

PRIMARY RESEARCH

# Comparison of students' feedback between the application of a robot teacher and human

Noraidah Blar <sup>1,\*</sup>, Fairul Azni Jafar <sup>2</sup>, Radin Puteri Hazimah Radin Monawir <sup>3</sup><sup>1, 2, 3</sup> Universiti Teknikal Malaysia Melaka**Keywords:**Robot teacher  
Human-robot interaction  
Education

Received: 28 September 2015

Accepted: 3 October 2015

Published: 15 October 2015

**Abstract.** This paper aimed to display and elaborate the results obtained through experiments to study students' feedback when they learn from a robot and a human teacher. A questionnaire asking the questions related to the robot and human teacher, where the answer is listed under several feelings, was set up and distributed to the students during the experimental implementation. Nao robot was used as the robot teacher and is programmed to be able to teach the students. Each teacher (robot and human) delivered the same topic with the same sentences and gestures. The topic chosen for this experiment is "Introduction to Mechatronic" due to the scope that focuses on technical students at the university level. To make this research more applicable, some variables were decided when handling the experiment. The finding of this research is displayed in graphs for each question. The exciting feeling experienced by the students involved in the experiments is the important point for comparing robot and human teacher lecture class. However, some advantages and disadvantages for the feeling occur within the teacher's (robot and human) lecture session. As for the conclusion, students feel more excited towards the robot teacher compare to a human teacher. These experiments contribute one of valuable knowledge on how a new thing attracts people and keeps their attention to it.

© 2015 The Author. Published by TAF Publishing.

## INTRODUCTION

Human as a teacher is a conventional way to teach students to be a useful person. As a human, there are also different kinds of teaching method, either it is effective or not to make students fully understand what they try to teach. And yes, some students failed to understand what they learn due to many factors, which is one of them is the teaching method itself delivered by their teacher. Living in a world that increasingly advanced, forced human to find some other alternatives to make the education more interesting and effective. Starting 21st century, human discovers that robots can teach people in their education. Many advantages of the robot designed and installed that very useful in order to make education more effective. There are many researches that already being done to

\*Corresponding author: Noraidah Blar  
E-mail: [noraidahblar@yahoo.com](mailto:noraidahblar@yahoo.com)



identify the suitability of using robot in education. Although it is not proven yet that robot is an effective way to teach students in the future, but some improvement can be done to make it happen. Human behavior is very subjective to be observed. In this research work, human feedback is the catalyst and the use as measurement element to identify either the teaching is effective or not. Robot technology is increasingly used in classroom settings not only for learning about robots, but also for learning from robots. It is known that human teacher is the most used method to convey the education. However, robots are mainly used as teaching assistants and educational media rather than as a fully autonomous teacher. Many researches have been done to study if robots can teach people in their education. The researchers also would like to study the effectiveness of teaching method in using robot's services. The objective of writing this research paper is to review the feedbacks from technical university's students on the application of a robot as their teacher. This research work is focusing on the students that have the technical education background only. The questionnaire that used during the experiments in this research work are given to the students that currently studying their Diploma in Manufacturing Engineering.

#### LITERATURE REVIEW

Conventional type of teaching in most countries is by delivery from a human that capable to teach and deliver his or her knowledge. Before they become a teacher, there are some qualifications according to some institutes that must be fulfill, such as having a scroll of degree or good results during their study. Some institutions believe that taking a very high quality person (such as having a good grade, good skills, and personal values) can affect the students that they will teach. This means that, a good teacher will also produce a good student. Why is it important to know how effective the teaching lesson delivered by a teacher? According to (Berk, 2005) it is important to measure the effectiveness of teaching because a good academic is an important aspect in every student and for the future. In Berk's research, he found that there are twelve methods that can be used to measure the effectiveness of teaching. There are student ratings, peer ratings, self-evaluation, videos, student interviews, alumni ratings, employer ratings, administrator ratings, teaching scholarship, teaching awards, learning outcome measures, and teaching portfolios. However, the study did not show any experimental activities and results due to the high number of reviewing other researches on the effectiveness of teaching. After all, the research explains more about untested theory and compilation of evidence on the effectiveness of teaching in education. Another research found out that measuring the teaching effectiveness can be done by classroom observation instruments, student perception surveys, and student achievement gains (Bill and Melinda Gates Foundation, 2013; Harris, Ingle, and Rutledge, 2014; Rink, 2013; Shuls, and Trivitt, 2015). The researchers highlight that feedback and evaluation system is depending on information that can be trusted about teaching effectiveness to support improvement in teacher's practice and better outcomes of students. The research also measuring the effectiveness of teaching by collecting the data of students achievements of the students in each class.

Nonetheless, all of the reviewed papers have the same method in order to measure the teacher effectiveness. In (Mohammad, Abdullah, Khairani and



Saibon, 2011) the data was collected using a questionnaire with a sample size of 442 student-teachers. Descriptive analysis is using SPSS tools; independent sample t-test and ANNOVA. Therefore, this research work will also use the same method in measuring both the human and robot teacher.

One of the researches that used robot as educational purpose is written in (Beran *et al.*, 2011) which used a robot to teach children. They examining whether animism is exist in children's impressions of robots. The experiment was done by inviting a number of childrens and let them observe the robot solving a block stacking task. After that the children have to answer nine questions by scoring them. The points that can get in here is handling the experiment by observing the partipants. Another research that was done using children as the participant is written in (Billard, 2003). Robota is a mini-humanoid robot with a doll-shaped design created to teach students about the introductory of robotics.

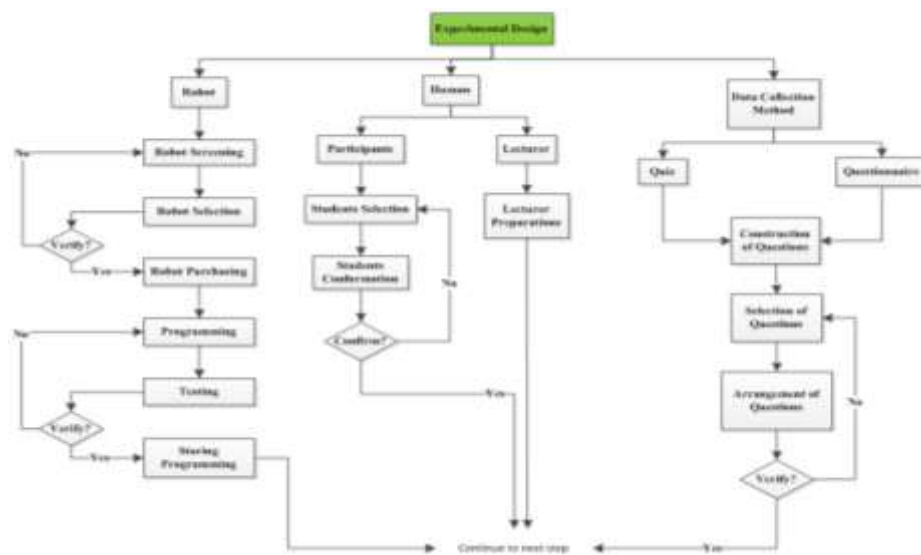


FIGURE 1. Experimental design

### Robot Preparation

NAO robot is decided to be used for this research work. This is because the robot is easily to be purchased in Malaysia, and it is also a research-friendly type of robot. After the robot screening process is done, the next step is setting the robot to the required technical specification.

The robot text is a script for the robot to speak. The preparation of the text is important in order to make the robot convey the teaching lesson according to its selected topic. The topic chosen for the robot to talk about is 'Introduction to Mechatronics'. This topic is chosen because it covers the basic knowledge about technical education in the university.

In order to prepare the text, the topic is studied first by referring to books and internet. As a result, basic components of Mechatronics, Mechatronic System, Hydraulic system, Pneumatic system, and control system are the subtopics that cover during the lesson. The robot text is then constructed and created by elaborating all the subtopics in speaking-way.

8	In mechatronic systems, there are four prime components. They are sensors, actuators, controllers, and mechanical components.
9	Example of mechatronic system is a robot, computer hard disk, washing machine, and many others.
10	Students, the first component of mechatronics system that we will learn are sensors. Sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an instrument.
11	Examples of sensors are displacement, position, motion, and velocity sensors.
12	Look at the figure in this slide. It shows how motion sensor conducts its function. When the sensor detect a movement, the red LED immediate turned on to show that the sensor detect a motion.
13	The next component is the actuators. An actuator is a type of motor for moving or controlling a mechanism or system. In simple words, actuators will convert energy into motion.
14	We can see actuators in pneumatic, hydraulic, electric, and mechanical systems. Examples of actuators are valves, pump, gear and chain, and motors.
15	Let's learn more about hydraulic system. Hydraulic system is a drive or transmission system that uses pressurized hydraulic fluid to drive hydraulic machinery.
16	In industry, hydraulic system is often used to lift a heavy load. Such as backhoe of a tractor.

**FIGURE 2.** A glance of the robot text constructed

The sentences of the robot text that are prepared separated by few lines so that each line can be easily inserted in the robot language programming. It also is used to decide the movement of the robots according to each line. Other than that, referring the text line and movements decided while programming the robot language can make the work easier.

In this research work, Python language is used because it is easier and simple. Choregraphe is an application that designed especially for NAO movement monitoring.

### Questionnaire

It is believed that the interaction between the students and the teacher is the most important element in teaching lesson. Therefore, a questionnaire is used is to know either the interaction between students and the teacher is good or not. Refer Appendix to view the full constructed questionnaire.

### EXPERIMENTAL IMPLEMENTATION

The experiment is held in a lab that can fit the students. The situation of the experiment is the same as ordinary lecture class. The lab is equipped with white screen and a projector so that the lecture slide can be shown to the students when the experiment is in progress.

Basically, the experiment flow is starting with lecture given by teachers followed by a quiz and a questionnaire. However, this paper only focuses on the questionnaire. According to the flowchart, there are some experiments that can be combined. This can be done to reduce the time consumed to do the experiments. Experiment 1 and 3, and Experiment 2 and 4 are the experiments that combined together. In Experiment 1 and 3, the experiment is conducted with the robot teacher lesson. After the robot teacher session is done, students for Experiment 3 can finish their session while students for Experiment 1 is



proceeding with the human teacher lesson. The next experiment for students in Experiment 3 is preceded to the other day for a human teacher session. The same goes to Experiment 2 and 4 in which the students for Experiment 4 can finish their robot teacher session and continues their human teacher session on the other day.

The explanations for each experiment are as follow;

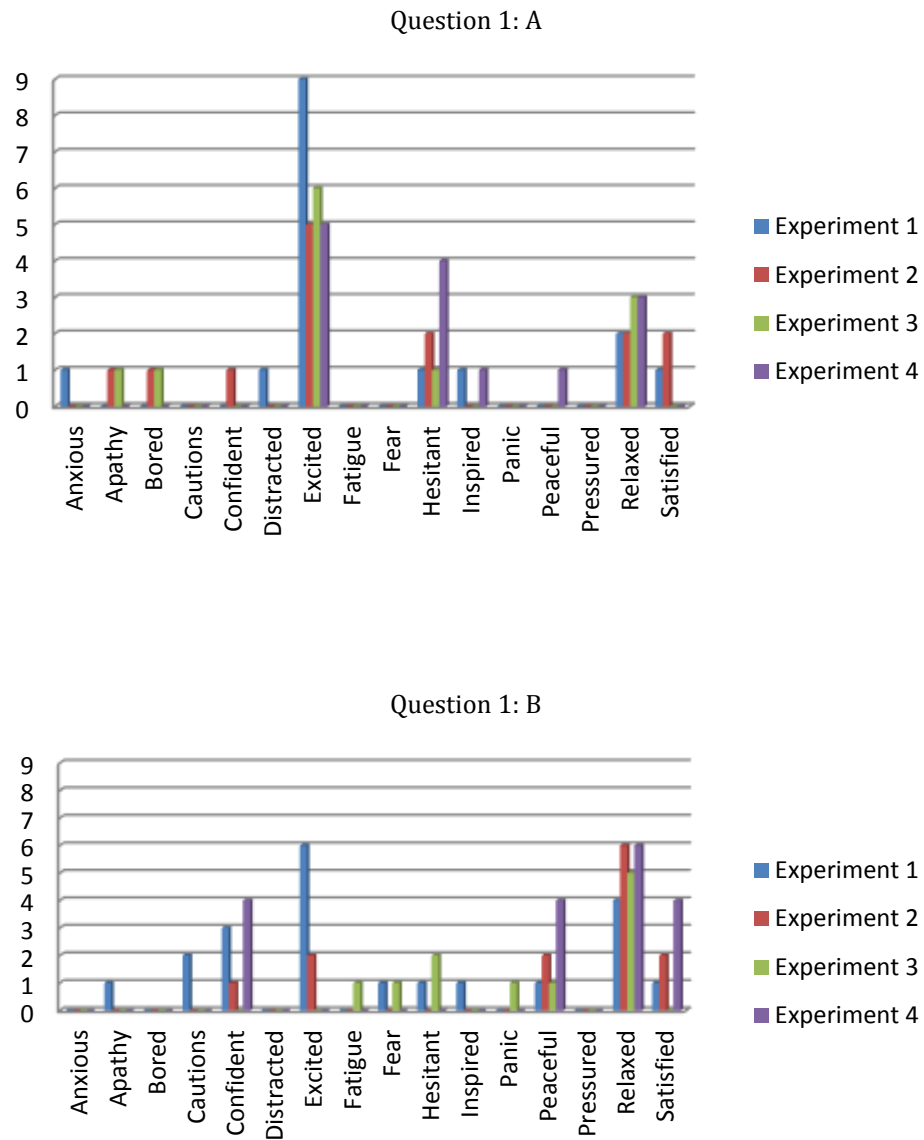
- i. Experiment 1–Robot and human teacher teaches in the same day with same lecture.
- ii. Experiment 2–Robot and human teacher teaches in the same day but different lecture.
- iii. Experiment 3–Robot and human teacher teaches in the different day with same lecture.
- iv. Experiment 4–Robot and human teacher teaches in the different day with different lecture.

### **DATA ANALYSIS**

The data is collected by the result from the questionnaire answered during the experiment implementation. Each questionnaire answered by the students is labeled according to the group of experiments. This is to make sure that there is no confusion while analyzing the data for each student and experiment. Data analysis tools that used in this experiment are Microsoft Excel and SPSS. This paper only describes the results from the Microsoft Excel.

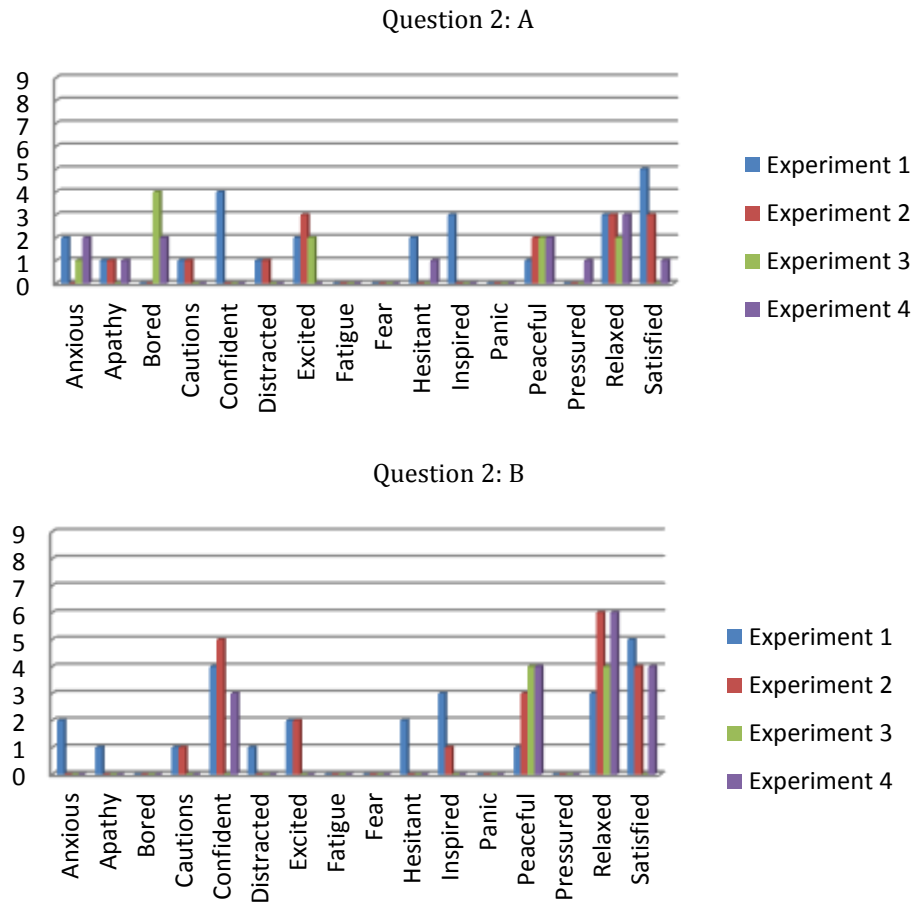
### **RESULTS**

The questionnaire that distributed to each student during the experiments has the same structure and questions. To be highlighted, each experiment consists of different number of participants. Therefore, the highest number for each feelings in the questionnaire questions should not show any significant matters. In fact, we are looking for which emotion achieve the highest result to indicate the students' feeling. Below are the results from each question in every experiment. Indicate that 'A' is for robot teacher session and 'B' is for the human teacher session.



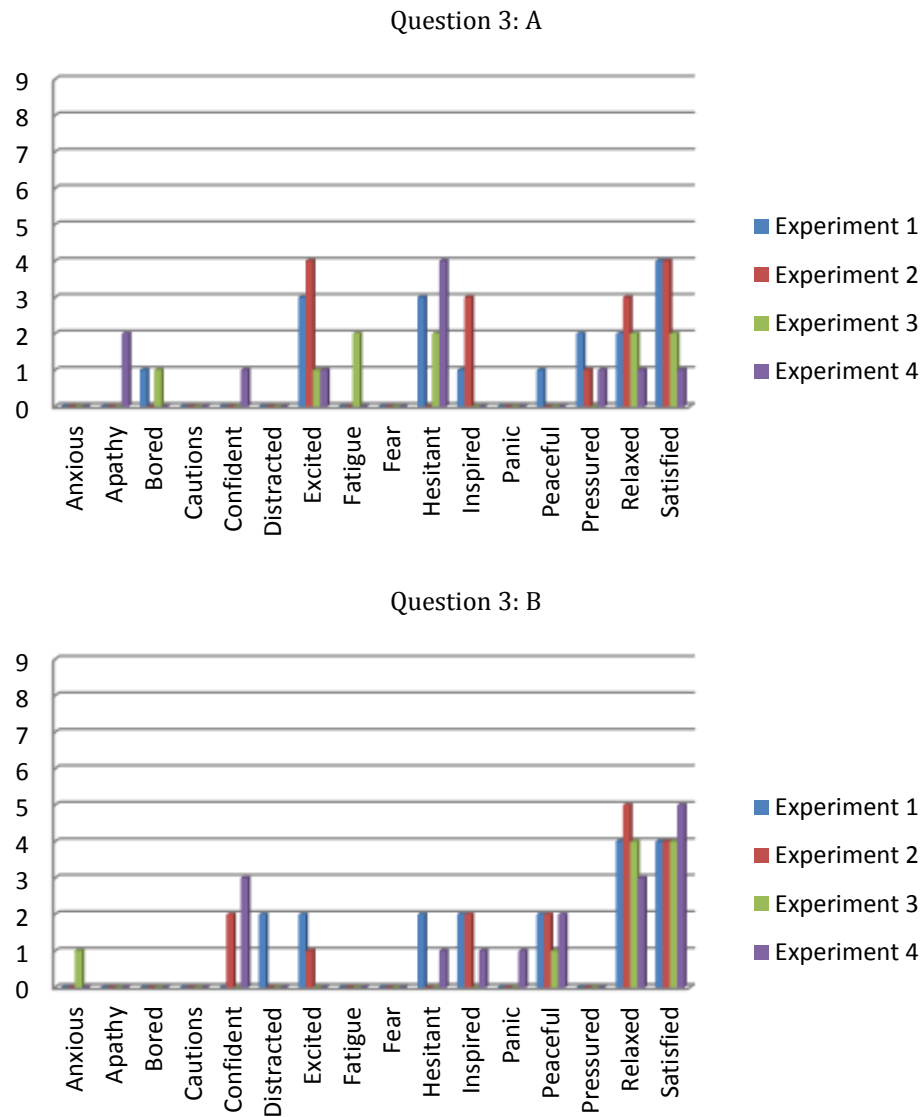
**FIGURE 3.** Excited feelings among the students for the robot teacher session

The first question in the questionnaire asked about the students feelings before the experiment is begin. From the graph, the most obvious numbers that are seen in the graph is the Excited feeling among the students for the robot teacher session. Differ to robot session, human session has much more participants with Relaxed feeling



**FIGURE 4.** Feelings when the experiment is conducted

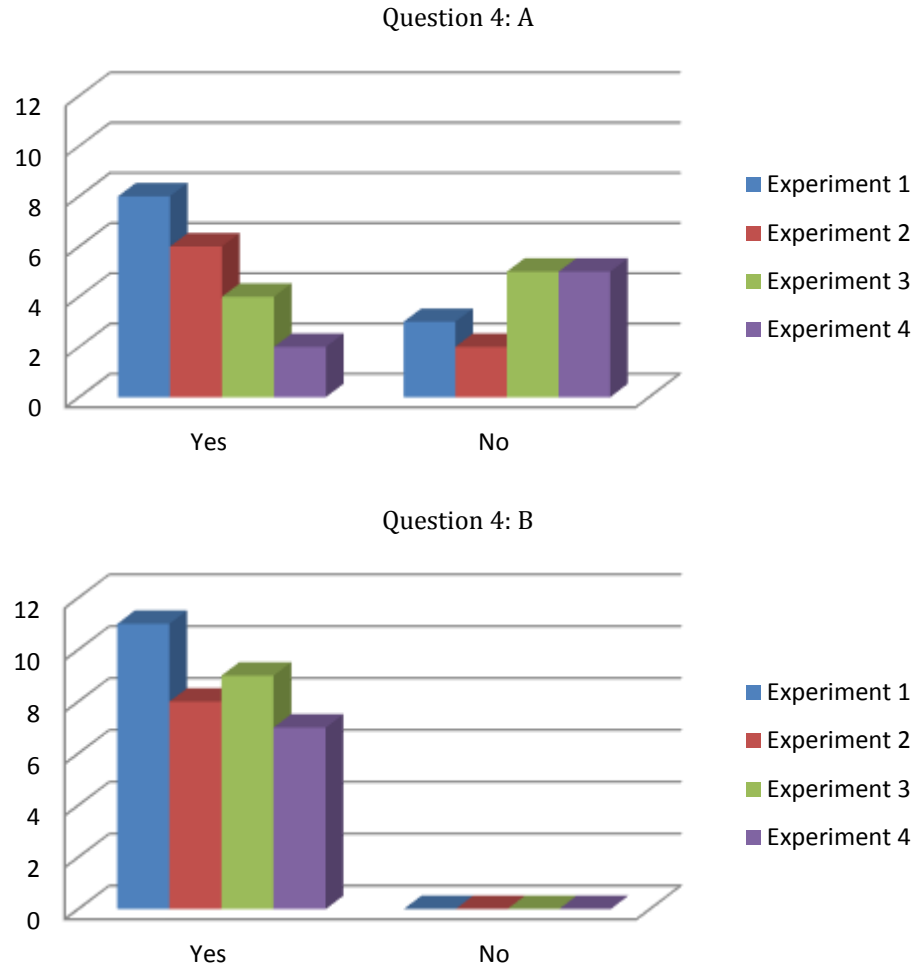
The second question of the questionnaire asked about the students' feelings when the experiment is conducted. They feel more Relaxed and Satisfied for both teacher's session. Seems like their Excited feeling before the experiment is decreased when the experiment started, and the students are focusing more on the lecture that bring them to be more relax.



**FIGURE 5.** Post experiment feelings of student.

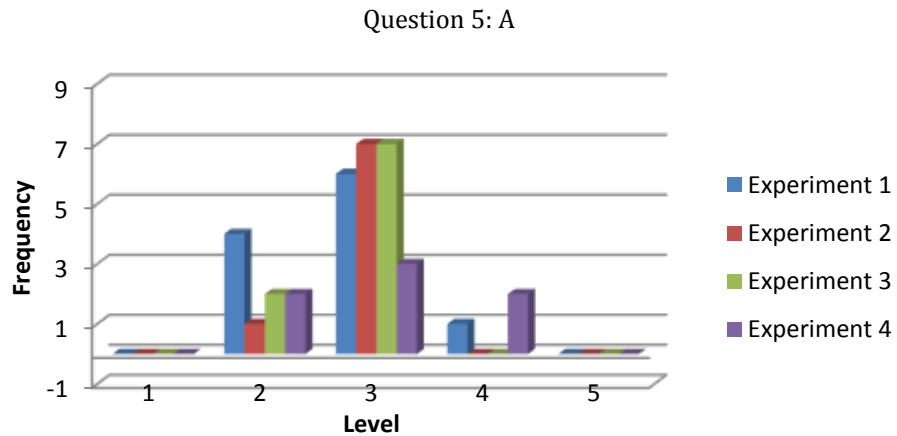
Question 3 in the questionnaire asked about the participant feelings after the experiment is done. From Figure 5, it is clearly seen that Relaxed and Satisfied have the obvious number when the experiment is done. This trending is remaining since during the experiment was conducted and obviously the Excited feeling has decreased among the students.

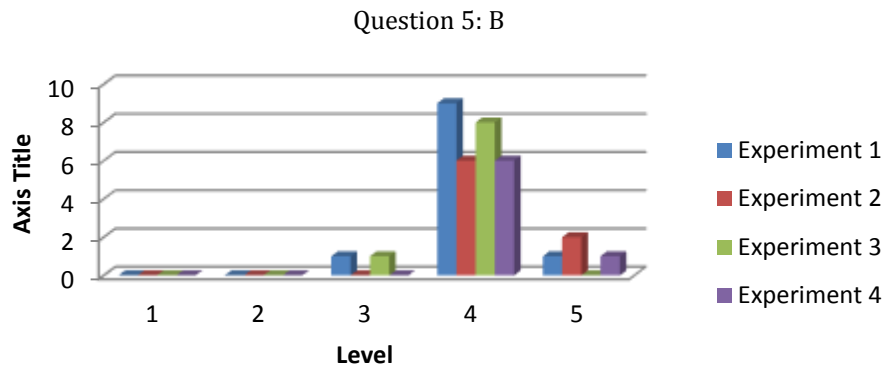




**FIGURE 6.** Response of student regarding lesson

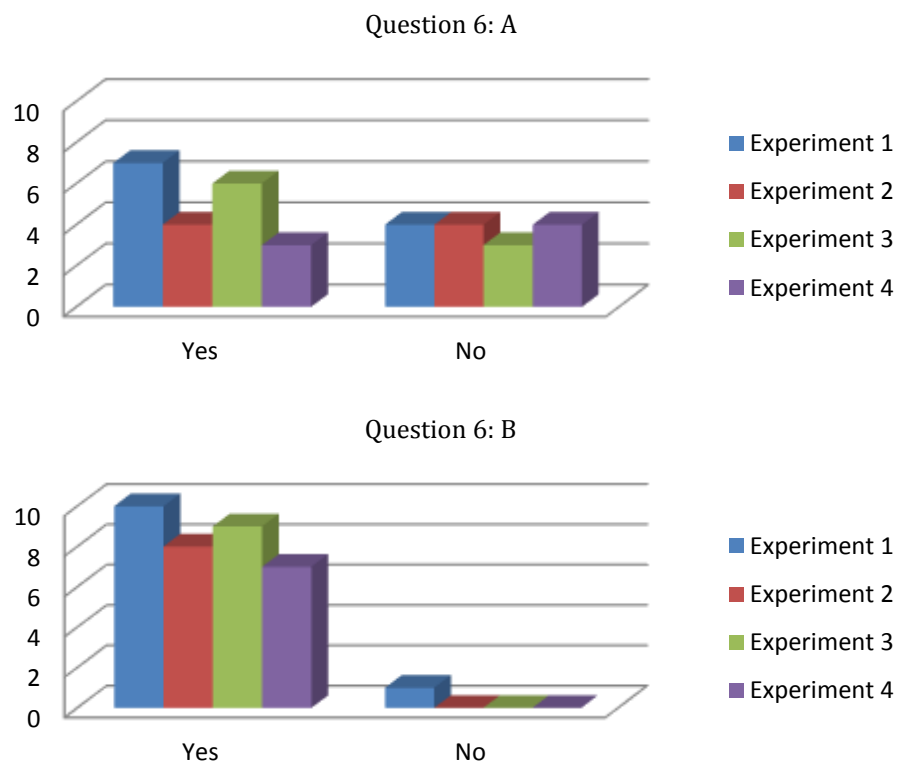
The question is asking whether the lesson is clear to the students or not. For human teacher session, apparently all of the students from every experiment understood on what the teacher delivered. Meanwhile, some students responded that they do not understand the lecture delivered by the robot teacher although for Experiment 1 and 3, the content of the lecture is the same.





**FIGURE 7.** Level of understanding of the teaching lesson

Question 5 asked the students on their level of understanding of the teaching lesson. Level 1 indicates the lowest while Level 5 indicates the highest. Differs from the robot teacher session, the human teacher session has almost higher level of understanding among the students. Most of the students mark their level of understanding at Level 4.



**FIGURE 8.** Response of student regarding teacher

The last question of the questionnaire asked the students to mark whether the teacher is a good or not good teacher. For robot teacher session, there are some number of students whom do not agree that the robot is a good teacher. Compare to robot teacher, human teacher seems to have a lot of agreement among the students to become their best teacher.

## DISCUSSION AND CONCLUSION

The purpose of constructing the questionnaire for this research work is to know the interaction and response from the participants of the experiments. That is why the questionnaire consists of questions that ask about the participant's feelings due to the robot that used in this research work is currently unable to detect and interact with the students directly. The same questionnaire is distributed for both human and robot teaching sessions.

Question 1 is about the student's feeling before the teaching lesson. The most obvious pattern that can be seen is excited feeling for robot session. It seems that most of the students feel excited before the robot starting its teaching session. This excited feeling level is quite low before the lecture for human teaching lessons. This means that students are more interested and looking forward to the robot teacher before the lecture session. The other clear graph patterns are Hesitant, Peaceful, Relaxed, and Satisfied. Hesitant is high for robot teacher compare to human teacher. Eventhough the participants feel Excited at the first place, but they also feel Hesitant whether the robot can teach or not. That is why their Confident feeling is also low (Figure 3) compare to towards human teacher. Moreover, they did not feel Peaceful and Relaxed before the robot teacher begins its teaching class. The feeling of Satisfied is high for human teachers compare to the robot. This is because they are normally face human as their teacher, but not a robot.

The second question of the questionnaire is asking the participants' feeling during the experiment is ongoing (Figure 4). Most of feelings occur among the students for robot teacher session differs from human teacher. Seems like the feeling of Bored occurs between the student during the robot teacher session, while this feeling is not seen for the human teacher session. One of the reasons why this feeling exists among the participants is the robot cannot interact with the students (one-way interaction). Next is Confident. The graph shows a high frequency of Confident for the human teacher. The pattern of this result seems more alike in each question of 1, 2, and 3. By this situation, it can be concluded that students will feel more confident with the human teacher. As usual, Excited feeling is high for robot teacher session. However the frequency decreases compare to Question 1. This shows that the students feel less excited during the robot teacher is teaching them. Most of the participants feel Peaceful, Relaxed, and Satisfied for the human teacher session compare to robot teacher session.

The third question (Figure 5) of the questionnaire asked about the student feelings after the teachers are finished with their lesson. Confident, Peaceful, Relaxed, and Satisfied are the emotions that have the same pattern throughout Question 1, Question 2, and Question 3, which is constantly having high frequency for human teacher session compare to robot teacher session. While, Excited feeling is also constantly high for robot teacher session. For Question 3, there is high frequency in Hesitant and Inspired for the robot teacher session. This is because they are facing the quiz session after the teaching lesson ends. Therefore, feeling Hesitant is normal while trying to answer the quiz given. In addition, they also did not have high confidence for their robot teacher session. Most of the students feel Inspired for the robot teacher after the teaching is over.

Question 4 (Figure 6) is the question that asked whether the lesson is clear or not. Apparently all the students clearly understand the teaching given by the human teacher compare to robot teacher which have a slightly number of

students that did not clear about the teaching lesson. By reviewing the comments given by the students in the questionnaire, they expect the robot can interact, and speak clearly (The original voice of the robot is used. Some pronunciation might be not very clear or fast enough to make the students capture what the robot is saying). Perhaps, this becomes the factor that the robot teaching delivery is not that good as human does.

The next question of the questionnaire requires the students to mark their level of understanding. The lowest level is 1 and the highest is 5. Figure 7 show the results for both robot teacher and human teacher session. For robot teacher session, most of the students mark their level by 3. This can be explained by recalling their less confident feeling and less clear understanding shown in Question 4's result. Meanwhile, level 4 recorded the most for the human teacher session.

The good or not good teacher is decided by using Question 6 (Figure 8). It appears that most of the students decided that human is a good teacher compare to the robot. This is already predicted when analyzing the results of the quiz and the questionnaire.

An important point that can be observed from the result is that the students feel more excited when a robot is teaching them compare to a human teacher. This can be described as a normal because everyone should be feeling the same way when they facing a new thing in their life. From that point, these experiments contribute one of a very valuable knowledge on how a new thing attracts people and they keep their attention to it. Although it is clearly shown that the human teacher is having a better respond in term of effectiveness compared to the robot teacher, this research work is still useful for us to know the preliminary steps that should be taken to design a better robot teacher. We managed to see that if the robot teacher is able to interact directly with the students, perhaps the feeling of the students toward the robot teacher could be in the other way after the experiment.

#### LIMITATIONS AND RECOMMENDATIONS

This study could see the potential of having a robot as a teacher with some arguments or weaknesses that required us to consider in developing and configuring a robotic teacher system. This will be the next challenge for us as well as other researchers, in which we should investigate more on the factor (of the robot) that could interact students to feel confident and happy to have a robotic teacher.

#### REFERENCES

- Beran, Tanya N., Ramirez-Serrano Alejandro, Kuzyk Roman, Meghann Fior, and Sarah Nugent. 2011. Understanding how children understand robots: Perceived animism in childrobot interaction. *International Journal of Human Computer Studies* 69, no. 7-8: 539–50. DOI: [10.1016/j.ijhcs.2011.04.003](https://doi.org/10.1016/j.ijhcs.2011.04.003)
- Berk, Ronald A. 2005. Survey of 12 Strategies to measure teaching effectiveness. *International Journal of Teaching and Learning in Higher Education* 17, no. 1: 48–62.
- Bill & Melinda Gates Foundation. 2013. *Ensuring fair and reliable measures of effective teaching: Culminating findings from the MET Project's three-year study*. MET Project Policy and Practice Brief. DOI: [10.1016/S0921-8890\(02\)00380-9](https://doi.org/10.1016/S0921-8890(02)00380-9)
- Billard, Aude. 2003. Robota: Clever toy and educational tool. *Robotics and Autonomous Systems*, 42, no. 3, 259-269.



- Darling-Hammond, L., Newton, S.P. and Wei, R.C., 2013. Developing and assessing beginning teacher effectiveness: The potential of performance assessments. *Educational Assessment, Evaluation and Accountability*, 25, no. 3: 179-204.
- Harris, D.N., Ingle, W.K. and Rutledge, S.A., 2014. How teacher evaluation methods matter for accountability: A comparative analysis of teacher effectiveness ratings by principals and teacher value-added measures. *American Educational Research Journal*, 51, no. 1: pp.73-112.
- Rink, J.E., 2013. Measuring teacher effectiveness in physical education. *Research Quarterly for Exercise and Sport*, 84 no. 4: 407-418.
- Shuls, J.V. and Trivitt, J.R., 2015. Teacher effectiveness: An analysis of licensure screens. *Educational Policy*, 29(4), pp.645-675.
- Syed, Abdullah, S.M., Ahmad Z. Khairani, Nordin Abd. Razak, Jamalsafri Saibon, and Azlinda Mohd. Ariff. 2011. Teaching efficacy among college student-teachers of diverse background. *Special Education*, 16, 28-33.

— This article does not have any appendix. —