comparative analysis among the cadets of a senior class, before and after a simulator based bridge team management course.

*Keywords: maritime education, teamwork, cooperative learning, bridge team management.*

## 1 Introduction

In response to the demands of global competition and the increasing use of knowledge to create products and services, organizations have been moving toward a form of work that organizes employees into teams rather than a rigid management hierarchy [1]. As a result teams and teamwork have received an increasing amount of attention and popularity over the last two decades.

The workplace in the maritime industry has been changing in recent years. In the shipping industry, masters, mates, helmsman, pilots, and in a wider approach, the engine room team, must coordinate their activities to realize safe, efficient and environmental sound voyages. This coordination needs teamwork skills. The ability to work together requires some people skills such as communication, teamwork, leadership, the ability to learn, and ability to adapt to changes. But the existence of these necessary skills among students is questionable [2]. Lecturers need a mean to provide these skills to the students [3]. Active learning strategies such as cooperative learning and simulator-based learning can be effective tools in higher maritime education to provide these skills.

## 2 Teams and teamwork

Although we use terms “teams” and “groups” interchangeable in our daily life, there is a need to make a distinction between these two terms. As opposed to a group, a team has clearly defined goals and performance objectives for which members are individually and collectively accountable. Also a team requires special training and time to develop before reaching peak performance [4]. There are many definitions for teams. Dessler [5] and Daft [6] define teams as a unit of “two or more people” who “interact” and “coordinate” their work to accomplish a specific “goal”. Salas et al. [7] define a team as “A distinguishable set of two or more people who interact dynamically, interdependently, and adaptively towards a common and valued goal/object/mission who have each been assigned specific roles or functions to perform”. Examples of teams that fit these definitions include military command and control teams, operating room and emergency room teams, cockpit crews, medical emergency teams, intensive care units, fire rescue teams, management teams and engine room and bridge teams in the shipping industry.

The next term that we have to clarify is teamwork. Teamwork is defined as those behaviors that facilitate effective team member interaction. Hoegl and Gemuenden [8] examined the Teamwork Quality (TWQ). The required teamwork behaviors vary depending on the team’s task, but recent research suggests that five teamwork behaviors such as team leadership, team orientation, mutual performance monitoring, back-up behaviors, and adaptability have been observed in all types of teams [9]. Teamwork Skills refers to competencies that individual team members must possess in order to perform the necessary teamwork behaviors.

### 3 Bridge team training

In complex and high risk working environments where cooperation among workers is needed, teamwork plays an important role in ensuring safety and avoiding errors. Teams make fewer mistakes than do individuals, especially when each team member knows his or her own responsibilities and also those of other team members. However, teamwork is not an automatic consequence of placing people together in the same room; it depends on a willingness to cooperate toward shared goals [10, 11].

A “bridge team” is a type of “command team” which is created by the organization to attain specific goals through members’ joint activities and interactions. These types of vertical teams are composed of a manager (master) and his or her subordinates (mates, helmsman, etc.) in the organization’s formal chain of command.

According to Australian Transportation Safety Bureau (ATSB) and Canadian Transportation Safety Board (TSB Canada) data, 25% and United Kingdom Marine Accident Investigation Board (MAIB) data, 23% of causal factors of shipping accidents are associated with “Management Group Factors”. These consist of fatigue, communications, bridge resource management, procedures, manning, business management, and watch handoff [12]. This study shows that weakness in bridge organization and management has been an important cause for marine casualties worldwide. Bridge Resources Management (BRM) and Bridge Team Management (BTM) courses have been performed in all nautical schools for many years. BRM/BTM focuses on bridge officers’ skills such as teamwork, teambuilding, communication, leadership, decision-making and resource management [13]. Cross-checking of individual decisions, making roles and responsibilities clear to team members, involving all team members in problem solving and decision making, and making team members clearly understand the chain of command will improve safety and can help detect errors, and correct and respond them as early as possible in both routine and emergency operations.

Simulator-based training has become a popular technique and a powerful training tool for training teamwork skills in high risk industries such as aviation, health care, maritime, and nuclear power production. Beaubien and Baker [9] mentioned that there is no direct relationship between the level of simulation fidelity and teamwork training effectiveness.

### 4 Cooperative learning

The use of active learning strategies, such as Cooperative Learning, is growing at a remarkable rate in all disciplines. Cooperative learning (CL) is the instructional use of small groups so that students work together to maximize their own and each other’s learning [14]. CL is the concept of teamwork applied within a practical educational setting and provides a highly relevant and effective

model for the higher education institutions for teaching and developing teamwork skills for future workforces.

A real and effective application of the CL method has many benefits both to students and to the education outcomes of higher education institutions. Researchers commonly report student gains in problem solving skills [15]. Also by eliminating the competition and working together, students will learn more in a shorter time frame while developing social and teamwork skills [16]. CL also results in greater transfer of what is learned within one situation to another [14].

#### **4.1 Elements of the cooperative learning model**

CL should be well structured and include five essential components or principles for small-group learning to be truly cooperative [17]. These components are Positive Interdependence, Face-to-Face Promotive Interaction, Individual Accountability/Personal Responsibility, Teamwork Skills and Group Processing.

#### **4.2 Formal learning groups**

Cooperative learning can be structured in many different ways. Formal Cooperative Learning (FCL) groups that are used to teach specific content and problem-solving skills are probably the most difficult to implement, but they have the greatest potential for affecting positive change [18].

FCL groups that encourage teamwork and cooperation are built in Bridge Team Management (BTM) Courses. Leadership in emergencies, effective internal and external communication, situational awareness, voyage planning, teamwork, error trapping, and relationship with pilots are the main subjects that are covered. In formal cooperative groups in BTM courses, instructors accomplish the following tasks: Specify the objectives for the lesson, Make a number of instructional decisions, Explain the task and the positive interdependence, Monitor students' learning and intervene within the groups to provide task assistance or to increase students' teamwork skills, Evaluate students' learning and help students process how well their group functioned. Self-assessment plays a vital role in the learning process as students can develop a realistic sense of their own strengths and weaknesses [19]. The instructor provides time and a structure for members of each learning group to process how effectively they have been working together. This type of "Student Facilitated Debrief" technique is found an effective tool for simulation assessments [20].

### **5 Objective and hypothesis**

One of the most important expectations from maritime students is to be able to work in teams. Maritime education should be considered as an important tool for developing effective team members in maritime industry. Applications supporting teamwork should be made use of in maritime education. The main objective of this study is to analyze the effectiveness of the CL strategy to

develop teamwork skills during the BTM course among senior class students of a Nautical Science Department.

The main hypothesis of the study can be formulated as follows:

**H<sub>1</sub>:** Perceptions of senior deck students on CL dimensions; team member roles and required skills in teamwork are different before and after simulator-based training.

51 sub-hypotheses are developed to test this hypothesis (See Table 1).

## 6 Methodology

### 6.1 Questionnaire development

A questionnaire is applied to the senior class students before and after the simulator based bridge team management course. Formal CL groups are used to analyze the effectiveness of application of CL strategy.

To realize the objectives of the research, a questionnaire consisting of 3 parts is developed. A previous study by the authors made use of a similar questionnaire where the questions were derived from research about teamwork and cooperative learning [21].

A Likert-scale is developed as “1 = strongly disagree, 5 = strongly agree”.

The questionnaire made use of some of the scales that were developed and used by other researchers. The cooperative learning scale developed by Johnson and Johnson [22], and used by Ghaith [23], was applied. Ghaith [23] used a modified version of Johnson and Johnson’s [22] Classroom Life Measure in order to assess the connections of cooperative learning to learner’s perceptions of social support, feelings of alienation from school, and academic achievement. Group interaction and attitudes toward CL scale was adapted from Veenman et al.’s study [24]. Pupil Perceptions of Cooperative Learning scale for pupils from grades 4 to 8 was developed by Veenman et al [24] to gather information concerning pupils’ preferences for learning in groups, the potentially positive and negative outcomes of cooperative learning and other aspects of cooperative learning. On conceptual backgrounds, Veenman et al. [24] had developed two scales. The scales were attitudes toward CL and group interaction. Annett et al. [25] developed a team process model in which three processes, namely behavioral, cognitive and affective processes were defined. Behavioral process consists of communication and coordination. Annet et al.’s [25] variables were adapted to maritime undergraduate education to assess coordination in groups. Statements for *group processing*, *teamwork skills*, *individual performance in groups* and *effective team member* were developed through literature survey and their reliability was again tested in the authors’ previous study [21].

### 6.2 Sample

The research was carried out in the spring of 2005 among the senior class cadets of the Nautical Science Department of Dokuz Eylul University School of

Maritime Business and Management. The population of the class is 40 and 39 questionnaires were received before implementation of simulator-based training. Thirty-two questionnaires were received after simulator-based training.

### 6.3 Data analysis and procedures

The research covers a comparative analysis. The analysis is maintained by SPSS (Statistical Package for the Social Sciences) program. Means and standard deviations are obtained and t-test is applied to finalize the hypotheses test.

### 6.4 Evaluation and results

The means of the findings and the results of the comparative analysis are given in Table 1. The variables are tested for bridge teams before and after the simulator based training and as can be noted from the results, 16 sub-hypotheses out of 51 variables have been supported. The determinants that are perceived different from the sample are given below:

*Our job is not done until everyone in the group has completed the assignment, Our grade depends on how much members learn, I have to make sure that the other members learn if I want to do well on the assignment, We cannot complete an assignment unless everyone contributes, The lecturer divides up the material so that everyone has a part and everyone has to share, I have to find out what everyone else knows if I am going to be able to do the assignment, I am self-confident, Performance of each member is assessed and the results are given back to the member, We keep to planned time / event schedule, I have high motivation, I achieve better success, I am more productive, We always divide tasks equally, I improve my own learning, I am satisfied with structure of the group. (e.g. size, member), I always do my best when working in groups.*

The supported sub-hypotheses can be grouped under the following main areas of cooperative learning components: positive interdependence in groups, group processing and individual performance in groups.

Regarding the answers to the statements, the highest frequencies obtained before simulator based training are, *satisfaction with the problem solving skills (4.26), satisfaction with the communication skills (4.20) and satisfaction with the decision making skills (4.20)*. The corresponding highest frequencies after the simulator based training are as follows: *satisfaction with the problem solving skills (4.48), not being able to complete an assignment unless everyone contributes (4.41) and sharing work according to prearranged plans (4.34)*.

Regarding the answers to the statements, the lowest frequencies obtained before simulator based training are: *We always divide tasks equally (2.51), We always talk about things that have nothing to do with the task (2.57), The lecturer divides up the material so that everyone has a part and everyone has to share (2.84)*. The corresponding lowest frequencies after the simulator based training are as follows: *We always talk about things that have nothing to do with the task (2.20); I always have problems completing a task when working with other students in a group (2.65)*.

Table 1: Results of the comparative analysis.

Variables	Before		After		t	p
	Simulator		based training			
	Mean	SD	Mean	SD		
1. We try to make sure that everyone in the group learns.	3.62	1.33	3.63	1.36	.030	.976
2. Our job is not done until everyone in the group has completed the assignment.	3.36	1.34	4.03	1.12	-2.253	.027
3. We all receive the same grade.	3.58	1.42	2.94	1.26	1.961	.054
4. Our grade depends on how much members learn.	3.16	1.34	3.79	1.07	-2.019	.048
5. I have to make sure that the other members learn if I want to do well on the assignment.	3.24	1.47	3.94	1.27	-2.134	.036
6. We cannot complete an assignment unless everyone contributes.	3.13	1.41	4.41	.88	-4.600	.000
7. The lecturer divides up the material so that everyone has a part and everyone has to share.	2.84	1.46	4.19	.78	-4.904	.000
8. We have to share all materials in order to complete the assignment.	4	1.16	4.19	1.09	-.691	.492
9. Everyone's ideas are needed if we are going to be successful.	4.03	1	4.23	.96	-0.841	.403
10. I have to find out what everyone else knows if I am going to be able to do the assignment.	3.49	1.21	4.09	1.03	-2.246	.028
11. I am self-confident.	3.23	1.44	4.13	.87	-3.224	.002
12. Performance of each member is assessed and the results are given back to the member.	2.74	1.31	3.63	1.21	-2.914	.005
13. Performance of each group is assessed and the results are given back to the group.	3.46	1.23	3.75	1.27	-.968	.336
14. We identify helpful and unhelpful member actions.	3.34	1.258	3.84	1.11	-1.753	.084
15. I send correct information to the right individual at the right time.	3.61	1.198	3.94	.669	-1.461	.149
16. I receive correct information from the right individual at the right time.	3.53	1.1	3.53	.92	-.020	.984
17. I discuss situations/options with appropriate members of the group.	4	.95	4.00	.92	.000	1.00
18. I raise possible options for discussion.	4.16	.834	4.13	.92	.156	.877
19. I share work according to prearranged plan.	3.89	1.11	4.34	.83	-1.888	.063
20. We rearrange plan to balance work load.	3.67	1.28	3.88	1.10	-.725	.471
21. We keep to planned time / event schedule.	3.41	1.29	3.97	.97	-2.081	.041
22. I have high motivation.	3.28	1.39	4.16	.82	-3.286	.002
23. I achieve better success.	3.38	1.31	4.03	.86	-2.495	.015
24. I am more productive.	3.13	1.51	4.13	.72	-3.603	.001

Table 1: Continued.

Variables	Before		After		t	P
	Simulator based training					
	Mean	SD	Mean	SD		
25. We always divide tasks equally.	2.51	1.41	3.88	1.13	-4.419	<b>.000</b>
26. The group identifies norms.	3.03	1.46	3.61	1.28	-1.739	.087
27. We always talk about things that have nothing to do with the task.	2.57	1.16	2.20	1.24	1.204	.233
28. I improve my own learning.	3.37	1.26	4.09	.69	-2.789	<b>.003</b>
29. I am satisfied with physical climate. (e.g. Lighting, heating, equipment)	3.74	1.3	3.63	1.34	.353	.726
30. I am satisfied with structure of the group. (e.g. size, member)	3.24	1.42	3.88	1.19	-2.048	<b>.044</b>
31. I like to work on a task with other students.	3.63	1.23	3.84	1.19	-.702	.485
32. I like to explain things to someone of my group.	3.83	1.09	3.90	.98	-.290	.773
33. I like someone from my group explains something to me.	3.94	.99	3.65	.99	1.217	.228
34. I like to hear the other members' ideas.	4.06	.96	4.03	.91	.107	.915
35. The other members in the group always listen to me.	3.51	1.01	3.97	.88	-1.936	.057
36. I always tell other students that they did something good.	3.66	1.25	3.97	1.11	-.852	.398
37. I always do my best when working in groups.	3.54	.95	4.03	1.02	-2.022	<b>.047</b>
38. I always have problems completing a task when working with other students in a group.	2.85	1.07	2.65	1.20	.736	.464
39. I am familiar with my strength and weakness in a group study.	3.83	.785	3.94	.814	-.543	.589
40. I understand the different roles played by group members.	3.76	1.1	3.94	.93	-.672	.504
41. I understand how to work with people who have a style of work different from my own.	3.63	1.21	4.03	.89	-1.510	.136
42. I know how to work cohesively with a group of people toward a common goal.	3.8	1.13	4.13	.89	-1.303	.197
43. I know how to carry on multiple responsibilities for a project.	4.03	1	4.26	.89	-.969	.336
44. I am satisfied with my leadership skills.	4.14	.94	4.16	1.04	-.076	.940
45. I am satisfied with my decision-making skills.	4.20	.93	4.23	.81	-.120	.905
46. I am satisfied with my communication skills.	4.20	.79	4.29	.74	-.475	.636
47. I am satisfied with my conflict-management skills.	3.94	1.05	4.20	.93	-1.036	.304
48. I am satisfied with my problem-solving skills.	4.26	.95	4.48	.68	-1.103	.274
49. I am satisfied with my brainstorming skills.	4.17	1.07	4.26	.97	-.344	.732
50. I have gained the skills in higher education.	2.89	1.43	3.35	1.23	-1.421	.160
51. I have been taught these skills at school.	2.83	1.56	3.42	1.18	-1.747	.086



## 7 Conclusion

As the organizations have been moving toward a form of work that organizes employees into teams, education institutions must adapt themselves for these new requirements. Cooperative learning is an effective tool to fulfill these needs. This study analyzes the effects of cooperative learning dimensions among the cadets in a maritime higher education institute. Comparative analysis among the cadets of a senior class, before and after simulator-based bridge team management course, shows a statistically significant increase in positive interdependence in groups, group processing and individual performance in groups. “Positive interdependence” triggers cadets to improve their teamwork skills and be an effective team member. Satisfaction with the problem solving skills, not being able to complete an assignment unless everyone contributes, and sharing work according to prearranged plans are found to be improved after the simulator based bridge team training where cooperation and planning is important.

Limitations and further study. The study was conducted in only one institute so the number of students was limited. Further studies can be performed in other institutions and also in other disciplines.

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