

# **AC 2010-264: INNOVATIVE TRAINING STRATEGY (ITS) FOR TEACHING ASSISTANTS**

**Robert Brooks, Temple University**

**Tony Singh, Temple University**

**Hossein Rostami, Philadelphia University**

**Fernando Tovia, Philadelphia University**

**Amithraj Amavasai, Temple University**

# Innovative Training Strategy (ITS) For TAs

## Abstract

The Department of Civil and Environmental Engineering at Temple University offers an Environment Course to approximately 400 students (20 sections) every semester. An experiment was carried out during Fall 2007. During that semester, a control group of 8 teaching assistants (TAs) were given a manual on the 3 labs to be conducted. The TAs demonstrated the experiment and the students were asked to replicate the demonstration. This was the traditional method. Many students complained of lack of individual focus. 12 TAs were trained to use the new methodology in the first week of Spring 2008 and Fall 2008. All the TAs used the new methodology during the 2 semesters.

The steps in the new methodology included watching a trained presentation, engaging the students in group discussions, staying with the group while they perform the experiment, developing a rubric for evaluation of student reports, providing a link between experiments and theory, and helping the students to pick up a lifelong learning objective. The course content and the laboratory experiments include concepts on how students contribute personally throughout their lives to reduce the carbon footprint and maintain a safe, sustainable and healthy environment. Students are encouraged to choose at least one concept to take up in their life. Except for these steps, there was no difference between the control group and ITS group.

The students were asked to rank the overall performance of the TAs and overall learning experience in the labs on a scale of 1 (poor) to 10 (excellent). TAs were asked to rank the overall job satisfaction and evaluate the performance of the students. A rubric was provided to the TAs to evaluate the performance of the students. The improvements in all the seven performance indices over the control group were determined using t tests. The improvements in all the 7 indices were statistically significant at an alpha value of 0.05. Among the seven indices, improvement in TAs evaluating the performance of the students, which the authors consider to be the most important among the indices, was ranked the highest. In this category, the control group had scored 61% on the average whereas the ITS group scored 76%. The ITS group showed a 24.6% improvement over the control group.

The innovative strategy can be applied to other science and engineering courses. The authors plan to extend this strategy to 3 other courses over the next 3 years. The method presented in this study may be used at other institutions with appropriate modifications in order to engage our students to learn the laboratory experiments.

## Introduction

TAs have been traditionally used in many universities worldwide for student learning. According to Brooks, et al<sup>1-3</sup> as we learn more about the performance of TAs, the weakness of traditional methods employed by them becomes more and more clear. These authors stated that most of the

TAs use passive learning techniques rather than active ones such as hands on and minds on strategies involving dynamic interactions with the students. The authors have developed an innovative strategy for training TAs to effectively deliver their duties.

### **Importance of Active Learning and TA Training**

Davalos, Moran, and Kodkani<sup>4</sup> stated that active learning approach implies that the student is a dynamic participant in his or her acquisition of skills and knowledge. Bonwell and Eison<sup>5</sup> defined active learning as anything that involves students in doing things and thinking about the things they are doing.” They stated the importance of active learning as: “students are involved in more than listening; less emphasis is placed on transmitting information and more on developing students’ skills; students are involved in higher-order thinking (analysis, synthesis, evaluation), and students are engaged in activities (e.g., reading, discussing, writing).” The attention span of an average student wanes quickly in traditional lecture formats. Active learning environments can significantly enhance short-term retention of information by students. When active learning becomes interactive not only among the students but also the TA it becomes interactive learning.

At the authors’ institution and many other institutions several TAs are from different countries and are an important source of undergraduate instruction. Before the training program there was wide difference in the quality of TAs performance. As a result the authors have received several complaints about the TAs. After the training was founded, the number of complaints has become practically zero. The authors recognize the fact that everyone learns differently, and by adapting teaching styles to incorporate various techniques in the training program, the TAs can teach more effectively. Since the goal was to utilize the TAs as effective instruments for creating interactive learning atmosphere among the undergraduate students, the training was based on TAs’ own interactive learning. The TAs were able to learn in an informal environment that is congenial to posing of questions, sharing of ideas, participating in group work, and delivering presentations. In order to create an appreciation among the TAs for interactive learning the first class was deliberately delivered in lecture format virtually providing no group interaction. The TAs recommended that the lecture series be eliminated. Further classes were based on active interaction. It was brought to the attention of the TAs that based on their own experience and recommendation the lecture format was eliminated and the TAs need to implement interactive learning process while they demonstrate the experiments to the undergraduates. This is one of the highlights of the program. Stress breakers were used in between the sessions since these played an important role not only in establishing an interactive environment but also maintaining it. The stress breaker was simply a question like “What is your favorite food?” or a joke. These findings were similar to those reported by Roberts, Hollar and Carlson<sup>6</sup>.

## Methodology

An experiment was carried out during Fall 2007. During that semester, a control group of 8 teaching assistants (TAs) were given a manual on the 3 labs to be conducted. The TAs demonstrated the experiment and the students were asked to replicate the demonstration. This was the traditional method. Many students complained of lack of individual focus. 12 TAs were trained to use the new methodology in the first week of Spring 2008 and Fall 2008. All the TAs used the new methodology during the 2 semesters.

The steps in the new methodology included watching a trained presentation, engaging the students in group discussions, staying with the group while they perform the experiment, developing a rubric for evaluation of student reports, providing a link between experiments and theory, and helping the students to pick up a lifelong learning objective. The course content and the laboratory experiments include concepts on how students contribute personally throughout their lives to reduce the carbon footprint and maintain a safe, sustainable and healthy environment. Students are encouraged to choose at least one concept to take up in their life. Except for these steps, there was no difference between the control group and ITS group.

The students were asked to rank the overall performance of the TAs and overall learning experience in the labs on a scale of 1 (poor) to 10 (excellent). TAs were asked to rank the overall job satisfaction and evaluate the performance of the students. A rubric was provided to the TAs to evaluate the performance of the students. The improvements in all the seven performance indices over the control group were determined using t tests.

The students were split into groups while performing the experiment. As per Conrad, Goodlad and Hirst<sup>7,8</sup> encouraging students to hold out discussions would enhance learning. Therefore, the students were encouraged to hold out discussions and pose their questions to the TAs. The students found this method very informative. This created minds on activity compared to the monotonous traditional method. Ramsden<sup>9</sup> and Heabshaw<sup>10</sup> stated that group discussions promote student learning. In this study the students all agreed that the group discussions were useful, enjoyable and interesting. All students agreed that more opportunities should be provided for group discussions. The authors also agree Ramsden<sup>9</sup> and Heabshaw<sup>10</sup> that group discussions are one of the most important factors in improving the students' performance. This is supported by the results of the study.

When asked to write down the most important idea they came up with the following responses:

- Alternative ways to teaching
- The importance of showing students how to learn instead of teaching them the subject
- Be more open-minded in a group
- Groups skills and communication
- Not about teaching and how well and accurately you get the message across

- How to pose questions back
- How to develop group dynamics

The TAs stayed with the groups while the students performed the experiment. This method was found to give a sense of assurance to the students and they found it easier to learn the experiment. The TAs kept on correcting the mistakes that the students made.

A rubric, Appendix 1, for evaluating student reports was distributed to the students in advance. This helped the students to focus their efforts while making their reports. The rubric helped improve students' performance on the reports significantly. Rubrics were used as a tool to assess the students' performance. The original rubrics were inspired from rubrics provided by the teaching and learning center at Temple University. The rubrics included summary of the report, description of the experiment, identification of technical issues, discussion of the impact of the experiment, and reporting of numerical solutions. The TAs graded the report as Initial, Developing, Achievement or Exemplary. Table 1 shows an example of a rubric used to evaluate students' technical reports. The rubric was used not only in the experimental sections but also as a way to measure and compare both types of sections.

The TAs provided links between the experiments and theory. This was missing in the traditional method. Students appreciated this. A list of life-long learning objectives was provided to each student (Appendix 2). The course content and the laboratory experiments include concepts on how students contribute personally throughout their lives to reduce the carbon footprint and maintain a safe, sustainable and healthy environment. Students are encouraged to choose at least one concept to take up in their life. The authors have plans to measure the lifelong learning objectives by conducting telephone surveys once every two years for the next several years.

## **Results and Discussion**

The improvements of all the seven performance indices over the control group were determined using t tests<sup>11,12</sup> as shown in Table 1. The improvements in all the indices were statistically significant at an alpha value of 0.05. Among the seven indices, improvement in TAs evaluating the performance of the students, which the authors consider to be the most important among the indices, was ranked the highest. In this category, the control group had scored 61% on the average whereas the ITS group scored 76%. The ITS group showed a 24.6% improvement over the control group. The least improvement was shown in "helping the students pick up a life-long learning objective". The ITS group scored 10% improvement over the control group. The authors plan to work on this performance index over the next few years.

**Table 1. t-test Results**

Performance Index	Control Group (%)	ITS Group (%)	Improvement (%)	t
Engaging the students in group discussions	57	69	21.0	2.5
Staying with the group while they perform the experiment	53	62	16.9	2.2
Development of a rubric for evaluation of student reports	54	62	14.8	3.8
Provide a link between experiments and theory	57	65	14.1	2.9
Helping the students to pick up a lifelong learning objective	60	66	10.0	3.1
Overall job satisfaction of the TA	59	65	10.1	3.6
Performance of the students	61	76	24.6	2.7

## Conclusion

The innovative strategy statistically proved that the TAs and students' performance significantly improved. The strategy can be applied to other science and engineering courses. The authors plan to extend this strategy to 3 other courses over the next 3 years. The strategy presented in this study may be used at other institutions with appropriate modifications in order to engage our students to learn the laboratory experiments.

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### Appendix 1. Rubric Used to Evaluate a Written Report

The following elements were considered:

1. Summarize the report
2. Describe the experimental procedure
3. Clearly identify the technical issues involved
4. Discuss the impact of the experiment
5. What are the possible outcomes
6. Report the numerical solutions

	Initial	Developing	Achievement	Exemplary
Summary	Four or more of the required elements are missing	Three or more of the required elements are missing	Two or more of the required elements are missing	Summarizes the report, includes the date of the experiment and the source
Organization	Ideas are not presented in a clear manner	Ideas are made clear but not cohesive	Ideas are clear and concise, but report lacks organization	Report is organized logically with clear and concise ideas
Grammar	No proofreading was done	Some proofreading, errors are still visible	Trivial errors	No errors
Critique	Four or more of the required elements are	Three or more of the required	Two or more of the required elements are	The importance of the experiment is described



	missing	elements are missing	missing	
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## Appendix 2. Life Long Learning Objectives

<p>Air Pollution: Learn to live where Air Quality index is lower than 100</p> <p>Indoor Air Pollution: Learn to provide cross ventilation in your homes</p> <p>Noise Pollution: Find alternate routes with least noise pollution while you walk on campus and elsewhere</p> <p>Mercury: Avoid sources (example: warm water large predator fish) as much as you can</p> <p>Lead: Avoid sources as much as you can (Ex: old houses, down towns)</p> <p>Particulates: Avoid sources (Ex: down towns, construction sites, farming sites) as much as you can</p> <p>Electro-magnetic radiation: (Ex: use cell phones moderately)</p> <p>Acid concentration in the body: (Ex: reduce consumption of sodas)</p> <p>Global Warming: Change your regular car to hybrid car. Implement lifestyle changes increasing negative feedback mechanisms and decreasing positive feedback mechanisms</p> <p>Alternative Energy: Use hybrid cars, solar energy</p> <p>Exponential Growth: Use the nature of the curve to your advantage to accumulate money by wisely choosing to invest</p>
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## Reviewer Comments

# 1 \_\_\_\_\_

What you have done in your class is interesting enough for an ASEE conference paper, but your limited description of it is unacceptable. I would like you to elaborate for the final paper on the importance of active learning and TA training so that graduate students know how to do this. I would also like to see more detail on how you trained the graduate students. The lifelong learning objectives in particular are unusual, and it is unclear how these really contribute to student learning—do you measure these in any way besides having the students report that they have selected one? I was happy to see so many references to the literature, but I think you should explain what these references actually say about teaching and learning rather than just inserting them to support your own claims. Whether the rubric was used in just the experimental sections or as a way to measure and compare both types of sections was not as clear as it could be in the early sections of the paper. Table 3 in particular should come earlier, around page 3. It is OK if the other two tables come as appendices at the end. The student exercises are not necessary for this paper, particularly since it is in the graduate division. Please check the author's kit—I am not sure your line spacing and right justification are correct. Some of your paragraphs are justified, and some are not.

### Authors' responses

The final paper was elaborated on the importance of active learning and TA learning so that graduate students know how to do this. This was accomplished by adding a new section on the issue. More details were provided on how the graduate students were trained. The authors have plans to measure the lifelong learning objectives by conducting telephone surveys once every two years for the next several years (last sentence in the section of methodology). What the references actually say about teaching and learning was included. The rubric was used not only in the experimental sections but also as a way to measure and compare both types of sections (see the section of methodology). The control group scored only 54% where as the ITS group scored 62%. The improvement was 14.8%. This was shown in Table 1. Table 3 (Presently Table 1) was moved to page 3. Table 1 and 2 (as Appendix 1 and 2) came as appendices at the end. The student exercises were removed from this paper. Line spacing and justifications were modified as per the author's kit.

