# Qualitative Assessment of Process System Engineering, KKKR5714

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**Abstract**
*The new course has been introduced to the fourth year student, which is Process System Engineering. This paper discusses the qualitative assessment of this new course based on four (4) course outcomes (CO). At the beginning of semester once the students has been introduced the course syllabus of the subject, the survey has been distributed among the students to fill the questionnaire based on individual fundamental knowledge and theories on this subject. Then once again the same questionnaire has to be fill depends on their understanding output what has been learning in the class. This subject require student to relate the theories, principles to solve critical thinking problem case study based on real industry. This assessment would be the indicator of stating point and as measuring the students' satisfaction toward this course. Feedback on this survey form may help lecturer to improve teaching and learning aspect to be implement on future.*

***Keywords:*** *Component;Process Sytem Engineering;Qualitative assessment; course outcome (CO) ;student;*

## I. Introduction

In 2013 the course code of this new subject is KKKR5714, Process System Engineering has been introduced to chemical and biochemical engineering students of The Department of Chemical and Process Engineering (JKKP), Universiti Kebangsaan Malaysia. The definition of process is a series of action or steps taken in order to achieve a particular end product, system mean a structure or procedure according to which something is done and engineering definition is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind. The system engineering is consists of two significant disciplines: the technical knowledge domain in which the systems engineer operates, and

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systems engineering management, the definition is an interdisciplinary, collaborative approach that derives, evolves, and verifies a life-cycle balanced system solution which satisfies customer expectations and meets public acceptability.(IEEE P1220, *Standard for Application and Management of the Systems Engineering Process*, [Final Draft], 26 September 1994.) [1].

The Process System Engineering is treats the way in which a complex system behaves as a whole, and uses domain knowledge and mathematical and experimental techniques to build computer models of all the unit processes that make up a chemical plan, refinery, biological cell or supply chain. These models can be integrated to predict that behaviour of the system as a whole and used the outcome of various design options, process changes or failures at the system level.

Every program that leads to bachelor or master degree need to base on a set of "Program Educational Objectives" (PEOs) to accomplishment expected graduates period of years [2]. To determine the students achieved expected PEOs, the process requires evaluating the qualitative assessment by the students on the "Course Outcomes" (COs). The course outcomes (COs) is specified to the content of the course and describe the related students' abilities toward in the end of semester. The outcomes of the program and course are important to the improvement covering the curriculum, delivery methods, programme assessment and measurement methods [3].

To achieve the higher level of the teaching and learning process course outcome (CO) must be done to get the feedback of student respond at the beginning and end of semester. At the end of semester students should know and able to do on the learning outcome [4]. The learning outcomes that must be fulfilled include engineering knowledge, problem analysis and minimizing cost of the process. This course require student to perform case study on the previous Integrated Project (IP) on pinch analysis of heat and mass.

## II. Methodology

The method to implement the course outcome of this subject is by survey form, questionnaire of the qualitative assessment of this course by the forth (4) year student of chemical and biochemical engineering. 37 respondents of the 4$^{th}$ year student were enrolled the course code KKKR5714 has been evaluated at the beginning of the semester on the course outcomes and the end of semester respondents has been evaluate the same assessment of course outcomes.

There are four (4) course outcomes CO1, CO2, CO3 and CO4. The CO1 is the ability of respondents which is student to understand the basic theory of Process System Engineering, the CO2 is the ability to solve the pinch problem for heat and mass optimization. The CO3 is ability of students to design and solve design problem as dynamic simulation and the last outcome CO4 is ability to optimize a design process.

The questionnaire was created based on 6-point scale measurement as shown in table 1. Respondents were given six (6) scales to from zero (0) up to five (5) based on the course outcomes to reflect their individual evaluation.

The collected records were imported into the tabulated result using Microsoft Excel. Then come out with the bar chart to analyze every course outcomes. The horizontal axis is the likert scale that students evaluated based on each COs and the vertical axis is the percentage of evaluate scale. The margin at the right side of the chart indicates the result for early semester and end of semester. The blue color is the result of CO at the beginning of semester and the red color is the result for the end of semester.

$$\textit{Percentage of evaluation scale} = \frac{\textit{Number of student vote}}{\textit{37, Total student}} \times 100$$

**Table 1: 6-point Scale of Measuring Instrument**

| LIKERT SCALE | EVALUATION |
|---|---|
| 0 | No idea |
| 1 | Know specific facts, terms, concepts, principles or theories |
| 2 | Understand and able to interpret specific facts, terms, concepts, principles or theories |
| 3 | Able to apply related theories to new situation and bale to solve related problems |
| 4 | Able to use the related knowledge and theories to design a chemical or biochemical engineering system |
| 5 | Able to use the related knowledge and theories to analyse and evaluate a chemical or biochemical engineering system |

## III. Result and Discussion

The qualitative assessment is based on the course outcomes (CO1, CO2, CO3 and CO4) between the beginning of semester and end of semester. The respondent vote of evaluation scale for every course outcomes will be discussed in form of percentage. Total number of respondents is 37 as told before in methodology section. The data collected from respondents is analyse and represented in bar chart to compare the respondent assessment at beginning and end of semester.

### *A. Course Outcome, CO1*

The respondents evaluate themselves about their ability to understand the basic theory of Process System Engineering. Referring to the 6-point scale, respondents able to evaluate the course outcome individually, and the figure 1 shows the percentage of course outcome (CO1) at the beginning and end of semester. Majority 62% respondent choose the point scale 1 as they know the basic facts and theory of this course at the beginning of semester, at the end of semester 49%(rounded) respondents able to use the theories to design a chemical or biochemical engineering system and less 6% only respondents are able to apply the theories to new situation to solve related problems. The minority respondents choose the scale for this course outcome is scale 2, which is 14% respondents usually understand and able to interpret specific facts and theories at the beginning semester and percentage of respondents drop to 2.7% left at the end of semester, means that 11% percentage of respondent are more understand and able to perform the theories to solve the problem.

*B. Course Outcome, CO2*

Qualitative assessment of second course outcome is ability respondents to solve the pinch problem for Heat and Mass optimization. The figure 2 shows the percentage of CO2, the percentage of respondents have no idea about this course outcome is 22% that is 8 respondents actually no idea at the beginning of semester and at the end of semester there no respondents are have no idea to solve the pinch optimization problem. Scale number 1 recorded the highest percentage with 57% respondents knows the basic terms, concepts and theory to this course outcome. At the beginning 16% respondents understand and able to interpret the specific terms and theories to solve pinch problem and at the end the percentage of respondent drop to 2.7%. For the beginning semester only 2.7% respondents able to apply the related theories to solve pinch problem and at the end the number of percentage increase by 30% that show the more respondents able to apply the theory to the pinch problem. The point scale 4 also show that the respondent able to use the related knowledge and theories to design the chemical and biochemical pinch optimization problem from 2.7% at the beginning and up to 57% respondents marked. Only 5% respondents show that they able to use the related knowledge and theories to analyse and evaluate a chemical or biochemical engineering system.

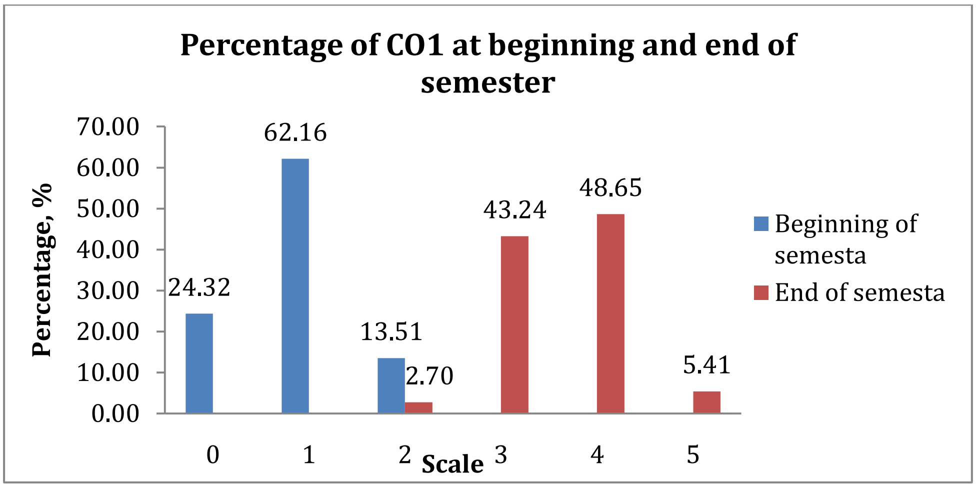


**Figure 1: Percentage of course outcome (CO1)**

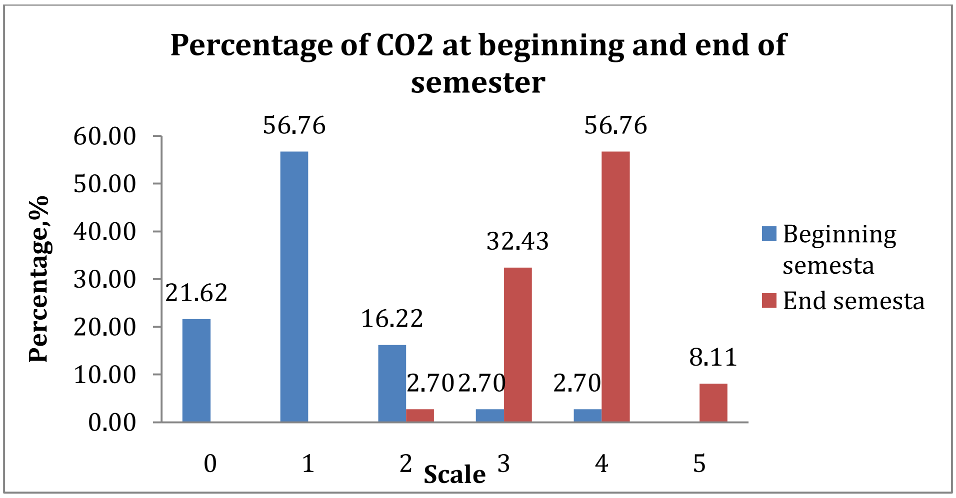


**Figure 2: Percentage of course outcome, CO2**

*C.* ***Course Outcome, CO3***

The course outcome (CO3) is the ability to design and solve design problem as dynamic simulation. From the bar chart of figure 3 shows that the percentage of respondent at the beginning of semester is 46%, rounded percentage respondents are no idea how to design and solve design problem by dynamic simulation and 51% respondents are knows specific terms concepts and basic principles or theories to this outcome. At the beginning of semester only 2.7% respondents are able to apply the related theories to new situation as dynamic simulation but at the end of semester respondents' percentage increase to

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11%. Furthermore, 30% respondents are evaluate that they are able to apply the related theories to solve design problem as dynamic simulation, the highest percentage at the end of semester are the scale no 4 with 57% and the left percentage of 2.7% respondent are able to use, analyse and evaluate the design of chemical or biochemical engineering system problem as dynamic simulation.

*D.* ***Course Outcome, CO4***

The ability to optimize chemical or biochemical design engineering system is the last course outcome, CO4. The beginning of the semester majority respondents evaluated the scale no 0, 49 per cent which is they have no idea to optimize design and slightly decrease by 6% respondents only know the basic terms, concepts and principles or theories to this outcome and drastically drop to 8% or respondents are understand to optimize the design. Moreover, at the end of semester respondents show that only 14% respondents are understand and able to optimize a design. 32% respondents are able to apply the related theories to optimize a design and 51% respondents are able to use the related knowledge and theories to optimize a chemical or biochemical engineering system design. The respondents that able to use the knowledge and theories to analyse and evaluate the engineering design of optimizing just only 2.7%.

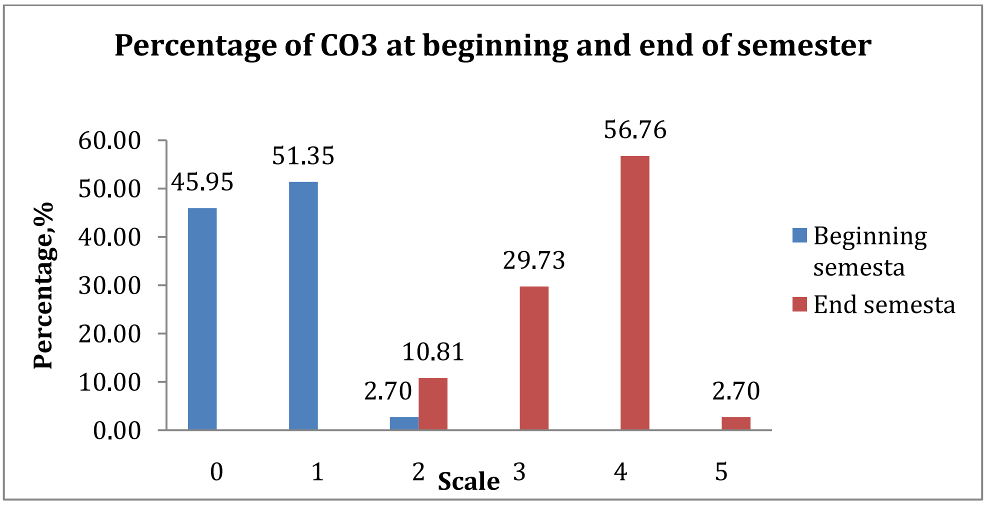


**Figure 3: Perctage of course outcome, CO3**

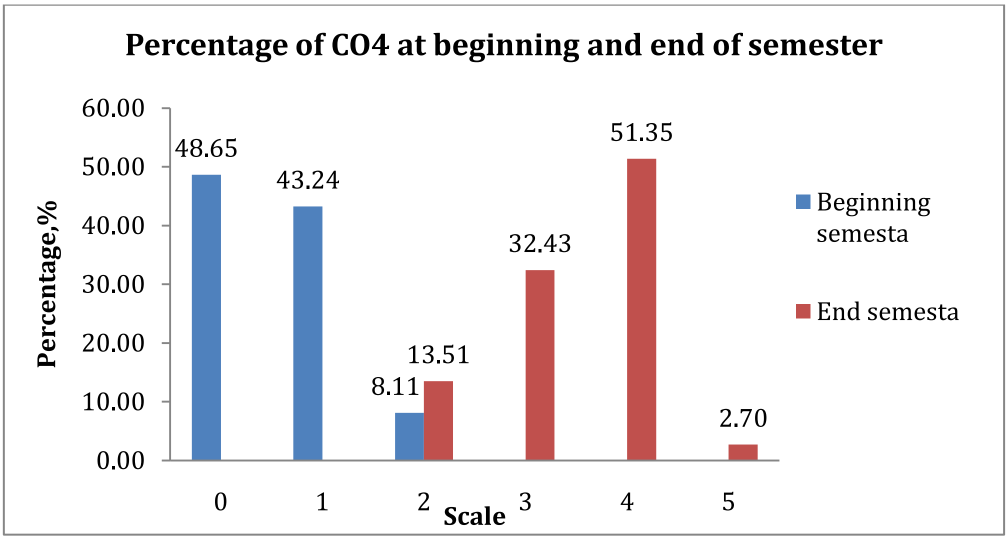


**Figure 4: Percentage of course outcome, CO4**

*E. Process of Improvement*

Teaching and learning process is the continuous process to keep update from time to time. This KKKR5714 Process System Engineering has implement about 2 years, the discussion between lecturers as teacher and student is important for both side. The beneficial meeting represent from student and academic organization will help to know what student needs and help to build up close relationship between both sides. The improvement plan as list below;

- Increase the tutorial class on the fundamental of dynamic simulation will help student know the advantages of software.
- Introduce the students with the real industrial design problem.
- Expose the knowledge of student with the industry visit and talk session.
- Addition more practical session after the theoretical class.
- Implement the case study based on the industry process design.
- Improve the one-way delivery lecture into the two-way lecture between students.

## IV. Result

Generally respondents are only know the basic specific facts, terms, concepts , theories or principle at the beginning of the semester and most of respondents are able to use the related knowledge and theories to design a chemical or biochemical engineering system at the end of semester. The course outcome feedback conclude that the course KKKR5714 help student to gain knowledge on how to optimize the design in way of reducing the production cost within increasing profit. Respondents are able to manage the design system manually and simulation.

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