

Practicing the Sensitivity of Social Life to Chemical Engineering Students Through Cooperative Learning

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Abstract. Students from several regions of Indonesia who come to study in Surabaya encounter new challenges in their academic life, which are not easy to deal with. In order to be ready to face these challenges, they need to be equipped with values for social life (such as teamwork) so that they are able to survive in their academic and social life. A combined cooperative learning and jigsaw method conducted in Thermodynamics 1 Class was meant to cultivate positive values of teamwork such as positive interdependence and individual accountability. Participants ($N = 58$) were Thermodynamics 1 class, which was divided into 15 groups to work on class assignments and laboratory projects. The enthusiasms of the students in class were shown by 89% minimum attendance of each activity. About 61% of the students reached their individual mid-term targets, showing a 10% increase if compared to the preceding semester result.

Keywords: social life, cooperative learning, jigsaw methods.

Abstrak. Mahasiswa dari berbagai daerah di Indonesia yang belajar di Surabaya menghadapi tantangan baru yang tak mudah diatasi dalam kehidupan akademiknya. Agar siap menghadapi beraneka tantangan tersebut, mereka perlu dilengkapi dengan nilai-nilai kehidupan sosial (seperti kerja sama) sehingga mereka mampu bertahan dalam kehidupan akademik dan sosialnya. Sebuah kombinasi metode pembelajaran kooperatif dan *jigsaw* diterapkan pada kelas Termodinamika 1 untuk menumbuhkan nilai-nilai positif kerja sama seperti kesaling-tergantungan yang positif dan akuntabilitas pribadi. Peserta ($N = 58$) adalah kelas Termodinamika 1, yang dibagi menjadi 15 kelompok untuk menyelesaikan tugas-tugas kelas dan proyek laboratorium. Antusiasme para mahasiswa dalam kelas tercermin dari minimum kehadiran yang 89% pada tiap aktivitas. Sekitar 61% mahasiswa mencapai target UTSnya, menunjukkan kenaikan 10% bila dibandingkan dengan hasil semester sebelumnya.

Kata kunci: kehidupan sosial, pembelajaran kooperatif, metode *jigsaw*

Generally, Chemical Engineering students at the University of Surabaya (Ubaya) come from several regions of Indonesia. Since they come from different regions of Indonesia, they must adapt in such a way to the new environment in order to survive in their academic and social life. Therefore, the students, in order to be ready to face these challenges, need to be equipped with values for social life (such as teamwork) so that they are able to survive in their academic and social life.

The various characteristics of students reflected

in their learning behavior include their learning style and adversity quotient. The data of learning style and adversity quotient of Chemical Engineering students at Ubaya are shown in Figure 1. The learning styles of students have strong influence on the success of the learning processes in class. Sometimes there are differences between the teaching styles of the lecturer and the learning styles of the students.

According to Felder and Brent (2005), most undergraduate students are sensing learners who focus on external inputs such as seeing, hearing, tasting, and touching while most lecturers are intuitive learners who emphasize on fundamentals, theories, and mathematical models. This shows the mismatch between the teaching style and learning style of most students that cause many students unable to

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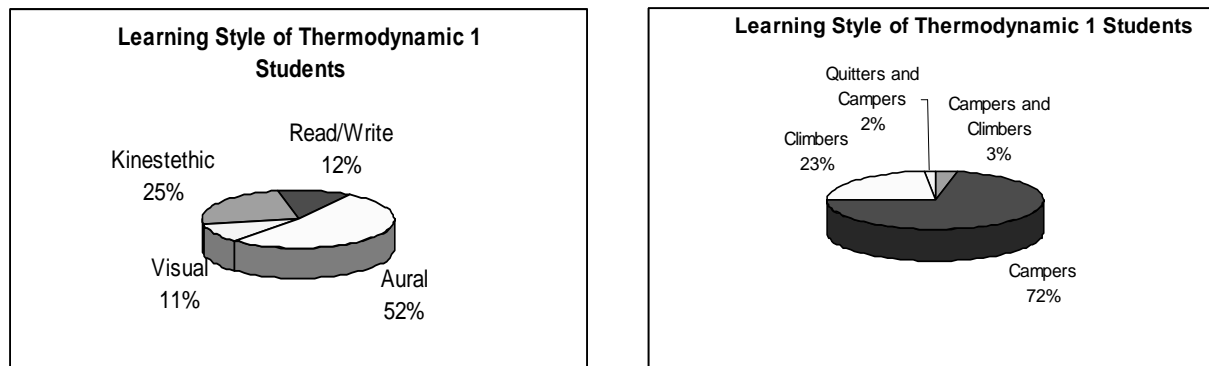


Figure 1. The learning styles and adversity quotient of new Chemical Engineering Students at Ubaya in 2005 (Source: Tim MOB Ubaya, 2005)

grasp what is taught. This has impact on the learning motivation and the study results. In addition, there are also differences in learning styles among the students which include visual, verbal, active, reflective, sequential or global learners. If the teaching style can not accommodate all kinds of these styles, some potential students can not get satisfying results because of the mismatch and the society will lose potentially excellent professionals in the future.

In spite of the learning styles, the adversity quotient of the students also affects their study results and their soft skills in social life. Interactions between students have strong impacts on the results of their study, especially, when the students have to work in groups. In these interactions, some students have abilities to cope with their adverse conditions until they manage to achieve their goals. Chemical Engineering students who belong to this group usually encounter no problems in their study and can pass the class with high marks. Some other students fight the adverse conditions; yet, stop if they are still unable to overcome the complicated problems in the subjects they take. This type of students is still able to solve the problems due to their strong determinations. The last type of students quits trying after facing their hardest problems and they usually have academic problems.

To overcome the above problems, Chemical Engineering Department at Ubaya tries to improve its learning processes through its delivery method innovations. The combined cooperative learning and jigsaw conducted in *Thermodynamics 1* Class was meant to accommodate the students' learning styles and to implant the positive values of teamwork in the minds of Chemical Engineering students at Ubaya. The im-

plant of these positive values is essential to prepare the students for their future careers and life.

Emotional and Adversity Quotients

According to Hurlock (2002) people who are at early stages of adolescence usually undergo emotional unrest and tend to have desires of transforming his or her environment. To help them adapt to their environment, they must be trained with skills to improve their emotional quotients. There are five main areas of emotional quotients which are related to self-emotion, emotional expression management, self-motivation, acquaintance with other people's emotion, and relationship with other people. These five areas strongly determine human socialization skills at the middle development stage. Undergraduate students are usually at the early stage of adolescence with the above characteristics. Failing to adapt with their surrounding will impact on their future life in career and families.

In fact, there are three things which make them succeed, they are adversity, emotional and intelligence quotients (Stoltz, 2000). Adversity quotient deals with the ability of a person to overcome the adverse condition to reach his or her success. There are three types of people according to this quotient which are climbers, campers, and quitters.

Cooperative Learning

Higher education institutions have significant roles to help the students explore five main areas of emotion.

According to Goleman, Boyatzis, and McKee (2004), both positive and negative emotions of a person can spread to other people, which are known as transferable skills. Therefore, student-centered learning which focuses on students should be conditioned so that they have positive emotions towards the teamwork.

Student-centered learning in which active contribution of students is required covers three learning styles, they are, active, collaborative, and cooperative learning. In active learning, individual student or students in groups can get involved actively in class. Collaborative learning is one form of active learning in which students work in pairs or team. Cooperative learning is the other form of active learning in which the students work in structured groups that meet certain criteria. According to D.W. Johnson, R. Johnson, and Smith (1998), there are five criteria that must be possessed by a cooperative team. These criteria include positive interdependence, individual accountability, face-to-face positive interaction, appropriate use of interpersonal skills, and regular self-assessment of group functioning.

There are three levels of cooperative learning which are informal cooperative learning, formal cooperative learning, and cooperative base group. Informal cooperative learning involves groups that stay together for a class period or less to answer questions or solve problems. This does not need to comply with the five criteria of cooperative team. Formal cooperative learning involves groups that stay together for extended periods until the entire course is completed in order to produce a product. Cooperative base group has groups that stay together to provide mutual academic and personal support possibly for several years. In practice, formal cooperative learning has several forms of activities such as team homework, team projects, and jigsaw. In the jigsaw method as used in this research paper, students work in teams on projects like laboratory exercises, design projects, and review tests that have several subtasks which require specialized knowledge.

Method

Implementation of Cooperative Learning in Thermodynamics Class

Before the class started, the lecturer team prepared students to work in their group. This step is im-

portant as students with different habits and characters will work during one semester. At the beginning of the semester, the lecturer team communicated the learning goal, the expected learning process, the assignments, and eventually, the evaluation system which was done at the end of the semester.

The implementation of cooperative learning in *Thermodynamics 1* class commenced with the preparation on the course content and teaching methodology before the first class meeting. The class consisted of 3 credits of lecture class and 2 credits of tutorial class. Fifty eight students were divided into two lecture classes but combined into one class for tutorial class. The teaching team including three lecturers and an assistant regularly meets for the preparation and during the class, and evaluates the class progress.

At the beginning of the tutorial class the lecturers assigned students' team coordinator and conditioned the team to use puzzle games. In the two-class meetings, the lecturers held cooperative note taking pairs by assigning four pairs of students to have discussion on their notes and to present them in front of the class. During the progress of the class the students were given two projects. In this project, jigsaw method was applied. In this case, the students with better skill in one subject (English or Computer) within the team can contribute to the project and delegate the tasks. To evaluate the responses of the students on the cooperative learning, questionnaires were distributed to the students. The learning processes were evaluated through two quizzes, mid-term exam, and final exam (10% projects, 10% assignments, 10% quizzes, 10% rewards and 60% exams). The students who achieved their personal and team targets were given rewards.

Results and Discussion

This part consists of three subparts: students' project, overall learning results, and students' interactions in teams.

Students' Project

There are two projects given to the students in *Thermodynamics 1* course. In the first project, stu-

dents were given an open ended problem concerning the restrictions on turning on mobile phone in fuel station related to the thermodynamics theory. Here, the students were trained and challenged to interact and communicate with related society with no scientific background such as mobile phone shopkeeper and gas station attendants. They also learnt to delegate works which fit with the competency of each team member. Based on the evaluation, there were 39% of students who had developed teamwork skills in their teams and were able to interact with community of different points of view.

The second project challenged the students to apply thermodynamics principle in ethylene glycol industry and English report writing. Again, the students must be able to delegate work which fits with the competency of each team member such as English or computer skills. This was the application of the jigsaw method.

Overall Learning Result

The application of cooperative learning and jigsaw method in *Thermodynamics 1* Class has overall results shown in Table 1.

The attendance rate (89% per activity) shows that the students are motivated and enthusiastic with the course. In addition, the high number of students who achieve their study target also shows student motivation. If compared to the preceding course (Material and Energy Balance), this achievement is considered higher as shown in Figure 2. The average grade comparison between Thermodynamics 1, and Material and Energy Balance (NME) is depicted in Figure 3. The figure shows that Thermodynamics 1 has better results. Through cooperative and jigsaw methods, students can master the material better as they can discuss and support one another in teams so that they can achieve better results. The percentage of students passing the course with minimum score of C is also quite high (70%). The evaluation here does not include only exam score (cognitive domain) but also laboratory skills (psychomotor) and teamwork (soft skills).

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Students' Interaction in Team

In accomplishing their assignments and project, students sometimes met and discussed within their teams either inside or outside the class. According to lecturers' and assistant's observation in the tutorial class, most of the students had already been able to delegate their works to their peers although a few team were still dominated by the superior members of the teams.

The interaction outside the class can be evaluated through questionnaires given to the students. Most students with GPA less than 3.25 felt that they were really supported by their teams in mastering the course material and accomplishing their assignment whereas students with GPA of more than 3.25 felt less supported by their team members (see Figure 4).

Conclusion

The skills for social life which include teamwork, communication, and positive values can be conveyed

Table 1
The Learning Result of Thermodynamics 1 Class

No.	Parameter	Result
1	Percentage of students passing the course with minimum score of C	70.18%
2	Percentage of students achieving their targeted result	
	a. Team target	
	- Mid-term exam	61%
	- Final exam	46.67%
	b. Individual target	
	- Mid-term Exam	61%
	- Final exam	52.63%
3	Average of attendance of each activity	Min. 89%

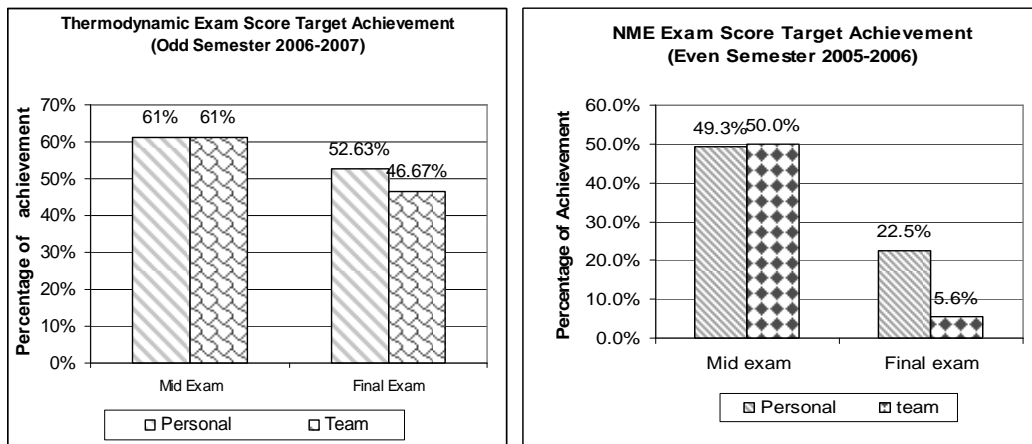


Figure 2. The percentage of students' target achievement for material and energy balance and Thermodynamics 1 Course

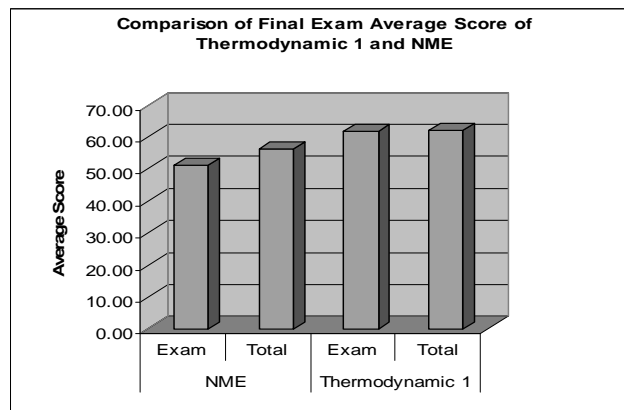


Figure 3. Final exam average score comparison between Thermodynamics-1 and NME

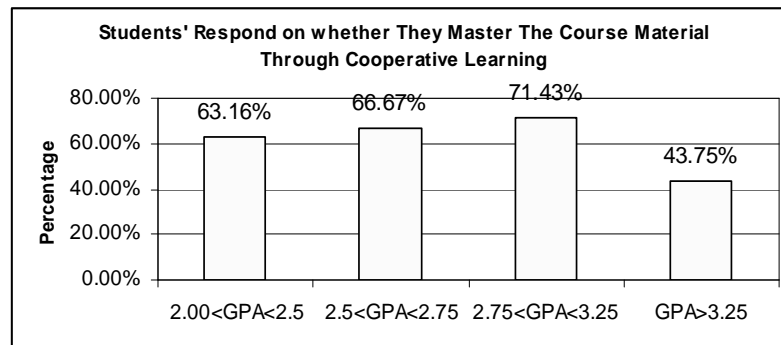


Figure 4. Questionnaire result of students' interaction evaluation

yed to students through designing course delivery method without reducing the course content and the level of learning. The skill can be embedded into structured group activities inside or outside the class. The cooperative and jigsaw methods used in Ther-

modynamics 1 Class show good academic results and class atmospheres which include interactions of the students and those of students and lecturers. Moreover, the methods also increase student's motivation and the sustainability of values implant can

support the students' career, social and professional lives in the future.

References

- Felder, R.M., & Brent, R., (2005). *Effective college teaching*. A two-day workshop, RCEE, Johor, Malaysia.
- Goleman, D., Boyatzis, R., & McKee, A., (2004). *Kepemimpinan berdasarkan kecerdasan emosi*. Jakarta: Penerbit PT. Gramedia Pustaka Umum.
- Hurlock, E.B. (2002). *Psikologi Perkembangan* (5th ed., S.W. Sarwono, Pengalih bhs.). Jakarta: Penerbit Erlangga.
- Johnson, D.W., Johnson, R., & Smith, K. (1998). *Active learning: Cooperation in the college classroom*. Edina, MN: Interaction Book Company.
- Stoltz P.G. (2000). *Adversity Quotient mengubah hambatan menjadi peluang*. Jakarta: Grasindo.
- Tim MOB Ubaya (2005a). *Detail Hasil Kuisisioner Gaya Belajar Program Studi Teknik Kimia*. Surabaya: Penulis.
- Tim MOB Ubaya. (2005b). *Detail Hasil Kuisisioner QCC Program Studi Teknik Kimia*. Surabaya: Penulis.