The Importance of Industrial Visit to Enhance Student's learning in Process Instrumentation and Control Unit of Engineering Courses

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Abstract

The objective of this plant visit is to help students gain first-hand information regarding application of instrumentation and control in process industry. In this paper the author presented the effectiveness of an industry visit in the process of learning process instrumentation and control in a 3rd year undergraduate Chemical Engineering core unit of Curtin University, Western Australia. This also demonstrated that the industrial visit is an integral part of this unit to achieve the learning outcomes. The unit is divided into lecture class, laboratory, mini-project and a site visit. Due to the large enrolment in this unit and also due to limitation of plant's capacity, the two different plant visits was conducted by three afternoon sessions. The plants were (1) Alcoa Kwinana Refinery and (2) Coogee Chlor-Alkali Pty Ltd, Kwinana, WA. These plants were chosen because both the plants are dealing with large processes with various automatic control system and also location wise they are closer to Curtin University. Three guides from each plant explained the various process sections of plant including control room. In a week after the visit, an anonymous questionnaires survey was conducted where they were asked to put their level of agreement with statement about (i) motivation, (ii) role of process control engineer, (iii) effective unit learning through plant visit, (iv), coordination of the site visit, (v) resources and (vi) overall satisfaction. The survey results indicated that the percentage of agreement on overall learning unit outcomes through integral plant visit was 78%. The average agreement for all the items was found as 66%. The percentage agreement on all items varied from 48% to 80% which indicate overall student's positive learning experience at the end of plant visit and this activity should be retained with the unit learning outcomes.

1. Introduction

Industrial visit is a vital part of engineering courses. It helps to bridge the gap between classroom and the real field world. Students are benefited to learn about "real life" examples of business and engineering management. According to Sanroman pazos and Longo (2010), industrial visits give students insight into their future professions by giving them the opportunity to observe industrial processes in operation. In addition to benefiting the student, industrial visits also benefit stakeholders by bringing them into contact with prospective employees (Nyamaptene, 2012). Moreover, industrial visits give universities to fulfil the accreditation requirements imposed by various professional bodies for engineering education (JBM 2009; Nyamaptene, 2012). One of important objectives of engineering course is desire to prepare graduates to quickly become productive upon entering the workforce. Therefore industrial visit make students understand the subject to its core and its deeper practical experiences in real field situation. Universities apply different methods to incorporate practical experiences and real world applications into their curricula to prepare students for the technical challenges they might face in workplace (Frempong et al., 2005). Such methods include "project-based learning", "virtual teaching", laboratory-based teaching, student's internship etc (Faisal, 2012; Sen, 2012; Frempong et al., 2005). Chanson (2001) was the first to address the importance of site visit in enhancing learning of undergraduate engineering unit. Further studies by Forest and Rayne (2009) reported that field trip is an excellent way to reinforce concepts learned in lecture and laboratory sessions and stimulate student interest in continuing their life-long unit learning. There are also few studies reported the ineffectiveness of industry visit on student's learning (Dewitt and Storksdierk, 2008). Lecture-based education can provide solutions to some of the problems. The use of slides, video and computer simulation, laboratory experiment can assist by creating a learning experience which does have some positive (Mills and Ashford, 2003). However, in spite of the success of this approach a belief remained that some site visits are still essential for engineering education. This has led to a closer evaluation of their full potential.

In this paper the author presented the effectiveness of an industry visit in the process of learning process instrumentation and control in a 3rd year undergraduate Chemical Engineering core unit of Curtin University, Western Australia. There were two different process plants visits, which were conducted towards the end of lecture class of process instrumentation & control. An anonymous questionnaire survey was conducted just after their industry visit and results were analysed to evaluate the effectiveness of field visit on their overall learning process in process instrumentation and control unit. This also demonstrated that the industrial visit is a vital part of this unit to achieve the learning outcomes. The unit is divided into lecture class, laboratory, mini-project and a compulsory site visit on overall student's learning. This study also reflected that industry visit give an idea to students about their job profile once they start working as 'process control engineer'.

2.0 Methodology and data collection

2.1 Participants from the unit process instrumentation & control 328

Curtin University of Technology, Perth is offering four year engineering undergraduate programme and two years post graduate programme. There are many

core engineering units that students have to complete during their course of study. This study was conducted on undergraduate students taking 3rd year core unit "Process instrumentation and control 328 at semester 2, 2012. The students taking this unit are assumed that they have already learned the fundamentals of process principles, various unit operations in mass transfer processes, process heat transfer, reaction engineering. Therefore this unit is designed for the application of various instrumentation and control in process industry to get various operational objectives. This unit syllabus covers the dynamics of various processes, equipment's and their control of operations, design of a control system etc. The unit is divided into lecture class, laboratory, mini-project and a site visit. Lecture class gives the solid foundation of theory. Laboratory experiments provide some small scale application of theory. Mini-project that is designed to include substantial practical application of equipment is useful in institutions. However field trips to process industries always allow the students to appreciate the relevance of the technological theory discussed in class and to experience their large scale application in real industrial situations. Effective learning occurs when the students are given opportunity to reflect on their real practical experiences. In order to provide such a practice-based active learning experience, an industrial visit to process industry was organized towards the end of the lecture class. Due to the large enrolment in this unit and also due to limitation of plant's capacity, the two different plant visits had conducted by three afternoon sessions. The plants were (1) Alcoa Kwinana Refinery and (2) Coogee Chlor-Alkali Pty Ltd, Kwinana, WA. These plants were chosen because both the plants are dealing with large processes with various automatic control system and also location wise they are closer to Curtin University. The students were both male and female with similar educational background.

2.2 Industry visit and data collection

Two different plant visits, namely Alcoa Kwinana Refinery WA and Coogee Chlor-Alkali Pty Ltd were organized towards in the month of Sept 2012. Prior to an agreed visit, lecturer has to organize transport for the visit and do all the security-related paperwork required by the host company. Due to the large enrolment in this unit and also due to limitation of plant's capacity, the two different plant visits had conducted by three afternoon sessions. The plants were (1) Alcoa Kwinana Refinery and (2) Coogee Chlor-Alkali Pty Ltd, Kwinana, WA. These plants were chosen because both the plants are dealing with large processes with various automatic control system and also location wise they are closer to Curtin University. One hundred and twenty five out of 145 students were taken part industry visit during three different afternoon sessions. As a general rule, no lectures classes are scheduled on site visit day. Students were taken by two buses for two different plants and it took one hour to reach the site from Curtin University. The plant visit took place for two hours and two guides from each plant helped students to understand various sections of the plant. Initially a group of 20 students were entered into control room of the plant and a demonstrator was showed various processes with fully control system PI diagram. After that students were divided into two groups of 10 students each and visited the different sections of plant with guide. These activities have led the students to observe closely the real application of instrumentation and control to process industry. The students are able to correlate the relevance of the technologies discussed in class and to experience their application in industry and finally their professional role in an industry. A paper based anonymous questionnaire survey on industry visit was conducted after one week of industry visit. The survey has 9 quantitative and one

qualitative item. The quantitative items were asked students to put their level of agreement with statement about (i) role of process control engineer (Q1), (ii) effective unit learning through plant visit (Q2-Q5), (iii) motivation (Q6), (iv), coordination of the site visit (Q7), and (v) overall satisfaction & site visit is an integral part of their learning (Q8-Q9). The anonymous answering style was used similar to the Curtin University online evaluating system- "eVALUate". Students may indicate Strongly Agree, Agree, Disagree, Strongly Disagree or Unable to Judge for each item. In addition, students were asked to put constructive comments on the qualitative item in order to improve learning outcomes from the plant visit. The survey was a volunteer participation and 50 students (35%) took part in the survey day. Large number of students were absent on that day because of their examination of other unit. Usually, more than 35% student's participation for a large unit is considered as representative on any feedback survey (Sen, 2012).

3.0 Data analysis and Discussion

3.1 Student Perception based on Quantitative Survey

The feedback gathered from students was examined for comparative analysis and understanding of perceptions. Table 1 shows the responses on each question from survey questionnaires. The detailed results on individual questions are shown in Figure 1-9. The results revealed that, an average 66.2% of agreement were recorded from the feedbacks gathered for Question 1 to Question 9 of the survey, with the majority of responses (48%) classified under the "Agree" scale. The teacher's role is as supporter and facilitator of the student's new learning experience. Were the students motivated and inspired to learn through plant visit? Therefore responses on motivation of Question 6 (Table 1) received the percentage of agreement with a total rate of 70%. Industrial visit make students understand the subject to its core. It also gives idea to students about their job profile once they start working. To know the student's learning experience it was asked question 1 i.e. from the plant visit, I could understand the job of a process control engineer and the percentage agreement was total 80%(Figure 1 & Table 1) Responses on question 1 also received the highest rate of agreement among the respondents with a total rate of 80%. A significant number of students (78%) on Q9 of Table 1 perceived the plant visit is an important part of their unit learning and it should retain with the unit outcome. Feedback related to the bridge between classroom theory and real world on positive students learning experience has been reflected by the responses of Q 1 to Q5 with total agreement of 48% to 80%. Response to Q 4 records the lowest rate of agreement with a total rate of 48%. This is because of high percentage of student's absentee in the survey as well as in lecture class. The agreement level of Q 3 (58%) which indicated that the students got sufficient lecture materials on PI & C to understand the different aspect of a plant. This result fairly coincided with the percentage of absent students in the lecture class. The main reason of these absentee was the late hour Friday lecture schedule for this unit (4-6 pm). However, significant level of total agreement (76%) on overall satisfaction with the plant visit was obtained. The level of satisfaction on the plant visit coordination (Q7) was 72%.

There was one qualitative item in the survey i.e. "How do you think that plant visit might improve your learning outcomes? Followings are few comments to response of this question-

- *A better coordination is needed between the lecturer of PIC unit and the person who is in charge in the plant, so that a more detailed explanation about the controller at the plant can be provided during the visit*
- *The presenter spoke to one person at a time was quiet and did not explain the process*
- *Our guide was not loud enough for everyone to hear over the noise. So I did not gain a full understanding of what happened at the plant*
- *I was motivated and did learn about the plant and day to day life of an engineer which was good*
- *While I am happy with the plant visit, it is only giving me some overall look of what PIC real life applications one. Some of the explanations given onsite are just too complex to understand*
- *Learn how they control the process in real life*
- *Help me learn about process control*
- *General understanding of what a process engineer working environment*
- *Dividing into many groups so that demonstrator's voice can be heard clear*
- *The plant visit helped to put the unit materials into context-especially in regard to the limitations of some types of control*
- *Helps to give an idea of the applications for the theory putting it in content, makes it seem more relevant and important*
- *It helps the practical side of the unit. It makes easier to understand the concept and ideas that I learned in PIC unit. Real world example of theory learnt in class, seeing the process helps to visible problems*
- *Get to understand the control system used in industry*
- *It makes us understand better and clear on the real plant. Overall I am happy with it and should continue next time onwards*
- *It shows us the application of different control systems over both a plant scale and for individual pieces of equipment*
- *Would be interesting to see the design work and troubleshooting aspects of a process control engineer role.*

Therefore, qualitative feedback also clearly reflected the student's very high positive learning experience from industry visit on PI & C unit. However, there are very few issues such as more efficient coordination between lecturer and plant demonstrator, more visit time, more professional demonstrator with loud voice are required in order to get more positive learning experience.

4. **Conclusion**

Survey results provide that industry visit is an important part of student's overall learning on process instrumentation and control unit 328. This is because industry visit tend to reinforce the theoretical knowledge that has been acquired while offering students the opportunity to experience real world situations in their chosen careers. This has been supported not only by student's quantitative feedback but also by qualitative statements. The overall satisfaction of learning process instrumentation and control 328 from industry visit was found 78% with an average agreement for all the items of 66%. A total of 70% agreement was found for their motivation and learning this unit through industry visit. This study clearly demonstrated that students understand their job profile as a process control engineer for which highest level of student's agreement 80% was obtained. A significant number of students (78%)

agreement perceived the plant visit is an important part of their unit learning and it should be retain with the unit outcome.

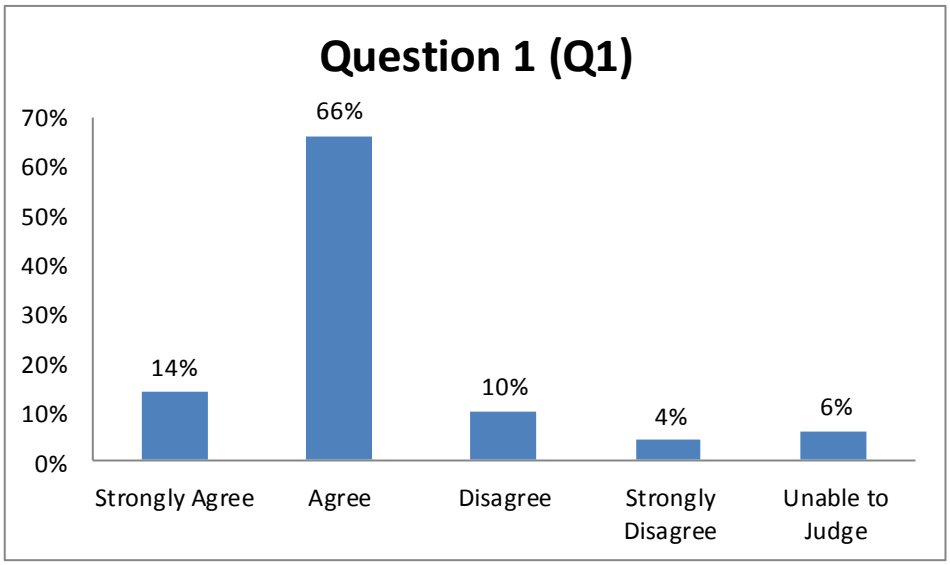
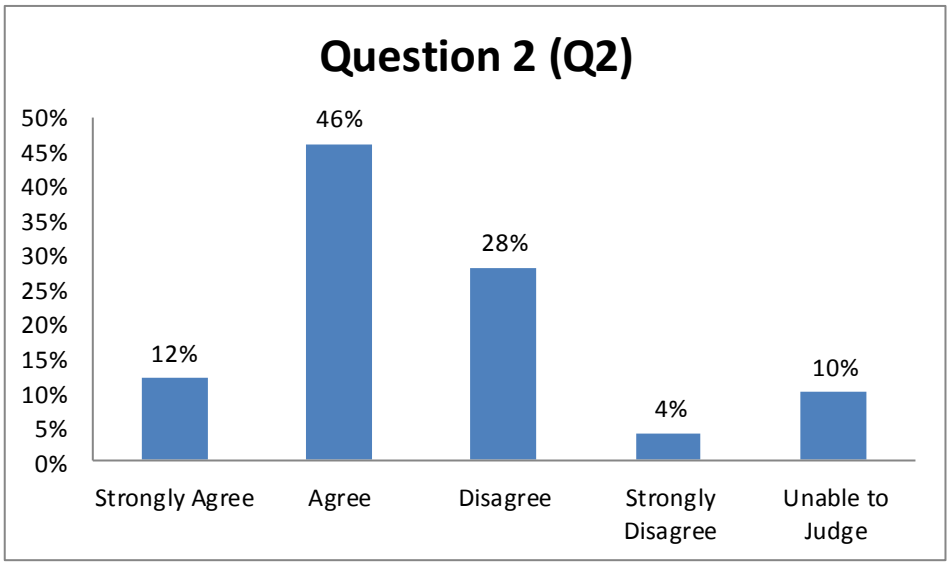


Figure 1



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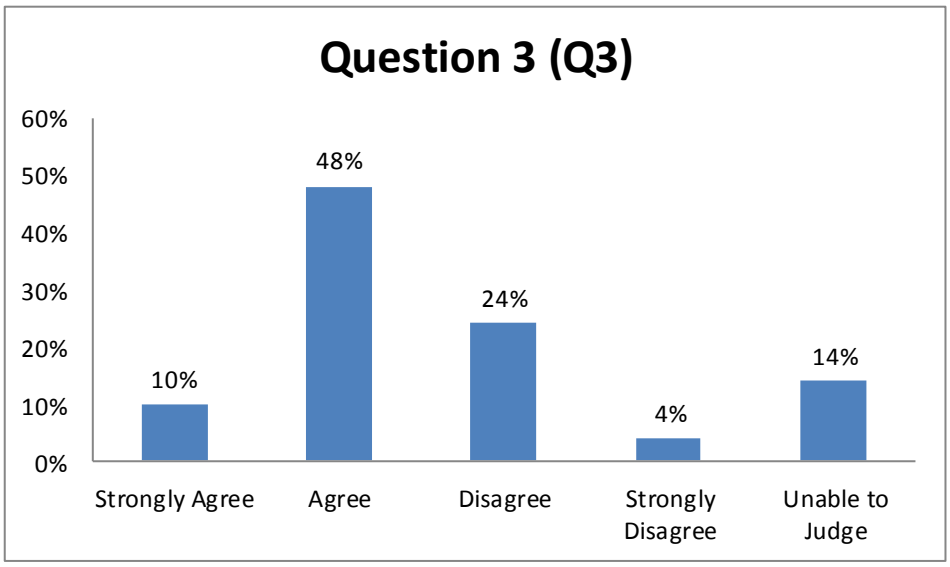

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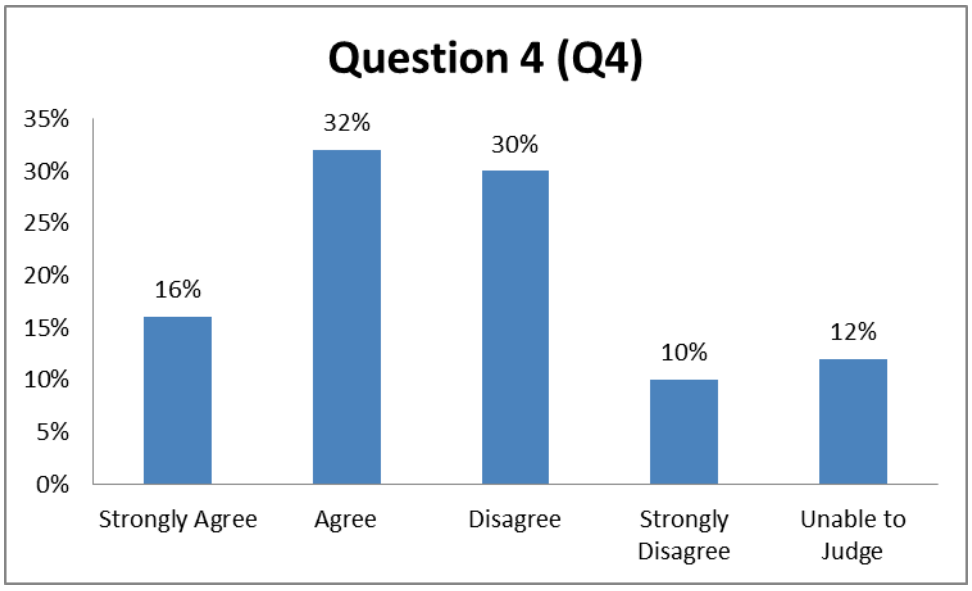

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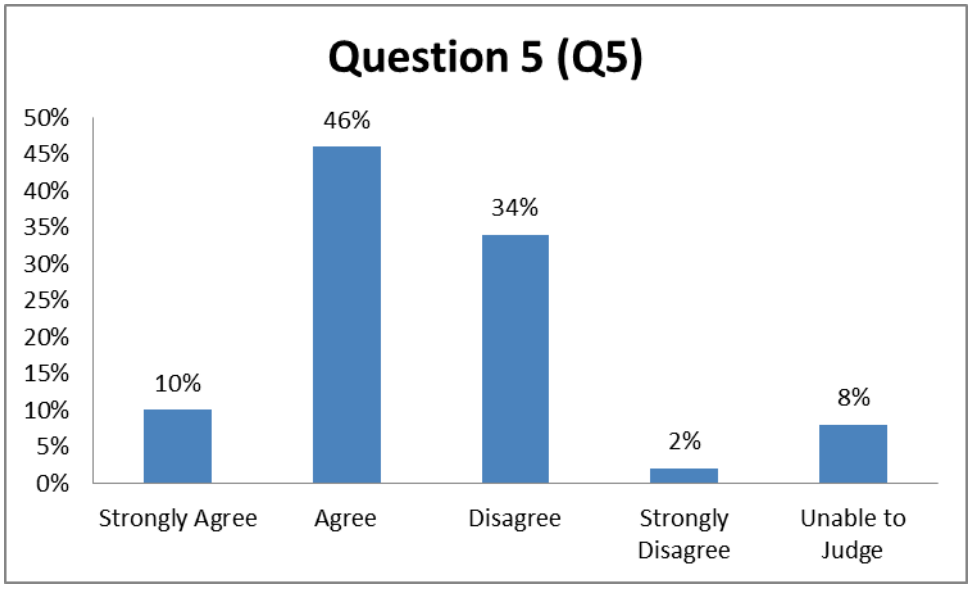

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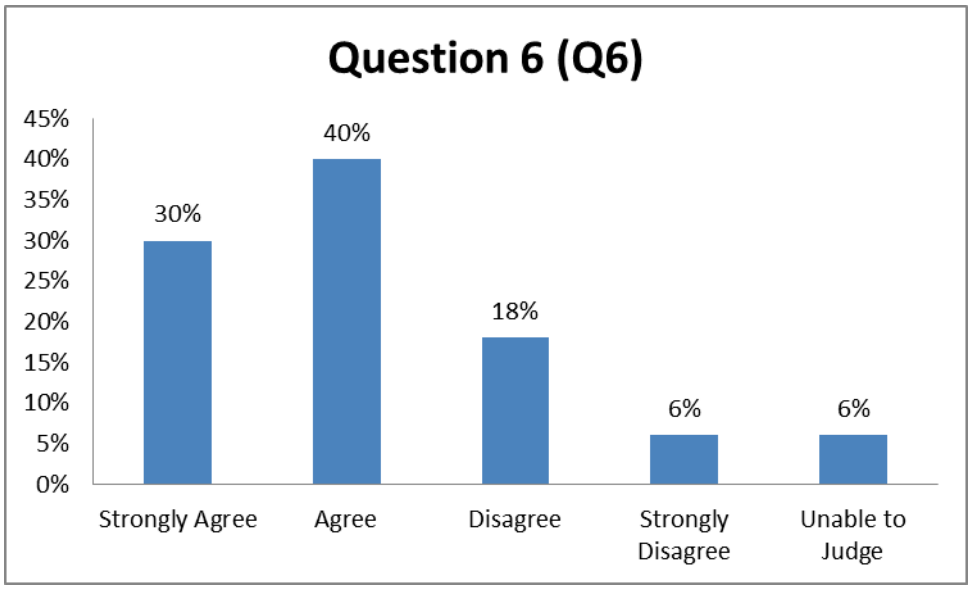

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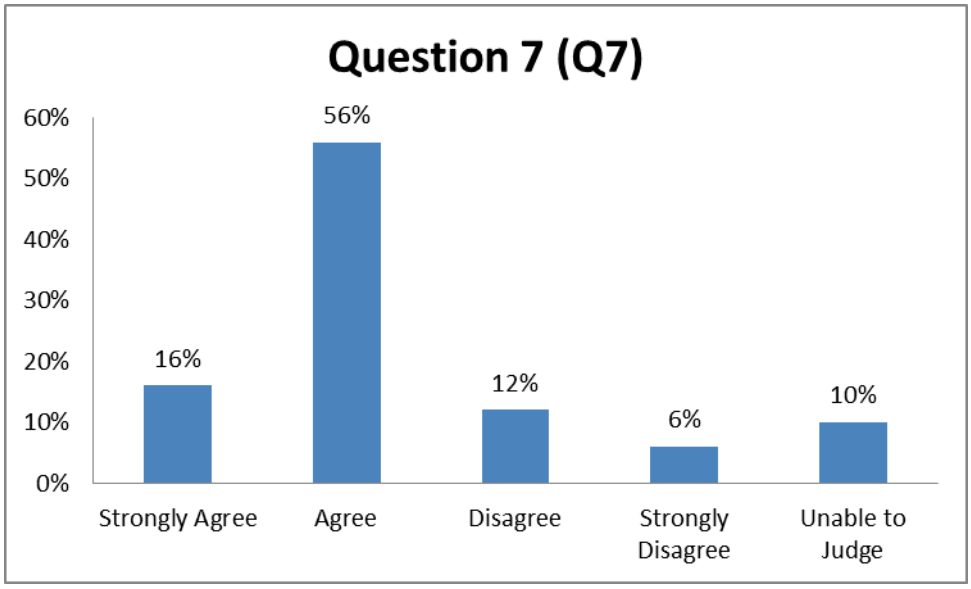

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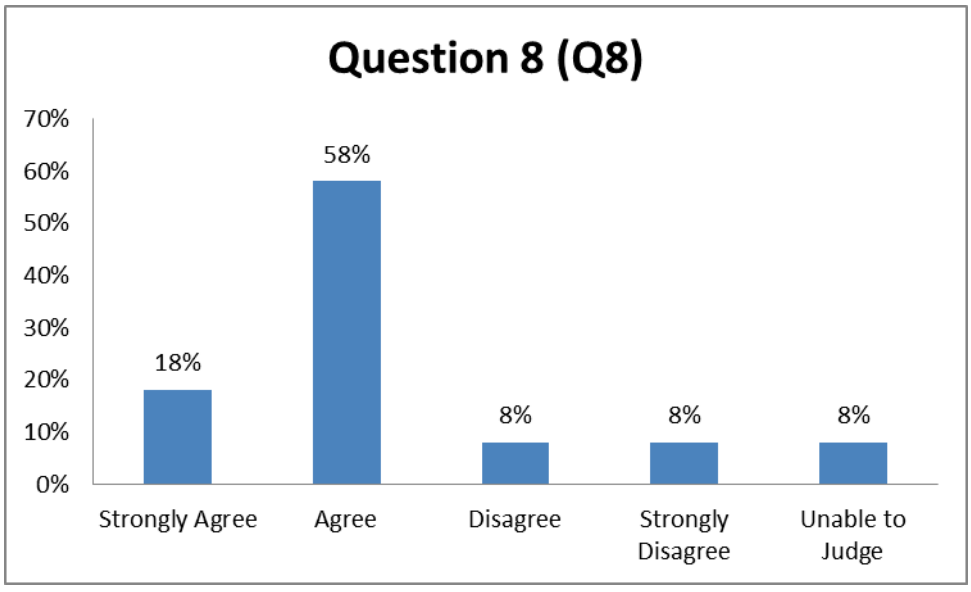

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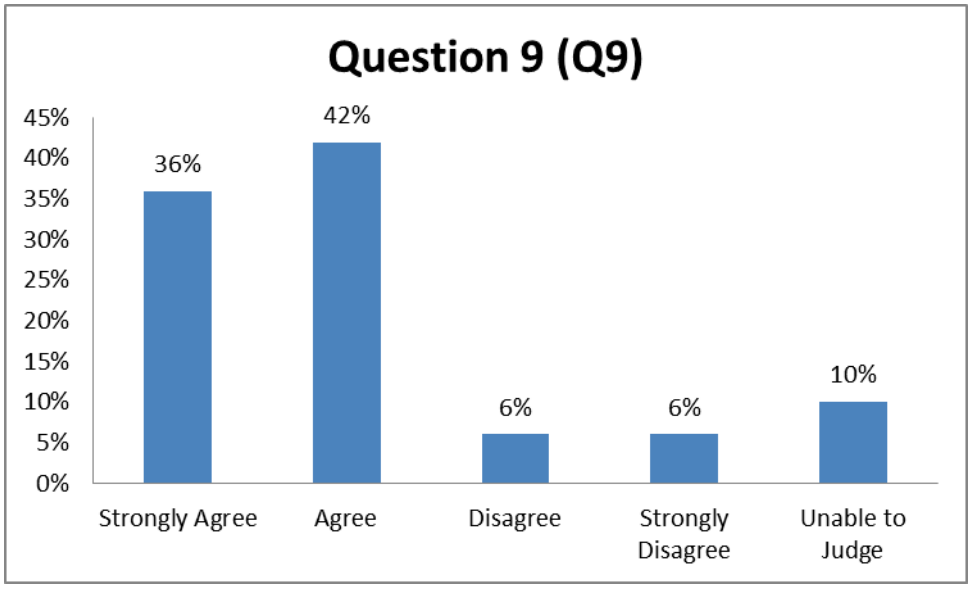

Figure 9

Table 1: Total Responses (35%) on each question from survey

Q1 (From plant visit I understand the job of a process control engineer)	Scale	Value	Frequency	Percentage, %	Cumulative, %
	Strongly agree	1	7	14	14
	Agree	2	33	66	80
	Disagree	3	5	10	90
	Strongly disagree	4	2	4	94
	Unable to Judge	5	3	6	100
Q2 (I understand the practical application of theories that I learned in lecture class)	Strongly agree	1	6	12	12
	Agree	2	23	46	58
	Disagree	3	14	28	86
	Strongly disagree	4	2	4	90
	Unable to Judge	5	5	10	100
			50	100	
Q3 (The lecture materials on PI&C are sufficient to understand the different aspects of a plant)	Strongly agree	1	5	10	10
	Agree	2	24	48	58
	Disagree	3	12	24	82
	Strongly disagree	4	2	4	86
	Unable to Judge	5	7	14	100
			50	100	
Q4 (I could learn PI & C more effectively through this plant visit)	Strongly agree	1	8	16	16
	Agree	2	16	32	48
	Disagree	3	15	30	78
	Strongly disagree	4	5	10	88
	Unable to Judge	5	6	12	100
			50	100	
Q5 (Plant visit helps me to achieve the overall learning outcomes of this	Strongly agree	1	5	10	10
	Agree	2	23	46	56
	Disagree	3	17	34	90
	Strongly disagree	4	1	2	92
	Unable to Judge	5	4	8	100

part of the unit)			50	100	
Q6 (I am motivated to take part of this plant visit)	Strongly agree Agree Disagree Strongly disagree Unable to Judge	1 2 3 4 5	15 20 9 3 3	30 40 18 6 6	30 70 88 94 100
			50	100	
Q7 (Coordination of the plant visit was appropriate)	Strongly agree Agree Disagree Strongly disagree Unable to Judge	1 2 3 4 5	8 28 6 3 5	16 56 12 6 10	16 72 84 90 100
			50	100	
Q8 (Overall I am happy with this plant visit)	Strongly agree Agree Disagree Strongly disagree Unable to Judge	1 2 3 4 5	9 29 4 4 4	18 58 8 8 8	18 76 84 92 100
Q9 (Plant visit is an important part of this unit and it should retained with the unit outcomes)	Strongly agree Agree Disagree Strongly disagree Unable to Judge	1 2 3 4 5	18 21 3 3 5	36 42 6 6 10	36 78 84 90 100
			50	100	

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