120th ASEE Annual Conference & Exposition
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June 23-26, 2013

Paper ID #6841

Active Learning in Nepal: A Case Study of Effectiveness, Cultural Considerations and Student Attitudes at a South Asian University

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Abstract

The growth of engineering education in South Asia is leading to the development of more interactions and joint projects between South Asian and U.S. Universities. A solid understanding of the differences between cultures and how education is delivered and received is a necessary ingredient for this educational cooperation. In the U.S., elements of Active Learning are increasingly viewed as critical to the success of educating engineers. These techniques have been tried in South Asia with varying success. This paper presents the cross-cultural experience of introducing Active Learning elements into the Mechanical Engineering program at Kathmandu University in Nepal. As part of a 2012 Fulbright project, the authors co-taught a second year (sophomore) level class 60 students in Strength of Materials and the Fulbright Grantee taught a small graduate class in Mechanical Design. Elements of Active Learning where introduced formally into the classroom for the first time in the Mechanical Engineering Department. Some activities in the undergraduate lecture-based class included think-pair-share, in-class group problem solving, ranking tasks and peer-based concept exercises. The graduate class was redesigned into a Project Based Learning (PBL) experience. This paper gives some background on the use of Active Learning in a South Asian culture, describes the pedagogy introduced into the two classes and finishes with an assessment of its effectiveness and of Nepali student attitudes about Active Learning.

Background

Kathmandu University was founded in 1991 in Dhulikhel, Kavre District at the edge of the Kathmandu valley in Nepal. The University is unique in Nepal in that it was built with Government funding, but intended to be self-supporting and is a not-for profit, non-governmental institution. Following its vision statement "To become a world-class university devoted to bringing knowledge and technology to the service of mankind"[1], the university is working to develop world class programs in STEM fields plus other professions such as medicine and business to promote economic development in the country. As part of this push, the university continues to develop its college of engineering which currently has five departments as well as Masters and Ph.D. programs. Within the college great emphasis is placed on laboratory and hands-on learning. Many classes contain a laboratory portion and efforts continue to develop more "hands-on" instruction. Outside the laboratory, most content is delivered in a standard lecture form with most classes taught in English.

Cultural values have a profound impact on how teaching and learning occur and set the expectations about the various roles of teachers and learners. Fadhronc and Lauridsen[2] give a description of the cultural impact on education and the difficulty of teaching in a culture that is not one's own. Nepal culture differs greatly from most western cultures and shares many attributes common with other South Asian cultures. In Nepali culture, the professor (teacher) is typically given large amounts of respect and treated as the foremost expert on knowledge in their subject. In Nepali education there is often more emphasis placed on memorization and less

emphasis on individual thinking and creativity. A measure of academic mastery in Nepal is likely to be characterized by the amount of information retained and reproduced verbatim on an examination. Although it is difficult to quantify culture, it is useful to review the work of Hofstede[3] in identifying discernable dimensions of culture. Hofstede identifies five measurable "dimensions" of a nation's culture. These are: 1) Power Distance Index (PDI: the degree to which the less powerful members of a society accept and expect that power is distributed unequally), 2) Individualism (IDV: defined as a preference for a social framework in which individuals are expected to take care of themselves), 3) Masculinity (MAS: the degree of preference in society for achievement, heroism, assertiveness and material reward for success), 4) Uncertainty Avoidance (UAI: the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity), and 5) Long-Term Orientation (LTO: a measure of how individuals in a society searches for virtue).

Although the Hofstede website does not currently contain cultural dimensions for Nepal, Lemone[4] reports that Nepali culture has a noticeable higher PDI than the United States, a much lower Individualism score as well as lower Masculinity and Uncertainty Avoidance scores. The Hofstede scores for the United States (US)[5], Nepal and India are summarized in Figure 1. The scores for Nepal are similar to India; the largest South Asian culture, and for the purposes of this work, both Nepal and India measures relate in the same way to US culture. That is both these South Asian cultures show higher Power Distance and lower Individualism, Masculinity and Uncertainty Avoidance scores.

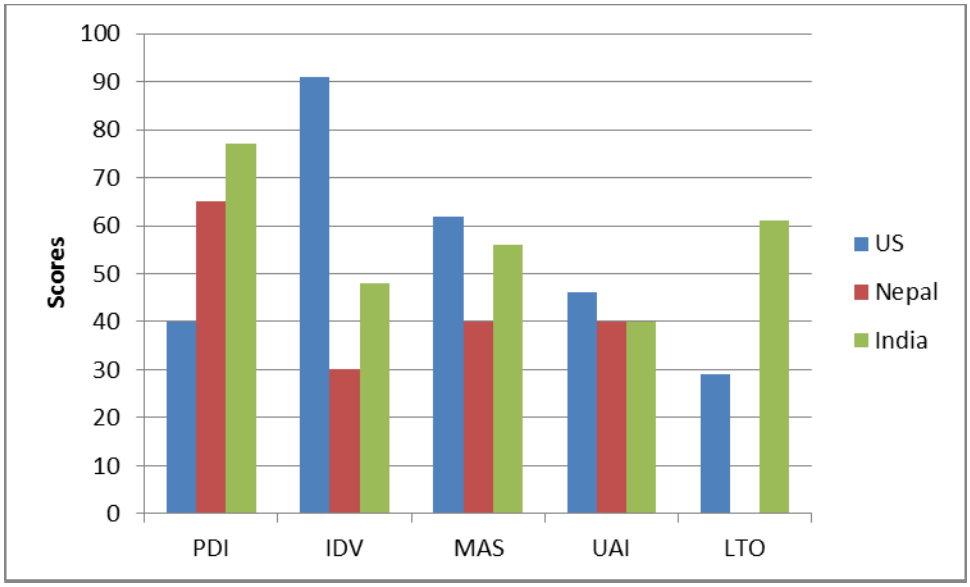


Figure 1 – Hofstede Cultural Dimension comparison between the US, Nepal and India (no LTO information is available for Nepal)

In other traditional measures, Nepali culture tends to be a high context culture where many things are not explicitly communicated relative to the US which tends to be lower context with greater emphasis placed on explicit communication and contracts. Nepalis also tend to give greater respect for elders and spend more time in extended family groups than is commonly found in the US. Nepalis tend to emphasize a collectivist orientation which is preferred and valued over individualism as is evidenced by Hofstede scores. Another key feature is that

Nepal's culture is polychronic, where often individuals value relationships over set schedules. This can lead to frustration of visitors from monochromic cultures like the US where time is treated as an absolute. Finally, Nepalis tend to be fairly formal and are reserved in their expressions of emotion. In broad terms, these cultural traits are similar to India's' in how they contrast to US culture. Knowledge of these cultural traits is essential for the success of visiting engineering educators to similar South Asian countries.

As a Fulbright Senior Scholar, the author traveled to Nepal to teach in the Mechanical Engineering department of Kathmandu University during the winter semester in 2012. This semester runs from January to June. During that time, he taught a graduate class in Mechanical Design and co-taught an undergraduate class in Strength of Materials with the co-author, a Kathmandu University professor. One goal of the Fulbright project was to ascertain whether active teaching methods (for a summary see Prince[6]) would be effective in a South Asian engineering education context. Would the faculty and students accept and embrace these methods as viable pedagogies for engineering education? How would the differences in culture affect the usefulness of the methods and which methods would be more or less effective? Resistance to Active Learning techniques might be anticipated given the culture of teacher/authority centered education that exists at the Nepali Universities while most Active Learning techniques or student-centered. As the number of interactions between South Asian Universities and Western Universities continue to grow (e.g. see Trivedi and Petrierackin[7]), understanding of cultural differences will be essential to making partnerships more effective.

Pedagogy

Strength of Materials

During this study, the authors co-taught an undergraduate class in Strength of Materials to a cohort of 2nd year mechanical Engineering students. It should be noted that Kathmandu University has lockstep programs in each engineering discipline; therefore, students of the same year and major will have identical schedules and class meetings. As a result the students are very familiar with their classmates by the end of their first semester on campus and will continue to build these relationships during their four years at the university. This is in contrast to most US engineering programs like the home University of the author. The Strength of Materials class consisted of 60 students. The department's curricular plan is for the class to meet for three hours of lecture each week and a one hour "Tutorial" or problem solving recitation each week. Due to scheduling and room conflicts, this cohort met with all the students for one three hour session and a one hour session each week. The organization of these class periods was split between the two instructors with approximately ½ of the instruction in an Active Learning mode where the other half was a traditional lecture and example problem format.

For the classes that were taught in the traditional lecture format, the class periods included a deductive learning approach to the material. General theory and concepts were presented via formal lecture and then followed by application examples. The students typically took notes during these sessions and then were assigned homework problems. There was not an assigned textbook for the course; instead the students used various textbook resources that could be found in the library. Although there was not a focus on using active learning in the lecture based classes, the instructor did make use of the Socratic method to encourage student attention and

thinking during class. This was employed more often in the recitation hour where the students were questioned as a group on how to tackle the presented example problems.

For the class meetings that used the Active Learning approach, several changes to the lecture mode were made. First, PowerPoint example problems were placed online prior to the class periods. These examples detailed the step by step procedures to solve certain types of problems that would be discussed in class. The students were requested (but not required) to view these PowerPoint examples prior to class. In class, several Active Learning techniques were used with the goal of keeping lecturing to a minimum. These included think-pair-share activities in the form of multiple choice concept questions, in-class group problem solving, conceptual Ranking Tasks and the liberal use of the Socratic Method.

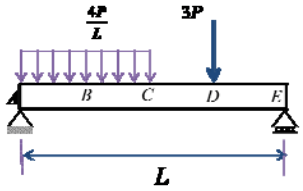
For the think-pair-share activities[8] the class was presented questions using PowerPoint slides. These were usually conceptual questions based on the current class topics or past topics. The students were then asked to think about the problem and how to answer it for 10 to 20 seconds. Then they were invited to share their thoughts with the person sitting next to them. This might be one other person or a group of three who were sitting at individual tables. Finally after 1 to 5 or more minutes of discussion (depending on the difficulty and the level of ongoing conversation) groups were invited to share their answers and reasoning with the class.

For the in-class group problem solving, example problems based on lecture material and somewhat similar to homework problems were given in a handout to groups of three in the class. The students then worked together to solve the problems while the instructor circulated around the room answering questions. In some cases the instructor would bring the entire group together to discuss important points or to make sure students were reaching milestones on difficult or multi-part problems. This problem solving could take anywhere from 10-30 minutes depending on the complexity of the problem. To succeed, students needed to become comfortable asking questions. The instructor would circulate and insure that all students were working toward the goal of solving the problem.

For the ranking tasks, the students were again given a handout which asked them to rank different scenarios based on a given quality metric. These conceptual tasks challenge students to judge between similar situations based on their conceptual understanding (minimally quantitative) of the course material. Many of the ranking tasks where taking from Brown and Poor[9] or of the instructors own design. An example of a typical ranking task from Brown and Poor is given in Figure 2. With the ranking task handout, the students would then work in a group of three to rank the five scenarios and support their reasoning of their ranking. When the groups had finished the task they were invited to share and discuss the results to the class until consensus was reached on the correct answer and supported by conceptual reasoning.

In addition to the three Active Learning techniques described above, there was also the liberal use of the Socratic Method in the discussion of course materials and the use of handouts to replace the copying of lecture notes that is prevalent in a traditional, lecture based class. These handouts typically had fill in the blank spaces where students were asked to put in the appropriate information promoting active thinking and discussion in class.

The figure below shows a simply supported beam. Assume the 3P load is slightly to the left of the cross section at D.
Rank these situations, from greatest to least, on the basis of the absolute value of the shear force at each cross section



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ Least

Or, the shear force is the same at every cross section. _____

Please carefully explain your reasoning.

How sure are you of your ranking? (Circle one)

Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

Figure 2: Example Ranking Task

Graduate Class in Mechanical Design

In contrast to the sixty student undergraduate class, the graduate class in mechanical design consisted of only three graduate students. The students were all male and had disparate ages: 22, 29 and 36. The course was project-based and centered on the design of an adaptive eating device for a person with cerebral palsy. The client did not have motor control of her upper body, but did have good control of her feet and lower extremities. The students learned the course material by actively designing the device. The instructor met with the students for three hours each week. This time was spent in a combination of short lectures and activities that focused the students on their design goal. For example, time during one three hour class was devoted to concept generation and another class was dedicated understanding and creating a Quality Functional Deployment (QFD) House of Quality. During the short lectures, the Socratic Method was employed to a large extent.

In order to assess the effectiveness of the Active learning in the South Asian context, two areas are considered. First is the level of learning and second the student attitudes toward the Active Learning and student center approach. Numerous studies have shown that Active Learning is an effective teaching method [See Prince[6], Self and Widmann[10], etc.] in western cultures in

engineering as compared to a traditional lecture format. Since this study did not contain any control group and there were many variables not controlled there is no statistical determination whether the active learning elements were more or less effective than the traditional teaching methods. The only indicator possible was the students' performance on the final exam as judged by the veteran Nepali professors. Note that the final exam counts for a major portion of the grade and the typical student approach at Kathmandu University is to do most of the effort towards learning the material in the two week study period before the final exam. Indications from the Examination section of Kathmandu University indicated that the students' performance was in the normal range of expectation.

Survey

In order to assess the Nepali student's attitudes about the active learning methods, a 22 question survey was given to the Strength of Materials students near the end of the course. A copy of the survey can be found in the appendix of this paper. The survey attempted to assess the students attitudes towards the various teaching approaches used in the class. Specifically the survey uses a Likert scale and asks the students about how effective and motivating they found each technique. It is thought that the more motivating a teaching activity or technique the more likely it will engage the student towards deeper learning. The survey also asked the students to rank the different techniques as to their perceived effectiveness in helping them learn the material. Finally some open ended comments were requested from the students. In all, 49 students completed the survey.

Results and Discussion

Table 1 gives the survey results rating the student's interest in the five surveyed course activities. Table t2 gives the survey results concerning the student assessment of how well each activity helped them learn the course material. In all cases the students agreed that each of the course activities were interesting and motivating while helping them learn the material. The students most strongly agreed that the two surveyed active learning activities (Ranking Tasks and multiple choice concept questions) were the most interesting and motivation and the students reported that these two activities helped the most in learning the course material. Both these techniques were completely new to the students.

Table 1: Interesting and Motivating

1) Strongly Disagree 2) Disagree 3) Neither Disagree or Agree 4) Agree 5) Strongly Agree

Surveyed Item	Average Likert Score
Q4: PowerPoint Examples	4.27
Q6: Homework	4.20
Q10: PowerPoint Class Slides	4.18
Q13: Ranking Tasks	4.50
Q15: In Class Multiple Choice Conceptual Quizzes	4.67

Table 2: Helped me Learn the Material

1) Strongly Disagree 2) Disagree 3) Neither Disagree or Agree 4) Agree 5) Strongly Agree

Surveyed Item	Average Likert Score
Q5: Example PowerPoint	4.31
Q7: Homework	4.33
Q11: PowerPoint Class slides	4.35
Q14: Ranking Tasks	4.45
Q16: In Class Multiple Choice Conceptual Quizzes	4.51

In Question 17 the students were asked to rank the eight major course activities based on which was the most helpful. The eight course activities along with their average ranking by the students are given in Table 3. The top ranked item again was an Active Learning element, the in-class problem solving activities. The students ranked the second most helpful item as the PowerPoint lecture slides that were used in class and posted online for student reference after class. This is not surprising since the students typically do not have textbooks and rely heavily on study material given by the professor. These PowerPoint lecture slides took the place of having a textbook. The next three highest ranked activities were all Active Learning activities. Note that traditional lecturing was ranked the second lowest by the students in helping them learn the material, above only learning from their classmates.

Table 3: Relative ranking of each activity's helpfulness in learning the material

Course Activity	Average Ranking	Number of top rankings
In Class Group Problem Solving	2.66	20
PowerPoint Slides (from class)	3.28	10
In Class Concept Quizzes	3.77	4
Homework	4.16	2
In Class Ranking Tasks	4.18	3
Reference Books (from library)	5.43	4
Traditional Lecture	6.09	2
Talking to Classmates	6.28	0

Typical comments on the survey addressed interest in having the class include more practical examples, less copying of homework and even more active learning elements. Especially interesting were the responses to "List the three most important things you learned in class". This question was intended to discover which subjects within strength of materials the student thought were most important. Instead, the many responses focused on what the students learned about teaching and learning. Some responses included:

"Active participation in class work is very interesting and helpful"
"Concept based knowledge is efficient rather than focusing on solving the problem."
"Teaching experience and methodology of teaching is the most influencing thing."

For the graduate class there was no formal survey given, but the author made the following significant observations throughout the semester. It was clear that the students were somewhat

uncomfortable with the Socratic Method and the freedom given to them by having to solve the open ended design project. For the project, they typically had a difficult time making decisions, managing their time and often waited for the instructor's guidance before moving forward with the project. As for the Socratic Method, the author observed that for any open-ended question, the two younger students would always defer to the opinion of the older student. This would be expected given the cultural deference given to elders in Nepal. During the conceptual design phase, the students were instructed on the importance of valuing all ideas (not matter where and who they come from), yet the students continued to defer to the ideas of oldest student. Despite acknowledging the importance of considering all ideas despite the source, it was difficult for students to observe how the ideas of the elder student were being given preference. After this, the author led a discussion of Hofstede's cultural dimensions and had the students participate in a discussion and homework assignment on differences between cultures. After this, the students attempted to put their cultural biases aside, and proceed to more effective creative design. The western instructor will do well to observe and discuss cultural barriers to creative work in these cultural contexts. Given the similarity between Nepali and Indian culture relative to the US, it is likely that the western instructor would have similar experiences teaching in India.

Conclusions and Recommendations

This paper describes the experiences of introducing Active Learning elements into a second year Strength of Materials class at Kathmandu University in Nepal, and the introduction of a project based learning graduate class in mechanical design. The historical mode of delivery in each of these classes was through a traditional lecture with a problem solving recitation and weekly homework assignments. In general the students were positive in their assessment of the Active Learning elements and felt there were useful in helping them learn the course material. The western instructor should feel confident the well-crafted Active Learning pedagogies are likely to be easily accepted by students in Nepal. In general the students found the activities presented in this work highly motivating and felt that they contributed greatly to their learning. It is interesting to note that the group work was particularly popular with the students. This may not be surprising given the strong cultural value placed on interdependence in Nepali. The author noted that it was much easier to get the Nepali student to work together on teams and on projects than his U.S. students (as Individualism holds a much higher value in US culture). Conversely there was some difficulty in getting the Nepali students to work independently and take individual credit for their own work! This again is not surprising given the lower emphasis placed on individual accomplishment in Nepali culture as compared to U.S. culture. The western instructor in Nepal should be aware of these fundamental differences in culture and make adjustments to insure that both group and individual learning is accomplished.

Acknowledgements

The authors would like to acknowledge the Fulbright Commission in Nepal (USEF-Nepal) for their support of this project. Also a special thanks to the College of Engineering at Kathmandu University and the faculty and students of the University's Mechanical Department.

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Appendix 1: Attitudes about Active Learning Survey

End of the Course Survey

The purpose of this survey is to improve the course and my teaching. Your honest feedback is very much appreciated. This is an anonymous survey. Your responses will not count as part of your grade. Please answer each question according to your true thoughts and feelings. No one will see your individual responses.

1) What grade to you anticipate getting from this class: _____

2) How often did you view the powerpoint example problems before class
____ Never _____Seldom _____ Sometimes _____Usually _____Always

3) How often did you view the powerpoint example problems after class
____ Never _____Seldom _____ Sometimes _____Usually _____Always

4) The example powerpoint problems were interesting and motivating
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

5) The example powerpoint problems helped me learn the material
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

6) The Homework problems were interesting and motivating
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

7) The Homework problems helped me learn the material
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

8) How many hours did you spend on each homework assignment _____

9) I copied the majority of the homework solutions from other students
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

10) The lecture powerpoints were interesting and motivating
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

11) The lecture PowerPoints helped me learn the course material
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

12) How often did you view the lecture powerpoints after class
____ Never _____Seldom _____ Sometimes _____Usually _____Always

13) The in-class ranking tasks were interesting and motivating
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

14) The in-class ranking tasks helped me learn the course material
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

15) The in-class multiple choice concept questions were interesting and motivating
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

16) The in-class multiple choice concept questions helped me learn the course material
____ Strongly Disagree_____Disagree _____Neither Disagree or Agree_____Agree_____Strongly Agree

17) Rank (1-8) the following course activities according to how they helped you learn the course material (i.e. the number 1 ranking helped you the most.)
____ Traditional lecture_____Powerpoint slides _____Homework_____ In-class group problem solving _____In-class ranking tasks _____Reading a reference book _____Talking to classmates outside of class _____In-class concept quizzes

18) Do you have any suggestions on how to improve the class meetings?

19) Do you have any suggestion on how to improve the homework?

20) Do you have any suggestions on how to improve the course as a whole?

21) List the three most important things you learned in the class.

22) What topic in the course confused you the most?